

BSCI - BIOLOGICAL SCIENCES PROGRAM

BSCI400 Animal Diversity and Evolution (3 Credits)

Focuses on deep-level diversity of animals and their evolutionary relationships, unique and repeated transitions in the course of animal evolution, and the evolutionary mechanisms that have shaped and continue to shape animal diversity. The course takes an integrative organismal approach to understanding animal evolution, considering morphology, development, physiology, life history, and ecology. It also explores how patterns of animal diversity have changed through time and the processes affecting animal diversity in our changing world.

Prerequisite: Minimum grade of C- in BSCI160 and BSCI207.

BSCI401 Animal Communication (3 Credits)

Examining the mechanisms by which animals produce and receive signals in each sensory modality; and quantifying the type and amount of information conveyed in signals and how animals attend to such information.

Prerequisite: BSCI160 and BSCI161; or BSCI106. And must have completed one semester of physics; and must have completed one semester of organic chemistry.

Recommended: A course in animal behavior or biopsychology.

Credit Only Granted for: BSCI401, BSCI338W or BIOL708W.

Formerly: BSCI338W.

BSCI403 Biology of Vision (3 Credits)

An upper level undergraduate course on the physical, molecular, and neural basis of vision.

Prerequisite: Minimum grade of C- in BSCI207, NEUR306, or BSCI353.

Recommended: BSCI222.

BSCI404 Cell Biology from a Biophysical Perspective (3 Credits)

An approach to cell biology by focusing on mechanisms and unifying physical paradigms. It will not assume a great deal of factual biological knowledge, but will expect a background that prepares students to think mechanistically and quantitatively.

Prerequisite: BSCI330.

Recommended: PHYS121 and PHYS122; or completion of PHYS131 and PHYS132 recommended. Jointly offered with BIOL704, BIPH704.

Credit Only Granted for: BSCI338O, BSCI404, BIOL704, BIOL708O, or BIPH704.

Formerly: BSCI338O.

BSCI405 Population and Evolutionary Genetics (3 Credits)

Genetic variation within a population provides the basis for future evolution as well as a record of past evolution. The genomics revolution provides data on this variation that, together with mathematical models, allow us to read this record to reconstruct evolutionary trajectories. Examples will focus on hominin and pathogen evolution. In the lab, students will use models to explore how genetic variation (allele frequencies) changes over time and space.

Prerequisite: Minimum grade of C- in BSCI222; and 1 course with a minimum grade of C- from (MATH131, MATH136, MATH141). Jointly offered with BIOL709.

Credit Only Granted for: BSCI405, BSCI339J, or BIOL709C.

Formerly: BSCI339J.

BSCI406 Membranes and Biological Interfaces (3 Credits)

An interdisciplinary approach to membrane biology, starting with the physical chemistry of interfaces and model systems and continuing into transport, excitability, and signaling. The course is oriented toward students with broad backgrounds in biology and biophysics. Success in the course will come from a background that prepares students to think mechanistically and quantitatively rather than having substantial factual biological knowledge.

Prerequisite: Minimum grade of C- in BSCI330.

Recommended: PHYS122; or PHYS132; or (PHYS260 and PHYS261).

Credit Only Granted for: BSCI339R, BSCI406, or BIOL709R.

Formerly: BSCI339R.

BSCI407 Behavioral Genetics (3 Credits)

Behavior represents an organism's most dynamic phenotype and allows an animal to respond immediately to both internal and external cues.

We will explore the genetic and epigenetic mechanisms that underlie behavioral variation and the associated neurological, hormonal, and developmental pathways. We will examine modern approaches used to study behavioral genetics in model and non-model systems, and in humans. Using case studies, we will explore a range of complex phenotypes including those related to mating, parental care, aggression, circadian rhythm, locomotion, learning, anxiety, and addiction.

Prerequisite: Minimum grade of C- in BSCI222.

BSCI410 Molecular Genetics (3 Credits)

An advanced genetics course emphasizing the molecular basis of gene structure and function in the context of modern approaches to the genetics of humans and model organisms.

Prerequisite: BSCI222. And must have completed CHEM233; or (CHEM231 and CHEM232).

BSCI411 Bioinformatics and Integrated Genomics (4 Credits)

Computational methods for the study of biological data. Pairwise and multiple sequence alignment, genome assembly and annotation, RNAseq analysis, and structural bioinformatics. Introduction to UNIX, Python, and R in the context of biological sequence data. Previous computational experience is not necessary.

Prerequisite: Minimum grade of C- in BSCI222.

Recommended: BSCI410.

Credit Only Granted for: BSCI380 or BSCI411.

Formerly: BSCI380.

BSCI412 Microbial Genetics (4 Credits)

A laboratory/lecture based course that covers the fundamentals of mutation, mobile genetic elements and transmission genetics of microbial organisms using both classical and molecular approaches.

Prerequisite: BSCI222; and (BSCI223 or BSCI283).

BSCI413 Recombinant DNA (3 Credits)

An advanced course presenting the tools and procedures of genetic engineering. Theory and practical applications of recombinant DNA techniques to understanding eukaryotic gene structure and expression.

Prerequisite: BSCI330, BSCI223, or BSCI230; and BSCI222.

Formerly: ZOOL452.

BSCI414 Recombinant DNA Laboratory (3 Credits)

An advanced course offering hands-on experience in performing recombinant DNA experiments. All current molecular biology techniques used for cloning prokaryotic genes, analyzing the gene products, and modifying the genes will be performed. Techniques include isolation of DNA, use of restriction enzymes; cloning procedures, PCR analysis, and Southern hybridizations. Lecture material focuses on interpretation of results generated in the laboratory.

Prerequisite: BSCI222.

BSCI415 Molecular Genetics Laboratory (3 Credits)

Problem solving laboratory organized around extended projects that employ different approaches toward linking gene and function.

Prerequisite: Must have completed or be concurrently enrolled in BSCI410.

Restriction: Junior standing or higher.

Credit Only Granted for: BSCI348G or BSCI415.

Formerly: BSCI348G.

BSCI416 Human Genetics (3 Credits)

Approaches to human genetics and applications to biology and medicine focusing on specific human genetic topics using primary research papers as the main resource.

Prerequisite: Minimum grade of C- in BSCI410.

Recommended: BSCI330.

BSCI417 Microbial Pathogenesis (3 Credits)

Current research in microbial pathogenesis and the molecular and cellular basis of bacterial disease. Comprehensive overview of the molecular basis of pathogenesis with a focus on model microbial systems to illustrate mechanisms of disease pathogenesis. Topics covered: how microorganisms attach to and enter cells; how host cells are damaged by microbial products; how the host responds to invasion; and host-pathogen evolution.

Prerequisite: BSCI222; and (BSCI223 or BSCI283).

Restriction: Junior standing or higher.

BSCI420 Cell Biology Lectures (3 Credits)

Molecular and biochemical bases of cellular organization and function in eukaryotes.

Prerequisite: BSCI330, BSCI222, CHEM231, and CHEM232.

Credit Only Granted for: BSCI420 or BSCI421.

BSCI422 Principles of Immunology (3 Credits)

The immune system in health and disease. Presentation and analysis of the cellular and molecular processes that comprise the immune system.

Prerequisite: BSCI222.

Recommended: BSCI330; and (BSCI223 or BSCI283).

Restriction: Junior standing or higher.

BSCI423 Immunology Laboratory (2 Credits)

Current techniques for assessment of immune status and evaluation of the immune response, including monoclonal antibody production, Western blotting, cytokine assays, ELISA and flow cytometry.

Prerequisite: BSCI222.

Corequisite: BSCI422.

Recommended: BSCI223 or BSCI283.

Restriction: Junior standing or higher.

BSCI424 Pathogenic Microbiology (4 Credits)

The role of bacteria and fungi in the diseases of humans with emphasis upon the differentiation and culture of microorganisms, types of disease, modes of disease transmission, prophylactic, therapeutic, and epidemiological aspects.

Prerequisite: BSCI223 or BSCI283.

BSCI425 Advanced Cell Biology Lab Practices (2 Credits)

Experimental techniques used to study the molecular, structural, and spatial organization of plant and animal cells. Using a combination of in vitro assays aimed at analyzing macromolecular and subcellular components and in vivo analyses designed to reveal the inner architecture of a typical eukaryotic cell, students will have an opportunity to: improve some of the basic technical and conceptual skills they acquired in an introductory cell biology course; develop a more sophisticated understanding of the nature of experimental cell manipulation; and tackle the ongoing challenge of articulating their findings in both written and oral communication.

Prerequisite: Must have completed BSCI330, BSCI222, CHEM231, and CHEM232; and must have completed or be concurrently enrolled in BSCI420.

Credit Only Granted for: BSCI421, BSCI425, or BSCI348C.

BSCI426 Global Change Biology (3 Credits)

Explore the biology of past, present and future global change and its impacts on the diversity of life. Focus on mechanisms of global change; organismal responses to that change, examples of past change, estimates of future change, and approaches to mitigation.

Prerequisite: Minimum grade of C- in BSCI207.

Recommended: BSCI361 and BSCI370.

BSCI430 Developmental Biology (3 Credits)

Structural, functional and regulatory events and mechanisms that operate during development to produce an integrated, multicellular organism composed of a multitude of differentiated cell types.

Prerequisite: BSCI222 and BSCI330.

BSCI431 The Origin and Evolution of Nervous Systems (3 Credits)

Explore how brains change through evolution along the animal tree of life. By comparing the nervous system structure and development across the animal kingdom, this course aims to reveal common designs and mechanisms that generate behavior, and to inform our understanding of how biology builds minds. Topics include the origins of neurons, the universal molecular patterning of brain development across invertebrates and vertebrates, the evolution of neurotransmission, comparative mechanisms of learning and memory, and what in our brain makes us human.

Prerequisite: Minimum grade of C- in NEUR200 or BSCI207.

BSCI432 Systems View of Cell Biology (3 Credits)

An integrated understanding of cell biology based upon reading of literature, discussion of new findings, and quantitative simulations. Exploration of ten topics including Heredity, Curing Diseases, and Synthesizing Life.

Prerequisite: BSCI330.

BSCI433 Biology of Cancer (3 Credits)

Causes and consequences of neoplastic transformations at the biochemical and cellular levels.

Prerequisite: BSCI222 and BSCI330; or permission of CMNS-Biological Sciences UG Program.

BSCI436 RNA Biology and Therapeutics (3 Credits)

The prediction of RNA structure from its sequence, and how the many types of cellular and viral RNAs function in and regulate cellular processes. Use of RNA-based drugs for controlling disease through RNA targeting, editing and vaccines.

Prerequisite: BSCI330.

Recommended: BSCI410.

Restriction: Must have junior standing or higher.

BSCI437 General Virology (3 Credits)

Discussion of the physical and chemical nature of viruses, virus cultivation and assay methods, virus replication, viral diseases with emphasis on the oncogenic viruses, viral genetics, and characteristics of the major virus groups.

Prerequisite: BSCI222; or permission of CMNS-Biological Sciences UG Program.

Restriction: Junior standing or higher.

BSCI439 Undergraduate Advanced Selected Topics in Biology (1-4 Credits)

Lectures, seminars, mini-courses, and other special instruction in various biological subjects.

Repeatable to: 9 credits if content differs.

BSCI440 Mammalian Physiology (4 Credits)

A study of the cardiovascular, hemopoietic, gastrointestinal, renal and respiratory systems. Chemical and endocrine regulation of physiological functions in mammals. Course does not count as an upper level lab for BIOL majors (see BSCI441).

Prerequisite: BSCI330; and (CHEM231 and CHEM232; or must have completed CHEM233). Or permission of CMNS-Biological Sciences UG Program.

Credit Only Granted for: BIOE340, BSCI440, or BSCI450.

BSCI441 Mammalian Physiology Laboratory (2 Credits)

Laboratory exercises in experimental mammalian physiology.

Prerequisite: Must have completed or be concurrently enrolled in BSCI440.

Credit Only Granted for: BSCI441 or BSCI451.

BSCI442 Plant Physiology (4 Credits)

An in-depth examination of the unique molecular and physiological principles necessary to understand how plants grow and respond to the environment at the cellular and organismal levels. Plants evolved unique metabolism and survival strategies, so students should be prepared to enter a world that may be new to them.

Prerequisite: Minimum grade of C- in BSCI170 and BSCI171; or minimum grade of C- in PLSC201; and minimum grade of C- in CHEM231 and CHEM232; or minimum grade of C- in CHEM237.

Cross-listed with: PLSC400.

Credit Only Granted for: BSCI442 or PLSC400.

BSCI443 Microbial Physiology (3 Credits)

Microbial cellular and population growth. Fermentation metabolism, physiology of anaerobiosis, and energy conservation and transformation in bacterial membranes. Efficiency of energy utilization for growth. Membrane structure and transport. Bacterial motility and chemotaxis. Regulation of bacterial chromosome replication, RNA and protein synthesis. Control of metabolic pathways. Bacterial stress responses. Antimicrobials.

Prerequisite: Minimum grade of C- in BSCI223 or BSCI283; and minimum grade of C- in BCHM461 or BCHM462.

BSCI446 Advanced Systems Neuroscience (3 Credits)

Neural development, neurobiology of sensation and perception, motor and integrative systems organization in the central nervous system. Neural systems dysfunction as related to medical pathologies and discussion of contemporary neuroscience methods used to understand brain function.

Prerequisite: Minimum grade of C- in BSCI353 or NEUR306.

BSCI447 General Endocrinology (3 Credits)

Functions and dysfunctions of the endocrine system with special reference to mammals.

Prerequisite: BSCI330, CHEM241, and CHEM242.

BSCI450 Mammalian Systems Physiology (3 Credits)

A study of the cardiovascular, hemopoietic, gastrointestinal, renal, and respiratory systems. Chemical and endocrine regulation of physiological functions in mammals.

Prerequisite: Minimum grade of C- in BSCI330; and minimum grade of C- in CHEM233 or both CHEM231 and CHEM232.

Credit Only Granted for: BIOE340, BSCI440, or BSCI450.

BSCI451 Mammalian Systems Physiology Laboratory (2 Credits)

Laboratory exercises in experimental mammalian physiology.

Prerequisite: Must have completed with a minimum of C- or be concurrently enrolled in either BSCI440 or BSCI450.

Credit Only Granted for: BSCI441 or BSCI451.

Formerly: BSCI441.

BSCI452 Diseases of the Nervous System (3 Credits)

An advanced course covering the neuroanatomy, function, and organization of the nervous system and its implication for pathology and disease.

Prerequisite: Minimum grade of C- in BSCI330; and must have completed with a minimum of C- or be concurrently enrolled in either BSCI353 or NEUR306.

Credit Only Granted for: BSCI452, BIOL708E, or NACS728N.

BSCI453 Biology of Hearing (3 Credits)

Acoustic and neural basis of hearing. The auditory system will be described with a comparative approach across species.

Prerequisite: Minimum grade of C- in BSCI207 or NEUR200.

Recommended: BSCI353 or NEUR306.

BSCI454 Neurobiology Laboratory (2 Credits)

Basic neuroanatomical techniques, intracellular and extracellular recordings of electrical potentials from nerve and muscle.

Prerequisite: Minimum grade of C- in BSCI330; must have completed or be concurrently enrolled in BSCI353; and must have completed or be concurrently enrolled in PHYS122, PHYS132, or PHYS142.

Credit Only Granted for: BSCI454, BSCI455, NEUR405, or PSYC401.

BSCI455 Neuroscience Laboratory (3 Credits)

Students will utilize neurophysiological techniques to examine fundamental principles of neurons and neural circuits. This course will reinforce content from prerequisite NEUR courses. Students will also strengthen skills in experimental design and scientific writing.

Prerequisite: NEUR306 or BSCI353; and PHYS132.

Recommended: NEUR305.

Cross-listed with: NEUR405.

Credit Only Granted for: PSYC401, NEUR405, BSCI455 or BSCI454.

BSCI456 Advanced Cellular Neuroscience (3 Credits)

Readings and discussion in cellular and molecular mechanisms underlying synaptic structure/function relationships, synaptic potentiation/depression, dendritic integration, homeostatic plasticity, and nervous system development including neurogenesis, axon guidance, synaptogenesis, and activity-dependent development among other topics.

Prerequisite: Minimum grade of C- in BSCI353 or NEUR306.

Recommended: Minimum grade of C- in BSCI440 or another upper-level neuroscience course.

Jointly offered with: NACS644.

Restriction: Permission of CMNS-Biology department.

Credit Only Granted for: BSCI339X, BSCI456, or NACS644.

Formerly: BSCI339X.

BSCI462 Population Ecology (3 Credits)

Theory of population growth and regulation, life tables, and theory of competition and predation, evolution in ecological settings, community structure and dynamics.

Prerequisite: MATH130, MATH136, or MATH140; and BSCI361.

BSCI464 Microbial Ecology (3 Credits)

Interaction of microorganisms with the environment, other microorganisms and with higher organisms. Roles of microorganisms in the biosphere. Microorganisms and current environmental problems.

Prerequisite: BSCI223 or BSCI283; and (CHEM271 or CHEM277); or permission of the instructor.

BSCI467 Freshwater Biology (4 Credits)

Biology and ecology of freshwater invertebrates in lotic and lentic habitats, their adaptation to aquatic life, their function in aquatic ecosystems, and their relationship to environmental deterioration. Laboratory will include field trips, demonstrations, and identifications.

Prerequisite: BSCI160.

BSCI471 Molecular Evolution (3 Credits)

Patterns of DNA sequence variation within and between species, caused by nucleotide changes and the movement of transposable elements. Theories of molecular evolution, such as the neutral theory. Molecular clock hypothesis: its importance as a practical empirical tool in molecular genetics and systematics and its theoretical foundation.

Prerequisite: BSCI222; or permission of CMNS-Biology department.

BSCI473 Marine Ecology (3 Credits)

Courses in evolution and animal behavior are strongly recommended. A detailed analysis of the evolutionary ecology of marine invertebrates; emphasis on testing of theories and on current literature.

Prerequisite: BSCI207.

BSCI475 Sexual Selection in Nature (3 Credits)

Sexual selection drives some of the most spectacular, if not bizarre, traits in nature. We will explore how organisms select and compete for mates and fertilization success, and how this powerful and pervasive evolutionary force shapes sexual traits and regulates species boundaries. We will focus on the key theories in the field and discuss recent and classic research papers. This is a student-directed class: course topics and materials will be selected based on student interests and involvement. On occasion, experts in the field will be invited to class to discuss their research.

Prerequisite: Minimum grade of C- in BSCI207; or permission of instructor.

Recommended: BSCI360 or BSCI370. Jointly offered with BIOL708.

Credit Only Granted for: BSCI338X, BSCI475, or BIOL708X.

Formerly: BSCI338X.

BSCI476 Evolutionary Genomics (3 Credits)

Application of genomics to understanding evolutionary processes, including genome evolution, organismal evolution, genomic diversity across the tree of life, human evolution and disease. Relevant concepts of evolutionary genetics and genome biology will be covered.

Prerequisite: Minimum grade of C- in BSCI222.

Recommended: BSCI370.

Credit Only Granted for: BSCI476 or BIOL708C.

BSCI477 Ecology and Evolution of Infectious Disease (3 Credits)

Parasites are a ubiquitous feature of ecological communities, and can strongly impact population growth, extinction risk, community structure and biodiversity, as well as pose serious risks to human health and food security. This course will cover basic principles of disease ecology, including; the diversity of parasitic organisms and transmission modes, host and pathogen traits for defense and infection, mathematical models of disease spread, the impacts of disease at different ecological scales, and host-parasite co-evolution. In the latter half of the course we will apply these basic concepts to current real-world problems in disease ecology including emerging infectious diseases in humans, wildlife and agriculture. We will use examples from plants, animals and humans to about an equal degree. This course will have a strong quantitative focus, and completion of the math series is recommended.

Prerequisite: C- or better in either BSCI370 or BSCI361 and either MATH136 or MATH140.

Credit Only Granted for: BSCI477 or BIOL708D.

BSCI480 Arthropod Form and Function (4 Credits)

Survey of the morphological, systematic and physiological diversity of the phylum Arthropoda.

Prerequisite: Permission of CMNS-Entomology (AGNR).

BSCI481 Insect Diversity and Classification (4 Credits)

A summary of the morphology, systematics and evolution of insects and techniques for their collection, preservation and identification. Emphasis is placed on the diversity of insects in North America, particularly Maryland and adjacent regions. An insect collection is required.

Prerequisite: BSCI337.

BSCI482 Insect Physiology and Molecular Biology (4 Credits)

Physiological and biochemical functions of insects. Insect endocrinology, neurobiology, sensory physiology, integument and molting, development and metamorphosis, immunity, metabolism and related topics.

Prerequisite: BSCI337.

BSCI483 Insects, Pathogens, and Public Health (3 Credits)

Mosquito- and tick-borne disease transmission poses significant challenges to human health and well-being globally, and is on the rise in North America. Arthropod parasites and the pathogens they transmit to humans and animals will be introduced, and the public health significance of these arthropods will be examined. The ecology and behavior of vectors in relation to disease transmission will be emphasized.

Prerequisite: BSCI207.

BSCI487 IPM: Science-Based Decision Making for Sustainable Pest Management (4 Credits)

Long-term global food security requires a sustainable increase in agricultural productivity to ensure the availability and accessibility of safe and nutritious food. Agricultural pests reduce global food production and threaten its sustainability. This course explores sustainable pest management in agroecosystems using the integrated pest management (IPM) paradigm. IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment.

Prerequisite: BSCI160 and BSCI161.

Restriction: Must have earned a minimum of 90 credits.

Credit Only Granted for: BSCI487 or ENTM609.

BSCI488 Summer Biology Institutes (1-8 Credits)

Prerequisite: Permission of CMNS-Biological Sciences UG Program.

Repeatable to: 12 credits if content differs.

BSCI494 Animal-Plant Interactions (3 Credits)

Theoretical, conceptual and applied aspects of evolutionary and ecological interactions between plants and animals. This course gives an overview of major ideas, historical controversies, and current research on animal-plant relationships. We will explore the mechanisms and evolution of plant defenses and animal counter-adaptations, behavioral ecology and interactions across trophic levels, the role of microbial communities in mediating interactions, and how these interactions color human experience through food and medicine. The course will have a blended lecture/discussion format and will include field walks to collect herbivory data and observe animal-plant interactions.

Prerequisite: BSCI160 and BSCI161; or BSCI106.

BSCI497 Insect Pests of Ornamentals and Turf (4 Credits)

The recognition, biology and management of insects and mites injurious to ornamental shrubs, trees, greenhouse crops, and turf. Emphasis on Integrated Pest Management (IPM).

Prerequisite: BSCI160 or BSCI337; or (PLSC110 and PLSC111) or (PLSC112 and PLSC113).