

BIOLOGY

These are thrilling times to study biology. Advances in molecular biology, epigenetics, and bioinformatics are leading to extraordinary new insights in every field, from evolution and ecology to development, cell biology, genetics/genomics, and neuroscience. These research areas are providing essential information as we address the urgent challenges of biodiversity conservation, global climate change, epidemiology, and human health and well-being. Biology is also at the heart of new ways of understanding ourselves as human beings in relation to other living things. Connections between biological disciplines are raising key questions in new ways, while biological knowledge has become fundamentally integrated with social and medical ethics, public policy, and journalism.

The Biology Department offers a broad range of courses that emphasize the process of scientific inquiry and current experimental approaches. Our courses also consider real-world implications of biological issues: the ethics of embryonic stem cell research, gender issues and reproductive technologies, the AIDS epidemic, and the impact of human activity on natural communities. Biology courses can be the start of a dedicated career in research, medicine, conservation, public health, bioethics, sustainable resource use, and many other areas. They can also bring the intellectual excitement of these investigations to students whose major focus is in the arts, humanities, or social sciences. We welcome students of all backgrounds and interests to join us.

FACULTY

Gloster B. Aaron

BA, Oberlin College; PHD, University of Pennsylvania
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EMERITI

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 Professor of Biology, Emerita; CPE Instructor

UNDERGRADUATE PROGRAM DEPARTMENTAL ADVISING EXPERTS

All departmental faculty

- Undergraduate Biology Major (<https://catalog.wesleyan.edu/departments/biol/ugrd-biol/>)
- Doctor of Philosophy in Biology (<https://catalog.wesleyan.edu/departments/biol/grad-biol/>)
- Master of Arts in Biology (<https://catalog.wesleyan.edu/departments/biol/grad-biol-ma/>)

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 two individuals that are male and female mate and have offspring. 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 "sex changes" to the (female) marmoset monkey that can give birth to twin male chimeras. As an organism pursues sex, what are the mating strategies? What are the chemicals of sex (pheromones and hormones)? By examining the biology of sex in detail, we will also debate age-old topics such as whether sexual reproduction is sexist, 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, SISP118**

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 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**

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: **OPT**

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: **OPT**

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**

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**

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 12 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: **A-F**

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 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. The course will use software to ensure academic integrity. 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: **OPT**

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: **Host**

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: **A-F**

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 as 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. 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: **0.50**

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 interdisciplinary study of human interactions with the environment and the implications for the quality of life examines the technical and social causes of environmental degradation at local and global scales, along with the potential for developing policies and philosophies that are the basis of a sustainable society. This will include an introduction to ecosystems, climatic and geochemical cycles, and the use of biotic and abiotic resources over time. It includes the relationship of societies and the environment from prehistoric times to the present. Interrelationships, feedback loops, cycles, and linkages within and among social, economic, governmental, cultural, and scientific components of environmental issues will be emphasized.

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: **CHEM142 OR CHEM144**

BIOL210 Genomics: Modern Genetics, Bioinformatics, and the Human Genome Project

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]**

BIOL212 Principles and Mechanisms of Cell Biology

The cell is the smallest structural and functional unit of an organism. Understanding the molecular basis for its behavior and function is critical to understand biological function at all levels, from molecular to organismic. The primary goal of this course is to understand how cells function within the context of the multicellular organism or tissue--an environment that cells regulate as well as respond to. We also focus on the process of scientific discovery in the field of cell biology--how do we know what we know? Hence whilst the textbook will provide background reading, we will also discuss original research in class. We will cover cell and organelle structure and function, trafficking, cell adhesion and motility, proliferation, signal transduction, and cell differentiation, and consider how these processes are integrated to generate coherent cell behaviors, or go awry in disease.

Offering: **Host**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Identical With: **MB&B212**

Prereq: **[MB&B181 or BIOL181]**

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: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **NS&B213, PSYC240**

Prereq: **None**

BIOL214 MacroEvolution, Pattern and Process

This course covers current areas of research in evolutionary biology. Topics include the evidence for evolution, the nature of variation, adaptive and random evolutionary processes in natural populations, mechanisms of speciation, origin of major groups, reconstruction of the history of life through comparative analysis of morphological and DNA sequence data, evolutionary developmental biology, coevolution of plant-animal interactions, and the application of evolutionary principles to conservation biology.

Offering: **Host**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Prereq: **[BIOL182 or MB&B182]**

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]**

BIOL218 Developmental Biology

This course covers the mechanisms of development at the molecular, cellular, and organismal levels. Special attention will be paid to the process of scientific discovery: the experiments. Students will read and discuss both original research articles and the secondary review literature. We will discuss ethical and medical considerations for some of the topics covered.

It's an extraordinary time to learn Developmental Biology! Topics can include aging, the environmental effects on development, genetic approaches, cancer, reproduction, growth, and much more, all tied to Development. We will take advantage of Zoom to bring in prominent outside scientists to give their perspective on research topics that they work on. Some of the lectures will be pre-recorded for you to watch at your convenience, scheduled class time will be reduced and focused on discussion and student presentations.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Prereq: **[BIOL182 or MB&B182]**

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.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **ENVS220**

Prereq: **[BIOL182 or MB&B182]**

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: **OPT**

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 E&ES199**

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&ES199 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: **[MB&B181 or BIOL181] OR [MB&B208 or BIOL208]**

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 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&ES199 OR [ENVS197 or BIOL197 or E&ES197]**

BIOL235 Comparative Vertebrate Anatomy

This course will provide a comprehensive overview of the basic structure and function of the main organ systems in vertebrates. Developmental anatomy will be an integral part of the class because of the importance of embryology to understanding both similarity and variation of common systems in different taxa. The course will consist of lectures and occasional laboratory sessions for dissection.

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])**

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

A mass of tissue the consistency of firm jello and weighing about 2.5 pounds in the adult human, the brain is an organ that controls nearly every function of the body. It also enables the highest cognitive functions of humans such as learning and memory, thinking, consciousness, and aesthetic appreciation. Its malfunction

results in a variety of diseases, including senility, mood disorders, and motor dysfunctions. This course will examine in some detail the complex organization of the brain and how it performs some of its basic functions. The course will be of special interest to premed students; NS&B, biology, and psychology majors; and anyone simply interested in how the brain works.

Offering: **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 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])**

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]**

BIOL252 Cell Biology of the Neuron

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

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **NS&B252**

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

BIOL254 Comparative Animal Behavior

An introduction to the study of animal behavior, this course will examine the factors that control the behavior of vertebrates and invertebrates within evolutionary, social, and physiological contexts. All animals face similar challenges, and we will examine the common and sometimes unique behavioral strategies used to meet these challenges.

Topics will include feeding and foraging, communication, agonistic interactions, parental care, hormonal modulation, and more. As this course explores the scientific study of animal behavior, students will also get introduced to some basic data analysis tools using computational notebooks to explore data from a small subset of the assigned primary articles.

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]**

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 resources 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**

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]**

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, ENV5286**

Prereq: **[BIOL182 or MB&B182]**

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]**

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: **None**

Identical With: **ENV5306, 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 the course will increase students skill in scientific writing and scholarship. Due to the ongoing pandemic, in the Fall of 2020 the course will be all online with both synchronous and asynchronous instruction, discussion groups and cloud based computational projects designed to train transferable skills in big data analysis.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **CIS310, MB&B311**

Prereq: **[MB&B181 or BIOL181]**

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.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL516**

Prereq: **BIOL214 OR [BIOL220 or ENV5220] OR [BIOL290 or BIOL590 or ENV5286] OR [BIOL216 or ENV5216]**

BIOL318 Nature and Nurture: The Interplay of Genes and Environment

In this advanced seminar, we consider how genetic and environmental factors interact to shape the development and behavior of organisms, including humans. After an initial series of lectures and discussions on foundational readings, the class will consist of in-depth student presentations and class discussion.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL518**

Prereq: **BIOL214 OR BIOL218 OR [BIOL210 or MB&B210] OR [BIOL224 or NS&B224]**

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: **OPT**

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. An overarching theme is how genomes encode and execute regulatory programs as revealed by a global systems biology approach in modern genomics research.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **None**

Identical With: **MB&B533, MB&B333, BIOL533**

Prereq: **[BIOL182 or MB&B182]**

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 relationship between embryonic development and morphological evolution. Subjects covered will include broad, fundamental issues such as the relationship between genotype and phenotype, the concept of homology and developmental characters and phylogeny, as well as the evolutionary significance of specific developmental phenomena such as animal segmentation, direct development, and major morphological transitions in evolution. The course will include a combination of lectures, discussion, and student presentations of papers chosen from the primary literature.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL540**

Prereq: **BIOL218 OR BIOL214**

BIOL342 Molecules to Medicine

This course will explore the process of drug development, including target selection, lead discovery using computer-based methods and combinatorial chemistry/high-throughput screening, organic synthesis, bioavailability, clinical trials, and other factors (some economics and politics) involved in bringing a drug to the marketplace. Critical consideration of the variables to contend with at each step will be described and discussed, including aspects of research ethics and patent law. The basic science of molecular recognition, computer-aided drug design, and the role of factors from synthetic chemistry to toxicology will be presented. Case studies of the development of drugs recently successful in making the journey from molecule to medicine will be discussed, as well as the story of some that did not, and why. Emerging new design strategies such as fusion-protein therapies, crisper technology, and enhanced use of rational design and combinatorial methods will be emphasized, and how pharmaceutical research is evolving in the postgenomic era, particularly with biologics. Job opportunities in the pharmaceutical industry will be discussed.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-CHEM**

Identical With: **CHEM342, CIS342, MB&B342**

Prereq: **CHEM252 OR MBB208**

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])**

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: **1.00**

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 E&ES199**

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. Almost all of the readings for this course will be taken from the recent primary literature; areas of the cortex that will be studied include sensory cortex as well as studies of hippocampal cortical circuits.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **NS&B347**

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

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: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **NS&B353, PSYC353**

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

BIOL354 Agricultural Food Webs

Ecological communities are structured by feeding interactions, and agricultural systems are no exception to this rule. This class will focus on attributes of food webs that impact agriculture, including topics such as natural biological control of insect pests, to soil microbes and nutrient cycling, to causes of honeybee colony collapse disorder. This course includes a rigorous survey of both ecological theory and applied environmental problems. Students will read primary literature from the fields of food web ecology and agroecology and discuss the implications through group work.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-ENVS**

Identical With: **ENVS353**

Prereq: **BIOL182 or BIOL197**

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 ingestion 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: **OPT**

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 assessment will include effortful and active participation, short written responses, one long response paper, and a poster presentation during our online symposium.

Offering: **Host**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **None**

Identical With: **NS&B357, FGSS357**

Prereq: **BIOL182 AND NS&B213**

BIOL358 Motor Systems Beyond 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 Calderwood Seminar in Public Writing: Neuroplasticity and the Brain

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

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-NSB**

Identical With: **NS&B360**

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

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 workshoping of each piece, in a collective student-led format.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Prereq: **None**

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: **E&ES500, CHEM500, ASTR500, 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: **A-F**

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: **A-F**

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, ENV5210**

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.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL316**

Prereq: **BIOL214 OR [BIOL220 or ENV5220] OR [BIOL290 or BIOL590 or ENV5286] OR [BIOL216 or ENV5216]**

BIOL518 Nature and Nurture: The Interplay of Genes and Environment

In this advanced seminar, we consider how genetic and environmental factors interact to shape the development and behavior of organisms, including humans. After an initial series of lectures and discussions on foundational readings, the class will consist of in-depth student presentations and class discussion.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL318**

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. An overarching theme is how genomes encode and execute regulatory programs as revealed by a global systems biology approach in modern genomics research.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **None**

Identical With: **MB&B533, MB&B333, BIOL333**

Prereq: **[BIOL182 or MB&B182]**

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 relationship between embryonic development and morphological evolution. Subjects covered will include broad, fundamental issues such as the relationship between genotype and phenotype, the concept of homology and developmental characters and phylogeny, as well as the evolutionary significance of specific developmental phenomena such as animal segmentation, direct development, and major morphological transitions in evolution. The course will include a combination of lectures, discussion, and student presentations of papers chosen from the primary literature.

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 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: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL346, E&ES238, E&ES538, ENV5340**

Prereq: **[BIOL182 or MB&B182] OR [ENV5197 or BIOL197 or E&ES197] OR E&ES199**

BIOL547 Environmental Biology Journal Club

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

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 neuroscience.

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**

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**

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, ENV5286**

Prereq: **[BIOL182 or MB&B182]**

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]**