BIOLOGY (BIOL)

BIOL106 The Biology of Sex
This course is featured as a general education course within the Department of Biology. Serving to complement courses currently offered within biology that only touch upon the subject of sex, this course will dive into specifics regarding sexual behavior and will serve to highlight new discoveries that have been facilitated by novel scientific techniques and approaches. As we study the biology of sex in the animal world, it becomes apparent that sex is achieved in a multitude of ways, many appearing rather bizarre and flamboyant. Yet under these guises, animals are still able to mate and reproduce. Sex is often defined according to sexual reproduction, whereby an egg is fertilized by a sperm, and offspring arise. However, many organisms engage in asexual reproduction and/or a combination of the two reproductive strategies. Reproductive anatomy and behavior will be addressed as we explore a variety of organisms, ranging from marine clown fish and their ability to produce both sperm and eggs along with the male chimeric marmoset (monkey) that mates with his brother's sperm. As an organism pursues reproduction, what are the mating strategies? What are the chemicals of sex (pheromones and hormones)? By examining the biology of reproduction, we will debate the competing strategies of males and females, and whether human cultural displays are yet another way to decipher quality in a potential mate.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL118 Reproduction in the 21st Century
This course will cover basic human reproductive biology, new and future reproductive and contraceptive technologies, and the ethics raised by reproductive issues.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **FGSS118, PHIL118, STS118**
Prereq: **None**

BIOL137 Writing About Evolution
This class will explore various interesting problems in natural history, using short writing assignments to build familiarity with concepts of organismic evolution.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL140 Classic Studies in Animal Behavior
This course will focus on the major concepts in the field of animal behavior. We will discuss the major selection pressures that shape animal behavior as individuals avoid predators, find mates, and produce offspring in their preferred habitats. What are the limiting resources for male and female animals, and why are some species sexually dimorphic? We will commence with the early pioneers in the field of ethology and highlight comparative studies in understanding territorial behavior, alarm calling, kinship, and the role of hormones/pheromones in reproduction. Both instinctual and learned behaviors are important components in an animal's behavioral repertoire and will be explored in field experiments. This course is designed for students to gain a clearer understanding of the mechanisms that drive the natural world around them. All biological jargon will be defined as original research is discussed.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL140F Classic Studies in Animal Behavior (FYS)
This course will focus on the major concepts in the field of animal behavior. We will discuss the selection pressures that shape animal behavior and whether the study of primate social and mating systems can provide insight into human behavior. Other questions include, Why do certain animal species exhibit altruistic behavior and others do not? What are the limiting resources for male and female animals, and why do they behave so differently? This is but a sampling of the subjects to be covered in a course that is specifically designed for students to gain a clearer understanding of the mechanisms that drive the natural world around them. We will commence with the early pioneers in ethology who were the first to describe the behavioral repertoire of a single species and progress onto the more current, comparative approach, in which two animals are compared for a more fine-tuned analysis. Biological jargon will be defined as original research is discussed.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL145F Primate Behavior: The Real Monkey Business (FYS)
This course will examine the full spectrum of the primate order. How has evolution shaped these different primate species, and what underlying mechanisms have fueled their development? We will discuss primate ancestry, primate environments, and primate competition, all factors that mediate primate behavior. In addition, we will take the lessons learned from primate studies to determine how humans might use this knowledge toward the preservation and conservation of their nonhuman relatives.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL146 Primate Behavior: The Real Monkey Business
This course will explore primate behavior starting with an overview of primate ancestry as gleaned from the fossil record. How has evolution shaped these different primate species, and what underlying mechanisms have fueled their behavioral repertoires? The major selection pressures on primates will be investigated together with parental care, self-medication, and Machiavellian intelligence. The class will also examine theoretical models explaining the evolution of the oversized human brain by Geoffrey Miller and how the advent of cooked foods supported a large brain mutation (Richard Wrangham). In addition, we will take the lessons learned from these aforementioned primate studies to determine how this knowledge can work toward the preservation and conservation of our nonhuman primate relatives.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL149 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: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B149**
Prereq: **None**

BIOL153F Stress: The Good, The Bad, The Ugly, The Resilient (FYS)
Stress, what is it and what is it good for? This course will introduce students to the neurobiology of stress. We will read the foundational works that helped us understand that stress can have real, measurable, and lasting effects on the entire body and across generations. Next, we will break down major concepts in the field (including allostasis, fight or flight, tend and befriend and hyperkatifeia) that describe how the body handles acute and chronic stress. Finally, we will end the course with a focus on stress resilience. We will discuss how social interaction, exercise, nutrition, and mindfulness approaches work to contribute to the remarkable resilience that has defined the success of our species. Our major sources of information will include original scientific reports, essays, magazine articles, podcasts, films, lectures and guest appearances by neuroscientists in the field. Throughout the course, students will maintain a journal with daily entries that document their understanding of the material and its relevance to their lives. As a final project, students will be asked to work in pairs to build a digital zine for distribution to other incoming frosh to help develop their appreciation for how stress can impair cognition and emotional regulation, how stress can aid learning and memory and what tools of resilience students can lean on throughout their time at Wesleyan to temper the former and facilitate the latter.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL155 Tiny Organisms with a Big Effect: The Microbiome
With the advent of advanced sequencing technology, we are able to characterize the microflora that lives on and inside of multicellular organisms, including humans. It follows that there are still many unknowns with respect to the function and dynamics of relationships between bacterial communities and their hosts. These bacterial communities, colonizing humans and other organisms with millions of microbes, have captured the interest of the public. Popular news outlets have made the disparate claims that the right human microbiome can act as a panacea and the wrong microbiome is such a calamity that it can destroy an individual's health. This course will look at the true nature of the microbiome, to the extent that current research has revealed. We will discuss both normal and abnormal bacterial community compositions and any related disease states. Similarly, we will cover changes in microbiome composition over time and with respect to host development. In class, we will also consider the microbiomes of other organisms and how the presence and composition of the microbiome relates to disease states and/or life history.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B155**
Prereq: **None**

BIOL155Z Tiny Organisms with a Big Effect: The Microbiome
With the advent of advanced sequencing technology, we are able to characterize the microflora that lives on and inside of multicellular organisms, including humans. It follows that there are still many unknowns with respect to the function and dynamics of relationships between bacterial communities and their hosts. These bacterial communities, colonizing humans and other organisms with millions of microbes, have captured the interest of the public. Popular news outlets have made the disparate claims that the right human microbiome can act as a panacea and the wrong microbiome is such a calamity that it can destroy an individual's health. This course will look at the true nature of the microbiome, to the extent that current research has revealed. We will discuss both normal and abnormal bacterial community compositions and any related disease states. Similarly, we will cover changes in microbiome composition over time and with respect to host development. In class, we will also consider the microbiomes of other organisms and how the presence and composition of the microbiome relates to disease states and/or life history.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B155Z**
Prereq: **None**

BIOL160 Life in the Oceans in the Anthropocene and Beyond
Little is known about life in the deep sea, the largest habitat on Earth, even about the largest animals living there, such as the giant squid. Humans, however, are severely affecting even these most remote areas of our planet, and wildlife populations in the oceans have been badly damaged by human activity. We will look at the amazing diversity of ocean life and the disparate building plans of its animals, and see how oceanic ecosystems are fundamentally different from land ecosystems. Then we will explore how human actions are affecting oceanic ecosystems directly, for instance by overfishing (especially of large predators and filter feeders), addition of nutrients (eutrophication) and pollutants, and the spread of invasive species, as well as indirectly, through emission of carbon compounds into the atmosphere. Rising atmospheric CO2 levels lead to ocean acidification and global warming, affecting the all-important metabolic rates of ocean life, as well as oceanic oxygen levels and stratification, thus productivity. We will try to predict the composition of future ecosystems by looking at ecosystem changes during periods of rapid warming in the geological past and see whether future ecosystems will become dominated by jellyfish, as they were 600 million years ago.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES160, CIS160**
Prereq: **None**

BIOL161 Science Materials For a Malagasy Classroom
Students will design and produce a variety of educational science materials to be used in a fifth grade classroom in Madagascar. These items include a science logo, bookmarks, educational science games, posters, and a comic book with conservation themes for children. Students who are interested in design and natural history as a means through which to communicate science themes on wildlife endemism, evolution, and climate change would be appropriate for this course. All students will need to conduct independent research into science topics, distill down the salient features, and use that information to design elementary school materials. Working both individually and in teams, students will conceive, design, critique, and move into product production (MakerSpace). In addition, prototypes of the materials will be reviewed and rated by fifth graders in a Middletown elementary school for feedback.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **ENVS261, IDEA261**
Prereq: **None**

BIOL173 Global Change and Infectious Disease
This course will cover how human demands upon the environment have come back to bite us through infectious diseases. The most devastating infections, now and in the past, have spilled into humanity from other animals through our quest for food, either through hunting and trade of wild animals (COVID-19 and HIV) or through agriculture (smallpox and measles). Additionally, taking over huge swaths of land has fragmented natural habitats, with the result that some pathogens have increased in abundance (Lyme disease) and some pathogens have moved closer to humanity when humans have encroached on natural lands (Ebola). Living at high density in interconnected cities has sustained the severe infections that became humanity's childhood diseases (mumps, measles, smallpox); high densities have also brought us diseases brought by fecally contaminated water, as well as those diseases brought by the animals that cohabit our cities and suburbs (rats, robins). Our demand on energy has brought us global warming, which is transporting tropical diseases, such as malaria, poleward from the tropics; the extreme weather events of a changed world are leading to outbreaks of zoonotic diseases (hantaviruses). Moreover, our penchant for transporting wild animals and ourselves has had the potential to spread any local flare-up of any novel disease to the whole world (plague, COVID-19). We will discuss how, even if we mitigate every existing human infection, we should expect an unending stream of new pathogens. We will discuss technological solutions to infectious diseases, as well as how changes in our ethics might help contain existing pathogens and avoid future spillovers. Lectures will cover these and other topics. There will be two 65-minute lectures each week, with frequent opportunities for students to break out into smaller sections to figure out interesting biological challenges. There will also be a 30-minute discussion each week for each of 11 discussion sections (probably about 15 students each). These discussions will focus mostly on how policy changes might best mitigate the environmental disturbances that are bringing us infections. The course has no formal prerequisites and will introduce material from ecology and microbiology, as needed, to allow students to read and interpret the recent literature on global change and infectious disease.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **ENVS260**
Prereq: **None**

BIOL181 Principles of Biology I: Cell Biology and Molecular Basis of Heredity
This course presents an exploration of the contemporary view of the cell and an introduction to the molecules and mechanisms of gene function. The course will have two major themes. First, we will focus on the central dogma of molecular biology, describing the process of information transfer from the genetic code in DNA through protein synthesis and function. Topics include DNA replication, chromosome dynamics, transcription, translation, and gene regulation. Second, we will focus on cell theory and the underlying molecular mechanisms of cellular activity, including transport across cell membranes, cellular energetics, protein sorting, cell motility, and cell cycling. Lectures will stress the experimental basis of conclusions presented and highlight important details and major themes. The course will also emphasize problem solving approaches in cell and molecular biology. This course will require about 10 hours per week of engagement. Students should enroll separately in MB&B/BIOL191 Principles of Biology 1 - Laboratory.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B181**
Prereq: **None**

BIOL181Z Principles of Biology I: Cell Biology and Molecular Basis of Heredity
This course presents an exploration of the contemporary view of the cell and an introduction to the molecules and mechanisms of genetics and gene function. The course will have two major themes. First, we will focus on the central dogma of molecular biology, describing the process of information transfer from genetic code in DNA through protein synthesis and function. Topics include DNA replication and repair, chromosome dynamics, RNA transcription, protein translation, gene regulation, and genomics. Second, we will focus on cell theory and the underlying molecular mechanisms of cellular activity, including cell signaling, energetics, cell motility, and cell cycling. Lectures will stress the experimental basis of conclusions presented and highlight important details and major themes. The course will also emphasize problem solving approaches in cell and molecular biology.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B181Z**
Prereq: **None**

BIOL182 Principles of Biology II
This course covers biological principles at tissue, organ, organismic, and population levels of organization. We will review how animals regulate their internal environment to control or adapt to changes in temperature, salt levels, nutrients, levels of oxygen and carbon dioxide, and the presence of infectious agents. We will examine the molecular, cellular, and tissue mechanisms that underlie the hormonal, neuronal, and behavioral processes that underlie these responses. We will learn how these systems develop in the embryo. At the population level, we will review evidence for evolution, including the tenets of Darwin's theory of evolution by natural selection. We will also discuss the nature and importance of variation among organisms, stochastic processes in evolution, and modern theories of speciation and macroevolution. Finally, the course addresses ecological aspects of population biology, including patterns and processes that inform the distribution and abundance of biodiversity, population growth, organisms' responses to environmental variation, and interactions among species. Each of the topics of the course is explored from a comparative viewpoint to recognize common principles as well as variations among organisms that indicate evolutionary adaptation to different environments and niches.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B182**
Prereq: **MB&B181 OR MB&B181Z**

BIOL182Z Principles of Biology II
This course covers biological principles at tissue, organ, organismic, and population levels of organization. We will review how animals regulate their internal environment to control or adapt to changes in temperature, salt levels, nutrients, levels of oxygen and carbon dioxide, and the presence of infectious agents. We will examine the molecular, cellular, and tissue mechanisms that underlie the hormonal, neuronal, and behavioral processes that underlie these responses. We will learn how these systems develop in the embryo. At the population level, we will review evidence for evolution, including the tenets of Darwin's theory of evolution by natural selection. We will also discuss the nature and importance of variation among organisms, stochastic processes in evolution, and modern theories of speciation and macroevolution. Finally, the course addresses ecological aspects of population biology, including patterns and processes that inform the distribution and abundance of biodiversity, population growth, organisms' responses to environmental variation, and interactions among species. Each of the topics of the course is explored from a comparative viewpoint to recognize common principles as well as variations among organisms that indicate evolutionary adaptation to different environments and niches.

Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B182Z**
Prereq: **BIOL181Z**

BIOL186 Introduction to the Biology of Nutrition and Impact on Human Health
This course will introduce students to the concepts of nutrition. It will cover the biology of the different food groups that make a balanced diet (carbohydrates, fats, proteins) and how our bodies obtain energy and important molecules, such a vitamins, from our food. The course will also cover the relevant anatomy involved in digestion and excretion. Other topics such as the effects of food production on the environment, fad diets, and disease states will also be studied, along with the latest hot topics in the news.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL191 Principles of Biology I--Laboratory
This laboratory course, to be taken concurrently with MB&B181 or BIOL181, provides experience with techniques used in cell biology and molecular biology. These include polymerase chain reaction (PCR), electrophoresis, enzyme assays, and spectrophotometry.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B191**
Prereq: **None**

BIOL192 Principles of Biology II: Laboratory
This laboratory course, designed to be taken concurrently with BIOL182 or MB&B182, will introduce students to experimental design, laboratory methods, data analysis, and empirical approaches to developmental biology, physiology, ecology, and evolution. A specific emphasis will be placed on science communication.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B192**
Prereq: **[MB&B191 or BIOL191]**

BIOL193 Principles of Biology I Laboratory (Online)
This laboratory course, to be taken concurrently with MB&B181 or BIOL181, provides experience with techniques used in cell biology and molecular biology. These include polymerase chain reaction (PCR), electrophoresis, enzyme assays, and spectrophotometry.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B193, NS&B193**
Prereq: **None**

BIOL194 Principles of Biology II: Advanced Topics
This course provides an optional supplement to the introductory course in physiology, development, evolution, and ecology (BIOL182, which should be taken concurrently). It is designed for highly motivated biology students who seek to enrich their understanding by engaging with current research in an intensive seminar setting. Students in BIOL194 will read and discuss recent journal articles that probe in greater depth some of the subjects covered in BIOL182. Weekly meetings will consist of a short lecture by the professor followed by group discussion of the readings.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B194**
Prereq: **BIOL181 or MB&B181**

BIOL197 Introduction to Environmental Studies
This course explores the interdisciplinary field of environmental studies to better understand the characteristics of human interaction with and dependence on the environment, and the causes and consequences of environmental degradation at local and global scales. We will explore key processes, characteristics, and phenomena of the natural world, and relevant human system and social dynamics. We will apply this information to identifying important issues and trends of global climate change and sustainability. Projects facilitate synthesis and application, skill development, reflection, and independent exploration.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **ENVS197, E&ES197**
Prereq: **None**

BIOL198 Principles of Biology II Laboratory _ Online
This laboratory course, designed to be taken concurrently with BIOL182 or MB&B182, will introduce students to experimental design, laboratory methods, data analysis, and empirical approaches to developmental biology, physiology, ecology, and evolution. Laboratory exercises use the techniques of electrophysiology, microscopy, computer simulations, and analyses of DNA sequence data. Some exercises will include exploration of physiological processes in living animals.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **MB&B198, NS&B198**
Prereq: **BIOL192**

BIOL208 Molecular Biology
This course is a comprehensive survey of the molecules and molecular mechanisms underlying biological processes. It will focus on the cornerstone biological processes of genome replication, gene expression, and protein function. The major biomacromolecules -- DNA, RNA, and proteins -- will be analyzed to emphasize the principles that define their structure and function. We will also consider how these components interact in larger networks within cells to permit processing of external and internal information during development and how these processes become perturbed in disease states.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B208**
Prereq: **MB&B181 OR MB&B181Z**

BIOL210 Genetics and Genomics
Genetics has provided a foundation for modern biology. We will explore the classical genetics and go on to consider how genomics has transformed this field. This course is intended to introduce students to the fields of genetics and genomics, which encompass modern molecular genetics, bioinformatics, and the structure, function, and evolution of genomes. We will discuss important new areas of research that have emerged from the genome projects, such as epigenetics, polymorphisms, transgenics, systems biology, stem cell research,

and disease mapping. Students will also discuss bioethical issues we face in this new postgenome era.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B210**
Prereq: **MB&B181 OR BIOL181 OR BIOL181Z**

BIOL212 Principles and Mechanisms of Cell Biology
The cell is the smallest structural and functional unit of an organism. The primary goal of this course is to understand the structure, organization, regulation and behavior of cells, because with this perspective one can begin to ask complex questions including: why does mutating a protein cause a cell to malfunction and how does this cause tissue malfunction or disease? We will examine the cell mainly in the context of the multicellular organism--where cells respond to as well as regulate their local environment. Hence, this course provides students with a firm foundation in cell biology as we examine eukaryotic cell structure, organelle function, cell adhesion and motility, signal transduction and cell differentiation, cell survival and apoptosis, and consider how these mechanisms integrate to generate coherent cell behaviors. Published research will be discussed throughout the course in order to build students' understanding of research in cell biology. Lectures, assignments and assessments include opportunities for students to develop a broad and deep knowledge of cell biology, gain understanding of the scientific process of inquiry, experimentation and interpretation, and develop skill in analytical and critical thinking and scientific writing.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B212**
Prereq: **MB&B181 OR BIOL181 OR BIOL181Z**

BIOL213 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: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B213, PSYC240**
Prereq: **None**

BIOL214 Evolution: Pattern and Process
Over the last 3.5 billion years, life has taken on a vast array of forms in a multitude of environments. In this class, we will use evolutionary analysis to reveal the key patterns and processes that produced this amazing diversity of life. Topics will include: the evidence for evolution, the nature of variation, adaptive and random evolutionary processes in natural populations, mechanisms of speciation, phylogenetic reconstruction with molecular and morphological data, and major events in the history of life on earth. Motivating examples will be drawn from across the domains of life.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **MB&B182 OR BIOL182 OR BIOL182Z**

BIOL215 Evolution in Human-Altered Environments
Human activities have altered natural environments and, indeed, have created entirely novel ecosystems such as cities and high-input farms. This course examines how these human alterations to the environment affect the evolution and coevolution of diverse organisms. Starting with an intensive overview of microevolutionary processes, we will consider a number of contemporary scenarios: evolutionary response to environmental contaminants, exploitation of natural populations, and global climate change; evolution in urban and agricultural ecosystems; and the evolutionary impact of nonnative, invasive, and genetically modified organisms.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL515, ENVS210**
Prereq: **[BIOL182 or MB&B182]**

BIOL216 Ecology
Ecology is the scientific study of interactions between organisms and their environment, both biotic and abiotic. We will look at how these interactions shape fundamental characteristics of populations, communities, and ecosystems. Topics will include predation, competition, symbioses, and effects of stress and resource limitation in diverse environments. We will cover important consequences of interactions such as coevolution, population outbreaks, ecological coexistence, patterns of biodiversity, ecological succession, species invasions, food web dynamics, nutrient and energy cycling, variation in ecosystem goods and services, and global change.

This course emphasizes several learning goals in biology, including skill in formulating original ideas and experiments, using quantitative and graphical tools and interpreting quantitative information, and scientific writing.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **ENVS216**
Prereq: **[BIOL182 or MB&B182]**

BIOL217 Microbial Genomics and Evolution
In this course, students will learn the principles governing the structure, regulation, and evolution of bacterial and viral genomes. We will emphasize the experimental logic and conceptual models that researchers use to link genotype to phenotype. Specific topics will include operons, genetic networks, horizontal gene transfer, phylogenetics, and genome-wide association studies. Motivating examples will be drawn from both medical and environmental microbiology.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **MB&B181 OR MB&B181Z AND MB&B182 MB&B182Z**

BIOL218 Developmental Biology
It's an extraordinary time to learn Developmental Biology: advancements in imaging and experimental strategies, especially those that manipulate gene expression, have led to an explosion in the amount that we know about how an organism develops and how developmental programs are also used in the

adult organism. This course covers the mechanisms of development at the molecular, cellular, and organismal levels. We may also cover tissue repair and regeneration, aging, cancer, and other topics that are tied to development. Special attention will be paid to the process of scientific discovery--the experiments--and students will read original research articles. We will discuss ethical and medical considerations for some of the topics covered. Lectures, class discussion, and assignments will include opportunities for students to develop a broad and deep knowledge of developmental biology, gain understanding of the scientific process of inquiry, experimentation and interpretation, and develop skill in analytical and critical thinking and scientific writing.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **BIOL182 OR MB&B182 OR BIOL182Z**

BIOL220 Conservation Biology
This course will focus on the biology of conservation rather than cultural aspects of conservation. However, conservation issues will be placed in the context of ethics, economics, and politics. We will cover the fundamental processes that threaten wild populations, structure ecological communities, and determine the functioning of ecosystems. From this basis, we will explore important conservation issues such as habitat loss and alteration, overharvesting, food web alteration, invasive species, and climate change. We will use readings from the primary literature and field projects to learn about current research methods used in conservation biology. This course emphasizes reading and interpreting primary scientific literature and quantitative information, thinking critically about morals and ethics in society, and includes some hands-on research methods.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **ENVS220**
Prereq: **BIOL182 OR MB&B182 OR BIOL182Z**

BIOL223 The Molecular Basis of Cancer
Cancer is a group of diseases characterized by unregulated cell growth and tissue invasion. This course will focus on the molecular events that lead to cancer. We will cover topics in both molecular and cellular biology and genetics that are relevant to understanding the differences between normal and cancer cells. Particular focus will be placed on oncogenes and tumor suppressor genes, DNA damage responses, the p53 signaling pathway, cell cycle regulation, and the molecular basis of cancer therapies. This course will utilize both the textbook and primary scientific literature in the study of cancer.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Identical With: **MB&B223**
Prereq: **MB&B181**

BIOL224 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: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B224**
Prereq: **[NS&B213 or BIOL213 or PSYC240] OR [BIOL182 or MB&B182]**

BIOL226 Invasive Species: Biology, Policy, and Management
Invasive species account for 39 percent of the known species extinctions on Earth, and they are responsible for environmental damages totaling greater than $138 billion per year. However, the general population has little knowledge of what invasive species are or what threats they pose to society. In this course, we will explore the biological, economic, political, and social impacts of invasive species. We will begin by exploring a definition of an invasive species and looking at the life history characteristics that make them likely to become pests. Then we will consider the effects of invasive species expansion on the conservation of biodiversity and ecosystem function, as well as their global environmental and political impacts. Finally, we will explore the potential future changes in invasive species distributions under a changing climate.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **E&ES240, ENVS226**
Prereq: **[E&ES197 or BIOL197 or ENVS197] OR [BIOL182 or MB&B182] OR EES199**

BIOL228 Introductory Medical Biochemistry
This introductory course will focus on the essential concepts of biochemistry important to students interested in the health professions, including the chemical and biological foundations of cellular metabolism and related disease states. Major topics will include the structure and function of biological molecules in the human body (proteins, carbohydrates, fats, nucleic acids, vitamins), enzyme catalysis, cellular signaling, and digestion, absorption, and processing of nutrients for energy and growth.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B228**
Prereq: **[MB&B181 or BIOL181] AND CHEM251**

BIOL229 Geobiology Laboratory
This laboratory course will explore more deeply some of the concepts introduced in E&ES234. Both the fundamental patterns and practical applications of the fossil record will be emphasized.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES235**
Prereq: **E&ES101 OR E&ES115 OR E&ES155 OR EES199 OR [ENVS197 or BIOL197 or E&ES197]**

BIOL231 Microbiology
This course will study microorganisms in action, as agents of disease, in ecological situations, and as tools for research in molecular biology, genetics, and biochemistry. Particular emphasis will be placed on new ideas in the field.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **1.00**

Gen Ed Area: **NSM-MBB**
Identical With: **MB&B231**
Prereq: **BIOL182 OR MB&B208**

BIOL232 Immunology
In this introduction to immunology, particular emphasis will be given to understanding both the innate immune response and its agents as well as the acquired immune response mediated by B and T cells. Cellular and antibody responses in health and disease will be addressed, along with mechanisms of immune evasion by pathogens, autoimmune disease, and cancer.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B232**
Prereq: **([MB&B181 or BIOL181] AND [BIOL182 or MB&B182]) OR [MB&B208 or BIOL208]**

BIOL233 Geobiology
Fossils provide a glimpse into the form and structure of ancient ecosystems. Geobiology is the study of the two-way interactions between life (biology) and rocks (geology). Typically, this involves studying fossils within the context of their sedimentary setting. In this course, we will explore the geologic record of these interactions, including the fundamentals of evolutionary patterns, the origins and evolution of early life, mass extinctions, and the history of the impact of life on the climate.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES234, ENVS233**
Prereq: **E&ES101 OR E&ES115 OR E&ES155 OR EES199 OR [ENVS197 or BIOL197 or E&ES197]**

BIOL235 Comparative Vertebrate Anatomy
This course will provide a comprehensive overview of the main organ systems in vertebrates, emphasizing phylogenetic relationships and anatomical features of major vertebrate groups. Using a comparative, systems-based approach students will explore the relationships between structure and function, evolutionary and developmental constraints on vertebrate anatomy, and the ways that a comparative anatomical approach informs our understanding of the human body. The course format will consist of two lectures and one lab per week, with lab sessions focusing on detailed dissection of several representative vertebrate species.
Offering: **Host**
Grading: **A-F**
Credits: **1.50**
Gen Ed Area: **NSM-BIOL**
Prereq: **([MB&B181 or BIOL181] AND [BIOL182 or MB&B182] AND [MB&B191 or BIOL191] AND [BIOL192 or MB&B192])**

BIOL236 Comparative Animal Physiology
This course studies the fundamental mechanisms that diverse animals (mostly vertebrates) have developed to deal with common functional problems posed by their environments, and the special mechanisms that some animals use to cope with extreme environments. Animal physiology focuses on the functions of tissues, organs, and organ systems, investigating the mechanisms that operate at all levels ranging from molecules to the whole organism. Animal physiology is thus an integrative science, attempting to bring together everything that is known about an animal's function to create an integrated picture of how that animal operates in its environment. The mechanisms of function and regulatory processes that will be covered include gas exchange, circulation, excretion, osmoregulation, sensing mechanisms, temperature regulation, muscle contraction/locomotion, and endocrine coordinating mechanisms.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **(BIOL181 OR MB&B181) AND (BIOL182 OR MB&B182)**

BIOL237 Signal Transduction
Cells contain elaborate systems for sensing their environment and for communicating with neighbors across the membrane barrier. This class will explore molecular aspects of signal transduction in prokaryotic and eukaryotic cells. Topics will include membrane receptors, GPCRs, kinases, phosphorylation, ubiquitination, calcium signaling, nuclear receptors, quorum sensing, and human sensory systems. We will integrate biochemical functional approaches with structural and biophysical techniques.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B237**
Prereq: **[MB&B208 or BIOL208]**

BIOL239 Functional Anatomy of the Human Brain
The human brain is an organ with the consistency of firm Jell-O, weighing about 2.5 pounds in an adult. It is made of 86 billion neurons and approximately the same number of non-neuronal cells. Contrary to common misconceptions, we use all the neurons in our brains, not just a small fraction of them from the regions dedicated to the function being performed. Brain cells organize in distinctive anatomical structures, which are interconnected through complex circuits that control nearly every function of the body, such as learning and memory, thinking, consciousness, and aesthetic appreciation. Its malfunction results in a variety of diseases, including senility, mood disorders, and motor/sensory 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 familiarize students with the medical terminology and neurological concepts for a general understanding of the human brain and spinal cord, being of special interest for pre-med students, NS&B, biology, and psychology majors; and anyone simply interested in how the brain works.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B239, PSYC239**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL241 Cell-Cell Interactions in Development
This course is about the exploration of the cellular interactions during development. Students will examine interactions between cells in the specification of the overall body plan, tissues and organs; the role of adhesions and migration; and the intracellular and extracellular cues that regulate these processes.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **(BIOL182 AND BIOL212) OR BIOL218**

BIOL242 Quantitative Methods for the Biological and Environmental Sciences
This course offers an applied approach to statistics used in the biological, environmental, and earth sciences. Statistics will be taught from a geometric perspective so that students can more easily understand the derivations of formulae. We will learn about deduction and hypothesis testing as well as the assumptions that methods make and how violations affect applied outcomes. Emphasis will be on analysis of data, and there will be many problem sets to solve to help students become fluent with the methods. The course will focus on

data and methods for continuous variables. In addition to basic statistics, we will cover regression, ANOVA, and contingency tables.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL542, E&ES270, E&ES570, ENVS242**
Prereq: **None**

BIOL243 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: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B243**
Prereq: **[NS&B213 or BIOL213 or PSYC240] OR [MB&B181 or BIOL181]**

BIOL244 Neuropharmacology
This course will introduce students to the physiological and molecular effects of drugs on neuronal activity and behavior. We will cover key concepts in neuropharmacology, including pharmacokinetics and pharmacodynamics, alongside techniques used in modern pharmacotherapeutic discovery as it relates to the treatment of neurological and neuropsychiatric disease. Student assessment will include in-class quizzes and exams.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B244, BIOL544**
Prereq: **BIOL182 OR BIOL182Z AND NS&B213**

BIOL245 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: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B245, BIOL599**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL247 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: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B247**
Prereq: **([NS&B213 or BIOL213 or PSYC240] AND [BIOL182 or MB&B182])**

BIOL248 Introduction to Human Body Morphology
The human body is both complex and fascinating. This introductory course in human anatomy, explored across different scales, is designed to provide students with a precise and comprehensive understanding of the human body's morphological organization, using accurate and specialized terminology. The course will primarily focus on anatomy, constantly relating it to histology concepts to understand the relationship between structure and function within the body's systems and organs. The program is structured into three modules: Module 1 - Organization of the Human Body and Methods of Study, Module 2 - Integration of Functions, and Module 3 - Interaction with the External Environment. Each module will offer foundational knowledge in anatomy and histology, laying a solid foundation for further study in disciplines related to the human body and other mammals. The goal is for each student to master essential concepts and develop cognitive skills that will deepen their understanding of the body's functioning. Students will be encouraged to actively engage in class discussions, adopt a reflective approach to knowledge, and, most importantly, foster a lasting passion for learning.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **(BIOL181 OR MB&B181) AND (BIOL182 OR MB&B182)**

BIOL250 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: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B250, NS&B555**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL251 Laboratory in Basic Practices in Neuroscience
This course will provide students with the knowledge and some tools to solve problems in neurobiology. Topics covered include a fundamental review of neurobiology and approaches in neuroscience research methods, behavioral studies, tissue/cell preparation, and histology/microscopy.

Students will learn how the applications of advanced neuroscience techniques have answered fundamental questions in neurobiology and neurophysiology.

Modern approaches and their applications will be discussed, including behavioral studies, tissue preparation and analysis, histology, and microscopy.

The learning outcomes will be assessed by a project, oral presentation of the project, written laboratory class reports (lab notebooks), and a lab practicum.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B251**
Prereq: **NS&B213 OR BIOL213 OR PSYC240**

BIOL252 Cell Biology of the Neuron
Understanding the cellular biology of neurons is critical for understanding neurological disorders as well as neuropharmacological methods for treating the nervous system. In this course, we will explore how neurons function, focusing on structure-function relationships of the molecular building blocks of neurons. We will examine the basic cell biological mechanisms that underlie the formation, function, and plasticity of neurons and circuits. Areas studied will include cytoskeleton, cellular polarity, synapse formation, synaptic transmission, inter- and intra-cellular transport, neuronal plasticity, and regeneration. This course is designed to follow on from NS&B213 Behavioral Neurobiology.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B252**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL254 Comparative Animal Behavior
In this survey course, we explore a wide range of animal behaviors at the proximate and ultimate levels of analysis. Main topics include: the principles of communication, genetic regulation of behavior, neuroethology, biological rhythms, hormones and behavior, reproduction, and animal cognition. Students gain foundational knowledge by engaging with textbook readings and traditional lectures. Students practice self-directed inquiry, peer-assisted learning, and scientific communication through in-class work sheets, group discussions, take-home assignments, and presenting topics of their choosing. Finally, students will learn about research and the academic career path through scholar highlights, interacting with guest speakers, and reading primary literature.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B254**
Prereq: **[BIOL182 or MB&B182] OR [BIOL196 or MBB196] OR [NS&B213 or BIOL213 or PSYC240] OR BIOL182Z**

BIOL256 Quantifying Evolution: The Genetics of Populations
How can we forecast the survival of an endangered species? How quickly can antibiotic resistance arise? Who is Lucy? Population genetics studies the genetic variation within and between populations that arise from several factors, including natural selection. Migration, mate choice, and habitat all influence the evolution of life. In this course, we will use mathematical modeling to describe how these fundamental forces change populations over time, and we will learn how these principles are used to breed our food supply, build our medicines, and manage our ecosystems. Class sessions will combine lectures with discussion and in-class problem-solving. Using these ideas, students will learn how evolutionary biologists reconstruct history using the principles of inheritance and variation.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **MB&B181**

BIOL257 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: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Identical With: **NS&B257**
Prereq: **BIOL181 AND BIOL182**

BIOL259 Genes to Greens: The Biology of Food Production
Climate change and rapid advances in biological technology are shifting the ways humans grow food. We can now produce food more efficiently than ever, but are losing arable land to harsh and unforgiving climates. We also must grapple with ethical questions about which natural resouces we should sacrifice for the good of the global food supply. In this course, students will gain an understanding of plant physiology, traditional agricultural techniques, and traditional and modern crop breeding strategies. Students will engage in the current debates surrounding food production.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **ENVS251**
Prereq: **None**

BIOL263 Demystifying Data: Introductory Data Analysis and Modeling
How do scientists make sense of the data they collect, especially as datasets grow in size and complexity? In this course, students will learn fundamental concepts in data collection, statistics, and modeling through hands-on analysis of publicly available datasets from the COVID-19 pandemic. We will cover the effects of biases in data collection, models of epidemic growth and spread, and the principles of studying a rapidly evolving pathogen. While we will use motivating examples from the life sciences, students can expect to learn techniques and ways of thinking that will form a foundation for evaluating and analyzing data across scientific disciplines. Students will learn the basics of using the R programming language to visualize, analyze, and model data, so no previous programming experience is expected.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **CIS263**
Prereq: **MB&B181 OR BIOL182**

BIOL265 Bioinformatics Programming
This course is an introduction to bioinformatics and programming for students with interest in the life sciences. It introduces problem areas and conceptual frameworks in bioinformatics. The course assumes little or no prior programming experience and will introduce the fundamental concepts and mechanisms of computer programs and examples (e.g., sequence matching and manipulation, database access, output parsing, dynamic programming) frequently encountered in the field of bioinformatics.
Offering: **Host**
Grading: **A-F**

Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **MB&B265, COMP113, CIS265**
Prereq: **[MB&B181 or BIOL181]**

BIOL266 Bioinformatics
This course is an introduction to bioinformatics for students with interest in the life sciences. The course is similar to BIOL265 but only meets in the second half of the semester (with BIOL265) and is designed for students with programming background, ideally in Python. The course introduces problem areas and conceptual frameworks in bioinformatics and discusses programming approaches used in bioinformatics such as sequence matching and manipulation algorithms using dynamic programming, clustering analysis of gene expression data, analysis of genetic nets using Object Oriented Programming, and sequence analysis using Hidden Markov Models, Regular Expressions, and information theory.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **COMP266, MB&B266, CIS266**
Prereq: **[MB&B181 OR BIOL181]**

BIOL267 Engineering Biology: Cells and Tissues
This course explores the intersection of biology, medicine, and engineering, where scientists are developing novel platforms to promote understanding, diagnosis, and treatment of human diseases. We cover modern techniques for manipulating biological systems, spanning single molecules to ensembles of cells. We will examine the trajectory of the field from studying cells in a plastic dish to the advent of organ-on-a-chip and organoid models and discuss how this transition from 2D to 3D biology has propelled increased understanding of both normal physiological homeostasis and also the pathophysiology of disease. Topics will include controlling behavior of cells through cell-matrix interactions, learning through building via synthetic biology, and advances in regenerative medicine. These topics will be explored through the thematic lenses of transport processes (supply of nutrients and removal of waste) and mechanoreciprocity (the sensing of and response to the physical properties of the cellular microenvironment). Lectures will review fundamental concepts in cell biology and physiology before delving into topical examples from current literature. Lectures and assessments will include opportunities to develop skill in thinking analytically and critically about using engineering tools to study fundamental questions in human disease, formulating original ideas and experiments, and communicating science through written and oral formats.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **IDEA267, BIOL567**
Prereq: **MB&B181 OR MB&B181Z AND MB&B182 OR MB&B182Z**

BIOL270 Systems Biology with Programming
Systems--collections of entities that interact to form an interconnected whole--are present at every scale of organization in the life sciences. Biologists can take advantage of computational and mathematical tools to understand how these systems function and predict how they might change over time. This approach is critical in applications ranging from epidemic modeling to evolutionary theory. In this course, students will learn how simple rules and interactions can lead to complex behavior using examples from three main areas: regulatory networks, population genetics, and ecology. Students will spend the first part of the course learning how to program in Python in order to model, simulate, and visualize these systems. No previous programming experience is expected.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **CIS270**
Prereq: **BIOL181 OR BIOL181Z AND BIOL182 OR BIOL182Z**

BIOL271 Systems Biology with Programming
This course is similar to BIOL270, but only meets in the second half of the semester with BIOL270 and is designed for students with a solid background in programming in Python. Systems--collections of entities that interact to form an interconnected whole--are present at every scale of organization in the life sciences. Biologists can take advantage of computational and mathematical tools to understand how these systems function and predict how they might change over time. This approach is critical in applications ranging from epidemic modeling to evolutionary theory. In this course, students will learn how simple rules and interactions can lead to complex behavior using examples from three main areas: regulatory networks, population genetics, and ecology.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **CIS271**
Prereq: **BIOL181 OR BIOL181Z AND BIOL182 OR BIOL182Z**

BIOL290 Plant Form and Diversity
The course begins with an overview of plant evolutionary history, then covers the basic structure and function of the plant body, the plant life cycle in nature, including interactions with animals, and ecological diversity of plants in contrasting habitats. Special events include a field trip to the Smith College Botanic Garden, two hands-on days for working with living specimens, and a special guest lecture by a local plant biologist.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL590, ENVS286**
Prereq: **BIOL182 OR MB&B182 OR BIOL182Z**

BIOL295 Physiology and Cell Biology of Cancer
This course focuses on the cellular and physiological aspects of cancer, examining the major hallmarks of cancer. Recent advances in cancer treatment are also covered.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **(MB&B181 or BIOL181) AND (MB&B182 or BIOL182) AND (BIOL212 or BIOL218)**

BIOL299 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: **Host**

Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B299**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL302 Neurobiology of Aging
This course is designed to explore the intricate relationship between the aging process and the nervous system. As our population ages, understanding the underlying neurobiology of aging becomes increasingly important. This course delves into the physiological, cellular, and molecular aspects of how the nervous system changes over time and the impact of these changes on cognition, behavior, and overall well-being.

This course will introduce the student to the study of aging (gerontology) and the effects of normal aging and pathological aging on the nervous system. We will discuss general concepts of aging, and biochemical, physiological, and behavioral age-associated changes in the motor, sensory, cognitive, and neuroendocrine systems. By the end of the course, the student should have a clear understanding of what aging is and what effects it has on normal brain function. In class, I will introduce the topic with slide presentation and after that, we will discuss the topic based on the scientific article discussion. After the last class, students will have extensive opportunities for feedback and will write a project and present it in class as an oral presentation. Student evaluation will include weekly quizzes, project, a midterm and final exams, and class participation/attendance.

Course Objectives:

By the end of this course, students will:

1. Gain a Comprehensive Understanding: Develop a comprehensive understanding of the neurobiological processes associated with aging, including neurodegenerative diseases.

2. Explore Structural Changes: Examine structural changes in the aging brain, such as alterations in neuron density, synapse formation, and brain volume.

3. Analyze Functional Changes: Analyze functional changes in the aging nervous system, including changes in memory, cognition, sensory perception, and motor function.

4. Study Neurodegenerative Diseases: Investigate common neurodegenerative diseases associated with aging, such as Alzheimer's disease, Parkinson's disease, and age-related macular degeneration.

5. Explore Cellular and Molecular Mechanisms: Explore the cellular and molecular mechanisms underlying age-related changes in the nervous system, including oxidative stress, inflammation, and genetic factors.

6. Examine Potential Interventions: Review potential interventions and strategies to promote healthy aging and delay or mitigate age-related neurobiological changes.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B302**
Prereq: **NS&B213**

BIOL302Z Neurobiology of Aging
This course is designed to explore the intricate relationship between the aging process and the nervous system. As our population ages, understanding the underlying neurobiology of aging becomes increasingly important. This course delves into the physiological, cellular, and molecular aspects of how the nervous system changes over time and the impact of these changes on cognition, behavior, and overall well-being.

This course will introduce the student to studying aging (gerontology) and the effects of normal aging and pathological aging on the nervous system. We will discuss general concepts of aging, and biochemical, physiological, and behavioral age-associated changes in the motor, sensory, cognitive, and neuroendocrine systems. By the end of the course, the student should clearly understand what aging is and its effects on normal brain function. In class, I will introduce the topic with slides presentation and after that, we will discuss the topic based on the scientific article discussion. After the classes, students will have extensive opportunities for feedback and will be requested to write a project for the last, oral presentation of the project in the class, and a final exam.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B302Z**
Prereq: **NS&B213**

BIOL304 Glia: Not just neuronal glue!
Historically, neuroglial cells (i.e., astrocytes, oligodendrocytes, and microglia) were considered the space-filling cells of the brain, simply the brain's "glue." Later, their primary role was considered metabolic support of neurons (e.g., buffer extracellular potassium, recycle neurotransmitters, myelination, etc.). However, the notion of glia as inert bystanders has recently been revised. It is now accepted that glial cells play critical physiological roles in normal nervous system development and function, including controlling brain wiring, modulation of synaptic transmission, regulating blood flow, and serving as the brain's lymphatic system just to name a few functions. Moreover, glia contributes to a variety of neurological disorders such as epilepsy, glioma, multiple sclerosis, neurodegenerative diseases, and psychiatric disorders like major depressive disorder and schizophrenia. Hence, these underappreciated cells are long overdue recognition. This is an interdisciplinary course in which students will engage in a focused, in-depth exploration of how glial cells contribute to neurological and psychiatric disorders. Lectures by both basic scientists and clinicians will highlight recent research on the molecular mechanisms by which glial cells contribute to the establishment and progression of neurological and psychiatric disorders.

This is a reading-intensive seminar course emphasizing classroom discussions, with readings from a textbook and the primary scientific literature. After the classes, students will have extensive opportunities for feedback and will be requested to write a simple paragraph for the next class and/or answer a small quiz, based on the new knowledge acquired. Student evaluation will include

quizzes and assessments for a lay audience, a midterm and a final exam, class participation, and attendance.

Course Objectives:

1. Describe the development, histology, and normal physiological function of glial cells.

2. Describe the role inflammation plays in neurological and psychiatric conditions.

3. Describe the role traumatic brain injury plays in neurological and psychiatric conditions.

4. Describe the role genetics plays in neurological and psychiatric conditions.

5. Describe the physiology, pathology, and disease mechanisms of neurological and psychiatric conditions.

6. Demonstrate effective written communication skills to construct a succinct "News & Views" style summary of a primary research report for a lay audience.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B304**
Prereq: **NS&B213**

BIOL306 Ecology and Natural History of Freshwater Fishes of South America
South America has the highest diversity of freshwater fishes anywhere in the world. In fact, there are more than twice the number of mammals and about the same number of birds in the world. Why has this remarkable radiation occurred in a relatively short period of time? How can so many fishes coexist in the same rivers, utilizing the same resources? In this intensive course, we will travel to Colombia during spring break (March 7-21) in order to gain firsthand knowledge about the ecology and natural history of freshwater fishes in South America. We will learn about the ecological and environmental factors that contribute to perhaps the largest biological radiation on the planet.

Students will obtain firsthand experience with the South American tropics, freshwater fishes, and with doing experiments in the field. Each day there will be a combination of lectures and field or laboratory exercises. We will travel to and explore fish ecology in different types of rivers at different elevations. Students will gather and analyze data about biological, physical, and environmental issues that are covered in the lectures. The habitats that we explore will be both terrestrial and freshwater rivers. Our base will be at the Instituto Humboldt in Villa de Leyva, Colombia. We will interact with Colombian students who are studying ecology and biodiversity at the Institute in order to exchange ideas about current environmental issues.

All the costs of travel, lodging, and meals will be covered by the course.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **ENVS306, E&ES306**
Prereq: **None**

BIOL310 Genomics Analysis
This course is an introduction to genomics and analysis for students with interest in life sciences. It introduces current applications of genomics techniques, covers how to build a genomics workflow, and introduces statistical analyses in R programming language. This course assumes little or no prior programming experience and will provide hands-on experience in taking raw next-generation sequencing data through a custom workflow and ending with analyses in R statistical software. This course emphasizes hands-on computational methodology, bioinformatics data analysis, and interpretation of quantitative information. The primary method of evaluation is through written work and weekly homework assignments and the course will increase students skill in scientific writing and scholarship. Classes will consist of lectures, discussion groups and cloud based computational projects designed to train transferable skills in big data analysis. Lectures, labs, assignments and assessments will promote deep knowledge in genomics and informatics, gaining understanding in the scientific process, thinking analytically and critically about biological questions, and formulating original ideas and testing them with big data. Skills gained during the course will include quantitative, statistical and graphical tools, scientific writing, oral communication and deep thinking about ethics in a genomics-enabled world.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **CIS310, MB&B311**
Prereq: **MB&B181 OR BIOL181 OR BIOL181Z**

BIOL312 Global Change Biogeography
On our home planet, Earth, the current geologic epoch is characterized by rapid changes to the environment due to human behavior. Biogeography examines the spatiotemporal distribution of life on Earth, from species to ecosystems and from landscapes to continents. How is anthropogenic climate change modifying the distribution and function of organisms and ecosystems? What can we learn from the evolutionary history of the life-planet system that can help us understand the possible impacts of future climates on the biosphere? To address these questions rigorously, we will explore primary literature from a wide range of theoretical and empirical studies. The course emphasizes inquiry, contact with primary literature, discussion, statistical and spatial coding, learning to obtain data, and visualization. The beginning of the semester provides an overview of physical geography and the Earth System, with field and data experiences that build remote sensing and spatial analysis skills. The second half of the semester is focused on the exploration of relevant scientific literature based on student interests and recent papers, as well as independent research projects.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-EES**
Identical With: **E&ES312, ENVS311**
Prereq: **None**

BIOL316 Plant-Animal Interactions
This course will explore the ecology and evolution of interactions between plants and animals, including mutualism (e.g., pollination, frugivory) and antagonism (e.g., herbivory, granivory), that are central to the functioning of ecosystems and the generation of biodiversity. The format will be seminar-style, involving reading, discussion, and student presentations of key papers on chosen topics. This course emphasizes reading and interpreting primary scientific literature and

quantitative information, formulating original ideas in scientific inquiry, writing, and oral communication.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL516**
Prereq: **BIOL214 OR [BIOL220 or ENVS220] OR [BIOL290 or BIOL590 or ENVS286] OR [BIOL216 or ENVS216]**

BIOL317 Genes and Mechanisms in Vertebrate Sex Determination
Sex determination in vertebrates is a highly plastic process that centers on the decision within a bipotential organ, the gonad, to differentiate into either an ovary or a testis. Interestingly, the "problem" of how to determine sex has been solved in many different ways across the animal kingdom. This course will explore the basic principles and molecular networks involved in sex determination across vertebrate species including fish, reptiles, birds, and mammals. The format will be primarily seminar-style, involving brief introductory lectures, reading, discussions, and individual and group presentations of key papers on chosen topics.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **BIOL212 OR BIOL218**

BIOL318 Nature and Nurture: The Interplay of Genes and Environment
Ever since Watson and Crick proposed the DNA molecule as a heritable genetic "code," biology has emphasized genes ("nature") rather than environmental influences ("nurture") as the primary agents of biological causation. This genetic determinism continues to shape perspectives beyond research, including such critical concerns as public health and human diversity. Recent insights to environmental and inherited epigenetic factors demand that we rethink this established view to build a more integrated understanding. In this advanced seminar, we consider how genetic and environmental factors jointly determine the development and behavior of organisms, including ourselves. After an initial series of lecture/discussion sessions on foundational concepts, this seminar course will consist of student-led discussions of scientific articles on genetic and environmental causes of specific diseases, capacities, and behaviors. Subject to class choice, possible topics will include: causes of lung cancer and of asthma; variation in IQ; the Human Genome Project; and "personalized medicine." Any 200-level course in genetics, development, or neuroscience can fulfill the required prereq; interested COE or other students without this background are encouraged to directly contact Prof Sultan to request a prerequisite override. Students gain understanding of scientific inquiry and interpretation, as well as specific knowledge of a range of human health issues and behavioral capacities. Through reading recent data papers, participating actively in small-class discussions, and giving short oral presentations, students will build their skills in critical thinking about biological and environmental questions and related ethical issues, scientific scholarship, and oral communication of scientific information.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL518, ENVS338**
Prereq: **BIOL214 OR BIOL218 OR [BIOL210 or MB&B210] OR [BIOL224 or NS&B224]**

BIOL322 Cell Migration in Development and Disease
What do the formation of an embryo, the healing of a wound, the surveillance of the immune system, and the invasion of metastatic cancer all have in common? Each of these processes requires the coordinated movement of cells, alone or in groups. In this course, we will learn how and why cells move, and explore what happens when they stop moving properly. We will build up our knowledge from "small" to "large," spanning biological scales from molecules to tissues. Topics will include: (1) the biomolecules of migration: cytoskeleton, focal adhesions, molecular motors; (2) cellular locomotion: protrusion, adhesion, contraction, retraction; (3) cell mechanics and force generation; (4) collective motions during morphogenesis and repair; (5) mechanisms for steering migration: chemotaxis, haptotaxis, galvanotaxis, durotaxis, etc.; (6) cancer as a disease of aberrant cell migration. Throughout the course we will emphasize model systems, experimental design, and technology and measurement techniques. We will focus on seminal works, with attention paid to how these works rippled forward in time, along with cutting edge research.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **MB&B181 AND (BIOL212 OR BIOL218 OR BIOL223 OR BIOL232 OR BIOL252 OR BIOL267)**

BIOL325 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: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B325**
Prereq: **([MB&B181 or BIOL181] AND [BIOL182 or MB&B182])**

BIOL327 Evolutionary and Ecological Bioinformatics
Bioinformatic analysis of gene sequences and gene expression patterns has added enormously to our understanding of ecology and evolution. For example, through bioinformatic analysis of gene sequences, we can now reconstruct the evolutionary history of physiology, even though no traces of physiology exist in the fossil record. We can determine the adaptive history of one gene and all the gene's descendants. We can now construct the evolutionary tree of all of life. Bioinformatics is particularly promising for analysis of the ecology and biodiversity of microbial communities, since well over 99 percent of microorganisms cannot be cultured; our only knowledge of these organisms is through analysis of their gene sequences and gene expression patterns. For example, even when we cannot culture most of a microbial community, we can determine which metabolic pathways are of greatest significance through analysis of community-level gene expression. All these research programs are made accessible not only by breakthroughs in molecular technology but also by innovation in the design of computer algorithms. This course, team-taught by an evolutionary biologist and a computer scientist, will present how bioinformatics is revolutionizing evolutionary and ecological investigation and will present the design and construction of bioinformatic computer algorithms underlying the revolution in biology. Students will learn algorithms for reconstructing phylogeny, for sequence alignment, and for analysis of genomes, and students will have an opportunity to create their own algorithms.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **COMP327, BIOL527, COMP527, CIS327**
Prereq: **[BIOL182 or MB&B182] OR [BIOL196 or MBB196] OR COMP112 OR COMP211**

BIOL328 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: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B328**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL332 Genomics Era Cell and Development
Each decade, technological advances shape the kinds of research questions that can be asked and solved. This past decade, sequencing technologies have delivered rich data sets analyzing genomes and transcriptomes. In this functional genomics course, we'll discuss several cases where the starting point for research was a genetic change (or several genetic changes) found in a tissue, disease, or population. We'll look at the cell and molecular research that was then done and what was learned. For case studies that relate to disease we will also consider how research discoveries shaped treatment options.

This course will greatly expand students' foundational knowledge of cell and developmental biology. Students will also develop their data interpretation and communication skills. Since we all harbor genetic changes that modify our susceptibility to a disease or condition, we will also think critically about moral and ethical issues that arise from the case studies we discuss in class.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **BIOL208 OR BIOL210 OR BIOL212 OR BIOL218**

BIOL333 Gene Regulation
This course aims to develop a genome perspective on transcriptional gene regulation. The genome sequence, now completed in a number of organisms, is described as a blueprint for development. More than simply a parts list (i.e., genes), this blueprint is an instruction manual as well (i.e., regulatory code). A next critical phase of the genome project is understanding the genetic and epigenetic regulatory codes that operate during development. Through a combination of lectures and discussion of primary literature, this course will explore current topics on promoters and transcription factors, chromatin structure, regulatory RNA, chromosomal regulatory domains, and genetic regulatory networks. We will discuss various "Omics" tools, and in particular, sequencing-based strategies that provide information about the transcriptome and epigenome. We will also discuss current models on how transcriptional regimes unfold during the activation (or silencing) of genes, and how these processes become disrupted in various diseases. Finally, we will consider stochastic attributes of gene regulation that challenge "all or nothing" perspectives on cellular states (e.g., perspectives that genes are either "on" or "off," or that cells are either "differentiated" or not). An overarching theme is how genomes encode and execute regulatory programs in response to environmental and developmental cues.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Identical With: **MB&B533, MB&B333, BIOL533**
Prereq: **MB&B181 OR BIOL181**

BIOL334 Shaping the Organism
We are composed of tissues and organs of distinct shapes, but how are these shapes formed? To answer this question, biologists turn to the embryos and developing tissues of model organisms to study the mechanisms that build tissues with distinctive shapes and patterns. These mechanisms include changes in the cytoskeleton and cell adhesion, changes in cell shape, changes in the forces within a cell and across a tissue, and signals that determine whether cells live or die. It turns out that most of the processes required to correctly shape embryos and tissues have also been found to function incorrectly in a variety of human diseases!

This is a part-seminar, part-laboratory course that examines tissue and pattern generation in Drosophila (the fruit fly), an accessible model organism that has been extensively used to study the conserved processes and proteins that shape tissues. First, we will examine how the Drosophila embryo is shaped and patterned. Second, we examine how the Drosophila eye is assembled and patterned. Students will set up Drosophila crosses, use popular techniques to manipulate protein expression, and dissect and image fly tissues.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **([MB&B181 or BIOL181] AND [BIOL182 or MB&B182] AND [MB&B191 or BIOL191] AND [BIOL192 or MB&B192])**

BIOL337 The Origins of Bacterial Diversity
Wherever there is life, there are bacteria. Free-living bacteria are found in every environment that supports eukaryotes, and no animal or plant is known to be free of bacteria. There are most likely a billion or more species of bacteria, each living in its unique ecological niche. This course will explore the origins of bacterial biodiversity: how bacteria evolve to form new species that inhabit new ecological niches. We will focus on how the peculiarities of bacterial sex and genetics facilitate bacterial speciation. Topics will include the characteristics of bacterial sex, why barriers to genetic exchange are not necessary for speciation in bacteria, the great potential for formation of new bacterial species, the evolutionary role of genetic gifts from other species, and the use of genomics to identify ecologically distinct populations of bacteria.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL537, ENVS337**
Prereq: **[BIOL182 or MB&B182]**

BIOL338 Biology and MB&B Symposium I
Weekly seminars by distinguished national and international scientists. The seminar series provides an exciting opportunity to hear about advances in research in the life sciences.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **MB&B338, BIOL538, MB&B538**
Prereq: **None**

BIOL339 Biology and MB&B Symposium II
Weekly seminars by distinguished national and international scientists. The seminar series provides an exciting opportunity to hear about advances in research in the life sciences.
Offering: **Host**
Grading: **Cr/U**

Credits: **0.25**
Gen Ed Area: **None**
Identical With: **BIOL539, MB&B339, MB&B539**
Prereq: **None**

BIOL340 EvoDevo: Origins of Variation in the Phenotype
This advanced seminar explores the field of evolutionary developmental biology (EvoDevo). EvoDevo seeks to understand the developmental mechanisms underlying the origin of newness in the biological world, by exploring the origin of morphological novelty, understanding how development permits (or constrains) the types of bodies that can be produced, and describing how developmental mechanisms themselves evolve. In this course, we will explore central concepts in EvoDevo, consider the role of development in evolution writ large, and connect both to case studies from the primary literature. The course format will consist of a mixture of lecture, class discussion, guest lectures by visiting evolutionary developmental biologists, and assignments focusing on both oral and written scientific communication skills.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL540**
Prereq: **BIOL218 OR BIOL214**

BIOL343 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: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B543, 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])**

BIOL344 Developmental Biology of the Nervous System
Near the top of the list of unsolved mysteries in biology is the enigma of how the nervous system constructs itself. Here is a part of our body 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. We will also discuss some disorders and dysfunctions that may happen during the neurobiology of development, such as cerebral palsy, autism, and attention-deficit hyperactivity disorder (ADHD). 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. After the classes students will have extensive opportunities for feedback and will be requested to write a simple paragraph for the next class and/or answer a small quiz, based on the new knowledge acquired. Student evaluation will include weekly quizzes and/or assessment, a mid-term and a final exam, and class participation.

Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B344**
Prereq: **NS&B213 OR BIOL213 OR PSYC240**

BIOL345 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: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B345, 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)**

BIOL346 The Forest Ecosystem
This course examines basic ecological principles through the lens of forest ecosystems, exploring the theory and practice of forest ecology at various levels of organization from individuals to populations, communities, and ecosystems. Lectures, lab exercises, and writing-intensive assignments will emphasize the quantification of spatial and temporal patterns of forest change at stand, landscape, and global scales.
Offering: **Host**
Grading: **A-F**
Credits: **1.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL546, E&ES238, E&ES538, ENVS340**
Prereq: **[BIOL182 or MB&B182] OR [ENVS197 or BIOL197 or E&ES197] OR EES199**

BIOL347 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. Most 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: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B347**
Prereq: **NS&B213**

BIOL351 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: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B351**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL353 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 including schizophrenia, Alzheimer's disease, sleep disorders, anxiety disorders, 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: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B353, PSYC353**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL356 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 ingration 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: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B356, PSYC356**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL357 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 evaluation will include effortful participation, biweekly concept checkpoints, a final paper/presentation, and weekly editorials.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **None**
Identical With: **NS&B357, FGSS357**
Prereq: **BIOL182 AND NS&B213**

BIOL358 Neurobiology of Movement
This course is designed to take a comparative approach to understanding the major motor systems of the brain and will cover the basic elements of motor "control." However, the motor system does much more than contract muscles. Even the most basic movements such as walking require whole-body coordination that must be learned and adapted to our environment. During active sensation, motor systems even modulate our sensory perceptions. Much of what we have learned about motor systems comes from animals as diverse as crickets, electric fish, and birds. This course uses a comparative approach to understand the functions various brain regions contribute to our active lives.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **NS&B358**
Prereq: **NS&B213**

BIOL360 Neuroplasticity and Neurogenesis in Health and Disease: Molecules, Cells, and Circuits
This course will examine structural and functional neuroplasticity in the nervous system. The ability of the nervous system 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 discover how adult neurogenesis is altered by the aging process, physical exercise, stress, and neuropsychiatric disorders, such as epilepsy and Alzheimer's disease. We'll also learn about potential stem cell therapies for enhancing brain repair and plasticity after brain injuries. Students will prepare for class by reading scientific papers and reviews on the topic. In class, I will introduce the topic with slide presentations, and after that we will discuss the topic based on the scientific article discussion. After the classes students will have extensive opportunities for feedback and will be requested to write a simple paragraph for the next class and/or answer a small quiz, based on the new knowledge acquired. Student evaluation will include weekly quizzes and/or assessment, a final exam, and class participation.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B360**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**

BIOL360Z Neuroplasticity and Neurogenesis in Health and Disease: Molecules, Cells, and Circuits
This course will examine structural and functional neuroplasticity in the nervous system. The ability of the nervous system 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 aging process, physical exercise, stress, and neuropsychiatric disorders, such as epilepsy, Alzheimer's Disease. We'll also learn about the potential stem cell therapies for enhancing brain repair and plasticity after brain injuries. After the basic material is introduced, class sessions will be scientific article discussion-based. Students will prepare for class by reading scientific papers and reviews on the topic. In class, I will introduce the topic with slide presentation and after that, we will discuss the topic based on the scientific article discussion.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B360Z**
Prereq: **None**

BIOL365 Calderwoods Seminar in Public Writing: 21st-Century Biology
Twenty years ago, the landscape of biology looked very different. As the century began, the "rough draft" of the human genome was nearing release, a year ahead of schedule. Biologists envisioned an era of unparalleled progress leading in a straight line from DNA sequence data to the precise causes of human health and behavior, and to the development of genetically modified crops that would end global hunger. As to populations in natural habitats, any evolutionary impacts of climate change were thought to be far in the future. Instead, 21st-century biologists are scrambling to understand the human-caused evolutionary changes taking place in our lifetimes. Genetically modified crops have led to unforeseen threats to the survival of their wild relatives, while constructed ecosystems provide alternative farming approaches. Molecular insights have uncovered the unexpected roles of epigenetics and the microbiome in development and disease. Tools are available to not just decode genes but to edit them, at once raising new possibilities and urgent ethical questions.

How can we approach this changed biological prospect? The course invites students to engage with these broadly resonant issues by framing them for general audiences rather than in specialized scientific terms. Drawing on common content from recent journal articles, guest research lectures/Q&A sessions, and a field trip to a local kelp-shellfish farm, students will unpack these contemporary themes by explaining the basic science in their own voices while considering them in larger contexts and exploring connections to their own knowledge and experience. The course will build strengths in communication and collaboration through individual writing and revising (in a variety of formats), active peer editing, and in-class workshopping of each piece, in a collective student-led format.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL368 Ecological Resilience: The Good, the Bad, and the Mindful
This course will examine the concepts of resilience, fragility, and adaptive cycles in the context of ecosystem and social-ecological-system (SES) structures. These concepts have been developed to explain abrupt and often surprising changes in complex ecosystems and SES that are prone to disturbances. We will also include nonhierarchical interactions among components of systems (termed panarchy) to compare the interactions and dependencies of ecological and human community systems. A systems approach will be applied to thinking about restoration ecology, community reconstruction, and adaptive management theory.

All of the terms--resilience, fragility, adaptation, restoration, reconstruction--are fraught with subjectivity and valuation. We will use mindfulness and meditation techniques (including breathing and yoga) to more objectively and dynamically engage in the subject matter, leaving behind prejudice or bias. Students will be expected to approach these techniques with an open mind and practice them throughout the semester. The objective is to provide students with a more comprehensive framework with which to gain deeper understanding and integration of the science with the social issues.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-ENVS**
Identical With: **ENVS369, E&ES342**
Prereq: **[E&ES197 or BIOL197] OR [BIOL182 or MB&B182]**

BIOL373 Exploring the Brain-Body Interface: The Neuroscience of Basic Survival
Basic survival depends on the brain's regulation of fundamental behaviors and physiological pathways, such as drinking, eating, digestion, thermoregulation, breathing, and cardiovascular function. How do the brain and body communicate with each other to achieve homeostasis under different physiological states, and what goes awry in disease? How have species adapted to thrive in challenging environments, such as extreme temperatures and resource scarcity? In this advanced seminar, students will take a deep dive into the exciting research taking place at the brain-body interface. We will explore the main components of the peripheral nervous system, such as the vagus nerve and the dorsal root ganglia, that act as gatekeepers into our internal and external sensory worlds. We will also explore pathways within the central nervous system that regulate our basic bodily functions. By reading primary literature and review papers and participating in in-class discussions, students will gain deep knowledge of this burgeoning field of neuroscience. Through short written assignments and oral presentations on topics of their choosing, students will gain practical skills in scientific scholarship and communication.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-NSB**
Identical With: **NS&B373**
Prereq: **(BIOL181 OR MBB 181) AND (BIOL182 OR MB&B182) AND (BIOL213 OR NS&B213)**

BIOL401 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL402 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL407 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**

BIOL408 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**

BIOL409 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL410 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL411 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL412 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL419 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**

BIOL420 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**

BIOL421 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: **Host**
Grading: **OPT**

BIOL422 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: **Host**
Grading: **OPT**

BIOL423 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: **Host**
Grading: **OPT**

BIOL424 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: **Host**
Grading: **OPT**

BIOL465 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**

BIOL470 Independent Study, Undergraduate
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **None**

BIOL491 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**

BIOL492 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**

BIOL496 Research Apprentice, Undergraduate
Project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **Cr/U**

BIOL500 Graduate Pedagogy
The elements of good teaching will be discussed and demonstrated through lectures, practice teaching sessions, and discussions of problems encountered in the actual teaching environment. The staff consists of faculty and experienced graduate students. An integral part of the course is a required one-day workshop BEFORE the first day of formal classes.

Training in pedagogy in the first semester of attendance is required for all incoming Wesleyan MA and PhD students who have not already fulfilled this requirement at Wesleyan. BA/MA students are not required to get training in pedagogy but may choose to do so.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **None**
Identical With: **ASTR500, CHEM500, E&ES500, MB&B500, MUSC500, PHYS500, PSYC500, MATH500**
Prereq: **None**

BIOL501 Individual Tutorial for Graduates
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL502 Individual Tutorial for Graduates
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL503 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**

BIOL504 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**

BIOL505 Cell and Development Journal Club I
Presentation and active discussion of a series of current research articles in the field of cell and developmental biology, from journals including Cell, Journal of Cell Biology, Development, Genes and Development, Developmental Biology, Science, and Nature.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

BIOL506 Cell and Development Journal Club II
Presentation and active discussion of a series of current research articles in the field of cell and developmental biology from journals including CELL, JOURNAL OF CELL BIOLOGY, DEVELOPMENT, GENES AND DEVELOPMENT, DEVELOPMENTAL BIOLOGY, SCIENCE, and NATURE.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

BIOL507 Evolution Journal Club I
Presentation and active discussion of current research articles in evolutionary biology. Each semester the class will choose one theme within evolutionary biology to be the focus of discussion. Themes from recent semesters have included genome-based evolution studies, coevolution, speciation, phylogenetic approaches for investigating natural selection, the role of competition in evolution, the evolution of host-parasite relationships, the evolution of behavior, and the impact of niche construction on adaptive evolution.
Offering: **Host**
Grading: **A-F**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

BIOL508 Evolution Journal Club II
Presentation and active discussion of current research articles in evolutionary biology. Each semester the class will choose one theme within evolutionary biology to be the focus of discussion. Themes from recent semesters have included coevolution, speciation, phylogenetic approaches for investigating natural selection, the role of competition in evolution, evolution of host-parasite relationships, and the evolution of behavior. Articles for discussion generally come from the journals EVOLUTION, AMERICAN NATURALIST, GENETICS, SCIENCE, and NATURE.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

BIOL509 Neuroscience Journal Club I
Presentation and discussion of current research articles in the field of neuroscience.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **NS&B509**
Prereq: **None**

BIOL510 Neurosciences Journal Club II
Presentation and discussion of current research articles in the field of neuroscience.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **NS&B510**
Prereq: **None**

BIOL511 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL512 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

BIOL515 Evolution in Human-Altered Environments
Human activities have altered natural environments and, indeed, have created entirely novel ecosystems such as cities and high-input farms. This course examines how these human alterations to the environment affect the evolution and coevolution of diverse organisms. Starting with an intensive overview of microevolutionary processes, we will consider a number of contemporary scenarios: evolutionary response to environmental contaminants, exploitation of natural populations, and global climate change; evolution in urban and agricultural ecosystems; and the evolutionary impact of nonnative, invasive, and genetically modified organisms.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL215, ENVS210**
Prereq: **[BIOL182 or MB&B182]**

BIOL516 Plant-Animal Interactions
This course will explore the ecology and evolution of interactions between plants and animals, including mutualism (e.g., pollination, frugivory) and antagonism (e.g., herbivory, granivory), that are central to the functioning of ecosystems and the generation of biodiversity. The format will be seminar-style, involving reading, discussion, and student presentations of key papers on chosen topics. This course emphasizes reading and interpreting primary scientific literature and quantitative information, formulating original ideas in scientific inquiry, writing, and oral communication.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL316**
Prereq: **BIOL214 OR [BIOL220 or ENVS220] OR [BIOL290 or BIOL590 or ENVS286] OR [BIOL216 or ENVS216]**

BIOL518 Nature and Nurture: The Interplay of Genes and Environment
Ever since Watson and Crick proposed the DNA molecule as a heritable genetic "code," biology has emphasized genes ("nature") rather than environmental influences ("nurture") as the primary agents of biological causation. This genetic determinism continues to shape perspectives beyond research, including such critical concerns as public health and human diversity. Recent insights to environmental and inherited epigenetic factors demand that we rethink this established view to build a more integrated understanding. In this advanced seminar, we consider how genetic and environmental factors jointly determine the development and behavior of organisms, including ourselves. After an initial series of lecture/discussion sessions on foundational concepts, this seminar course will consist of student-led discussions of scientific articles on genetic and environmental causes of specific diseases, capacities, and behaviors. Subject to class choice, possible topics will include: causes of lung cancer and of asthma; variation in IQ; the Human Genome Project; and "personalized medicine."

Any 200-level course in genetics, development, or neuroscience can fulfill the required prereq; interested COE or other students without this background are encouraged to directly contact Prof Sultan to request a prerequisite override. Students gain understanding of scientific inquiry and interpretation, as well as specific knowledge of a range of human health issues and behavioral capacities. Through reading recent data papers, participating actively in small-class discussions, and giving short oral presentations, students will build their skills in critical thinking about biological and environmental questions and related ethical issues, scientific scholarship, and oral communication of scientific information.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL318, ENVS338**
Prereq: **BIOL214 OR BIOL218 OR [BIOL210 or MB&B210] OR [BIOL224 or NS&B224]**

BIOL527 Evolutionary and Ecological Bioinformatics
Bioinformatic analysis of gene sequences and gene expression patterns has added enormously to our understanding of ecology and evolution. For example, through bioinformatic analysis of gene sequences, we can now reconstruct the evolutionary history of physiology, even though no traces of physiology exist in the fossil record. We can determine the adaptive history of one gene and all the gene's descendants. We can now construct the evolutionary tree of all of life. Bioinformatics is particularly promising for analysis of the ecology and biodiversity of microbial communities, since well over 99 percent of microorganisms cannot be cultured; our only knowledge of these organisms is through analysis of their gene sequences and gene expression patterns. For example, even when we cannot culture most of a microbial community, we can determine which metabolic pathways are of greatest significance through analysis of community-level gene expression. All these research programs are made accessible not only by breakthroughs in molecular technology but also by innovation in the design of computer algorithms. This course, team-taught by an evolutionary biologist and a computer scientist, will present how bioinformatics is revolutionizing evolutionary and ecological investigation and will present the design and construction of bioinformatic computer algorithms underlying the revolution in biology. Students will learn algorithms for reconstructing phylogeny, for sequence alignment, and for analysis of genomes, and students will have an opportunity to create their own algorithms.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL327, COMP327, COMP527, CIS327**
Prereq: **[BIOL182 or MB&B182] OR [BIOL196 or MBB196] OR COMP112 OR COMP211**

BIOL533 Gene Regulation
This course aims to develop a genome perspective on transcriptional gene regulation. The genome sequence, now completed in a number of organisms, is described as a blueprint for development. More than simply a parts list (i.e., genes), this blueprint is an instruction manual as well (i.e., regulatory code). A next critical phase of the genome project is understanding the genetic and epigenetic regulatory codes that operate during development. Through a combination of lectures and discussion of primary literature, this course will explore current topics on promoters and transcription factors, chromatin structure, regulatory RNA, chromosomal regulatory domains, and genetic regulatory networks. We will discuss various "Omics" tools, and in particular, sequencing-based strategies that provide information about the transcriptome and epigenome. We will also discuss current models on how transcriptional regimes unfold during the activation (or silencing) of genes, and how these processes become disrupted in various diseases. Finally, we will consider stochastic attributes of gene regulation that challenge "all or nothing" perspectives on cellular states (e.g., perspectives that genes are either "on" or "off," or that cells are either "differentiated" or not). An overarching theme is how genomes encode and execute regulatory programs in response to environmental and developmental cues.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Identical With: **MB&B533, MB&B333, BIOL333**
Prereq: **MB&B181 OR BIOL181**

BIOL537 The Origins of Bacterial Diversity
Wherever there is life, there are bacteria. Free-living bacteria are found in every environment that supports eukaryotes, and no animal or plant is known to be free of bacteria. There are most likely a billion or more species of bacteria, each living in its unique ecological niche. This course will explore the origins of bacterial biodiversity: how bacteria evolve to form new species that inhabit new ecological niches. We will focus on how the peculiarities of bacterial sex and genetics facilitate bacterial speciation. Topics will include the characteristics of bacterial sex, why barriers to genetic exchange are not necessary for speciation in bacteria, the great potential for formation of new bacterial species, the evolutionary role of genetic gifts from other species, and the use of genomics to identify ecologically distinct populations of bacteria.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL337, ENVS337**
Prereq: **[BIOL182 or MB&B182]**

BIOL538 Biology and MB&B Symposium I
Weekly seminars by distinguished national and international scientists. The seminar series provides an exciting opportunity to hear about advances in research in the life sciences.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **MB&B338, BIOL338, MB&B538**
Prereq: **None**

BIOL539 Biology and MB&B Symposium II
Weekly seminars by distinguished national and international scientists. The seminar series provides an exciting opportunity to hear about advances in research in the life sciences.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **BIOL339, MB&B339, MB&B539**
Prereq: **None**

BIOL540 EvoDevo: Origins of Variation in the Phenotype
This advanced seminar explores the field of evolutionary developmental biology (EvoDevo). EvoDevo seeks to understand the developmental mechanisms underlying the origin of newness in the biological world, by exploring the origin of morphological novelty, understanding how development permits (or constrains) the types of bodies that can be produced, and describing how developmental mechanisms themselves evolve. In this course, we will explore central concepts in EvoDevo, consider the role of development in evolution writ large, and connect both to case studies from the primary literature. The course format will consist of a mixture of lecture, class discussion, guest lectures by visiting evolutionary developmental biologists, and assignments focusing on both oral and written scientific communication skills.

Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL340**
Prereq: **BIOL218 OR BIOL214**

BIOL542 Quantitative Methods for the Biological and Environmental Sciences
This course offers an applied approach to statistics used in the biological, environmental, and earth sciences. Statistics will be taught from a geometric perspective so that students can more easily understand the derivations of formulae. We will learn about deduction and hypothesis testing as well as the assumptions that methods make and how violations affect applied outcomes. Emphasis will be on analysis of data, and there will be many problem sets to solve to help students become fluent with the methods. The course will focus on data and methods for continuous variables. In addition to basic statistics, we will cover regression, ANOVA, and contingency tables.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL242, E&ES270, E&ES570, ENVS242**
Prereq: **None**

BIOL543 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: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL343, NS&B543, 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])**

BIOL544 Neuropharmacology
This course will introduce students to the physiological and molecular effects of drugs on neuronal activity and behavior. We will cover key concepts in neuropharmacology, including pharmacokinetics and pharmacodynamics, alongside techniques used in modern pharmacotherapeutic discovery as it relates to the treatment of neurological and neuropsychiatric disease. Student assessment will include in-class quizzes and exams.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL244, NS&B244**
Prereq: **BIOL182 OR BIOL182Z AND NS&B213**

BIOL545 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, NS&B545**
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)**

BIOL546 The Forest Ecosystem
This course examines basic ecological principles through the lens of forest ecosystems, exploring the theory and practice of forest ecology at various levels of organization from individuals to populations, communities, and ecosystems. Lectures, lab exercises, and writing-intensive assignments will emphasize the quantification of spatial and temporal patterns of forest change at stand, landscape, and global scales.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.50**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL346, E&ES238, E&ES538, ENVS340**
Prereq: **[BIOL182 or MB&B182] OR [ENVS197 or BIOL197 or E&ES197] OR EES199**

BIOL547 Environmental Biology Journal Club
Presentation and discussion of current research articles in the field of environmental biology.
Offering: **Host**
Grading: **A-F**
Credits: **0.25**
Gen Ed Area: **NSM-BIOL**
Identical With: **E&ES547**
Prereq: **BIOL182 OR E&ES197**

BIOL548 Environmental Biology Journal Club II
Presentation and discussion of current research articles in the field of environmental biology.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **NSM-BIOL**
Identical With: **E&ES548**
Prereq: **BIOL182 OR E&ES197**

BIOL549 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: **Host**
Grading: **OPT**

BIOL550 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.

Offering: **Host**
Grading: **OPT**

BIOL557 Advanced Research Seminars in Biology
This course focuses on the specific research projects of individual graduate students in the Department of Biology, and it comprises student presentations and discussion including the department faculty, graduate students and post doctoral fellows. The course offers a forum for presenting new results and

exploring new ideas, as well as for providing researchers with feedback and suggestions for solving methodological problems. It also provides an opportunity for students to become familiar with the wide range of biological research taking place in the department.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **None**
Prereq: **None**

BIOL567 Engineering Biology: Cells and Tissues
This course explores the intersection of biology, medicine, and engineering, where scientists are developing novel platforms to promote understanding, diagnosis, and treatment of human diseases. We cover modern techniques for manipulating biological systems, spanning single molecules to ensembles of cells. We will examine the trajectory of the field from studying cells in a plastic dish to the advent of organ-on-a-chip and organoid models and discuss how this transition from 2D to 3D biology has propelled increased understanding of both normal physiological homeostasis and also the pathophysiology of disease. Topics will include controlling behavior of cells through cell-matrix interactions, learning through building via synthetic biology, and advances in regenerative medicine. These topics will be explored through the thematic lenses of transport processes (supply of nutrients and removal of waste) and mechanoreciprocity (the sensing of and response to the physical properties of the cellular microenvironment). Lectures will review fundamental concepts in cell biology and physiology before delving into topical examples from current literature. Lectures and assessments will include opportunities to develop skill in thinking analytically and critically about using engineering tools to study fundamental questions in human disease, formulating original ideas and experiments, and communicating science through written and oral formats.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL267, IDEA267**
Prereq: **MB&B181 OR MB&B181Z AND MB&B182 OR MB&B182Z**

BIOL571 Teaching: Techniques and Theory
This course will help teaching assistants working with the Principles of Biology labs prepare to teach weekly lab sessions. Students will obtain hands-on experience with various techniques in the areas of molecular and cell biology. In addition, best teaching practices will be discussed and students will share their teaching experiences with each other.

This course may be repeated up to two times for credit.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **MB&B571**
Prereq: **None**

BIOL572 Teaching: Techniques and Theory
The course will help teaching assistants working with the Principles of Biology labs prepare to teach weekly lab sessions. Students will obtain hands-on experience with various techniques in the areas of anatomy and physiology, evolution, and ecology. In addition, best teaching practices will be discussed, and students will share their teaching experiences with each other.

This course may be repeated up to two times for credit.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

BIOL574 Concept Building and Pedagogical Development
The course will help course assistants and teaching assistants working with BIOL 182 (Principles of Biology II lecture) prepare to lead weekly problem-solving sessions. Students will review the content and core concepts of each problem-solving session, develop strategies to use in assisting students with the Friday problems, review the progress of the peer mentored study sessions, discuss literature on teaching and learning, and discuss pedagogical best practices.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **NSM-BIOL**
Prereq: **None**

BIOL590 Plant Form and Diversity
The course begins with an overview of plant evolutionary history, then covers the basic structure and function of the plant body, the plant life cycle in nature, including interactions with animals, and ecological diversity of plants in contrasting habitats. Special events include a field trip to the Smith College Botanic Garden, two hands-on days for working with living specimens, and a special guest lecture by a local plant biologist.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-BIOL**
Identical With: **BIOL290, ENVS286**
Prereq: **BIOL182 OR MB&B182 OR BIOL182Z**

BIOL599 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, NS&B245**
Prereq: **[NS&B213 or BIOL213 or PSYC240]**