BIOLOGY (BIO)

BIO 601. Topics in Biology. (1-4 h)
Seminar and/or lecture courses in selected topics, some involving laboratory instruction. May be repeated for credit.

BIO 602. Topics in Biology. (1-4 h)
Seminar and/or lecture courses in selected topics, some involving laboratory instruction. May be repeated for credit.

BIO 603. Topics in Biology. (1-4 h)
Seminar and/or lecture courses in selected topics, some involving laboratory instruction. May be repeated for credit.

BIO 604. Topics in Biology. (1-4 h)
Seminar and/or lecture courses in selected topics, some involving laboratory instruction. May be repeated for credit.

BIO 605. Topics in Biology. (1-4 h)
Seminar and/or lecture courses in selected topics, some involving laboratory instruction. May be repeated for credit.

BIO 607. Biophysics. (3 h)
Introduction to macromolecules with studies of important biophysical tools, such as sedimentation, centrifugation, electrophoresis, X-ray crystallography, absorption and emission light spectroscopy, fluorescence, single molecule techniques and a survey of membrane biophysics. Also listed as PHY 607.

BIO 608. Biomechanics. (3 h)
Analyzes the relationship between organismal form and function using principles from physics and engineering. Solid and fluid mechanics are employed to study design in living systems.

BIO 608L. Biomechanics Lab. (1 h)
Laboratory study of biomechanics. P or C-BIO 608.

BIO 609. Comparative Anatomy. (4 h)
Study of the vertebrate body from an evolutionary, functional, and development perspective. Labs emphasize structure and function, primarily through the dissection of representative vertebrates.

BIO 610. Community Ecology and Global Change. (4 h)
An advanced ecology course covering mechanisms that determine the dynamics and distribution of plant and animal assemblages and their responses to and roles in global change. Lectures focus on ecological principles and theory. Lab includes local field trips and discussion of the primary literature. Weekend field trips to Outer Banks and mountains.

BIO 611. Ecology & Conservation Biology of Coral Reefs. (4 h)
In-depth study of the various biotic and abiotic components that come together to structure ecosystem function and biodiversity at all spatial scales in one of Earth's most productive and diverse environments, yet one most threatened by human use and climate change. Lab component is a one-week field trip over Spring Break.

BIO 613. Herpetology. (4 h)
Lecture course on the biology of reptiles and amphibians, emphasizing the unique morphological, physiological, and behavorial adaptations of both groups, and their evolutionary histories and relationships. Two local field trips are planned.

BIO 614. Evolution. (3 h)
Study of the evolutionary analysis of biological change in populations, lineages, and the history of Earth. Explores reconstruction of evolutionary histories, adaptation, complexity, and biodiversity through primary literature.

BIO 614L. Evolution Lab. (1 h)
Introduces evolutionary analytic methods and interpretation of trait and molecular data through practical tutorials. P or C-BIO 614.

BIO 615. Population Genetics. (3 h)
Study of the amount and distribution of genetic variation in populations of organisms, and of how processes such as mutation, recombination, and selection affect genetic variation. Lectures present both an introduction to theoretical studies and discussion of molecular and phenotypic variation in natural populations.

BIO 615L. Population Genetics Lab. (1 h)
Introduces quantitative modeling of population genetic dynamics, and experiments using populations of organisms. P or C-BIO 615.

BIO 616. Biology of Birds. (4 h)
Lecture plus lab course emphasizing ecological and evolutionary influences on the physiology, behavior, diversity, and population biology of birds, and case studies in conservation biology.

BIO 617. Plant Physiology & Development. (3 h)
Examines the growth, development, and physiological processes of plants. The control of these processes is examined on genetic, biochemical, and whole plant levels.

BIO 617L. Plant Physiology and Development Lab. (1 h)
Consists of structured experiments and an independently designed research project. P or C-BIO 617.

BIO 619. Biology of Soils. (3 h)
A survey of soil structure and biodiversity, with a detailed study of ecological interactions within soil communities and the impact of the soil biota on soil formation, nutrient cycling, and bioremediation within pristine, managed, and damaged soils.

BIO 619L. Biology of Soils Lab. (1 h)
Laboratory study of physical, chemical, and biological methods for analyzing the soil habitat. P or C-BIO 619.

BIO 623. Animal Behavior. (3 h)
Survey of laboratory and field research on animal behavior.

BIO 623L. Animal Behavior Lab. (1 h)
Laboratory study of animal behavior. P or C-BIO 623L.

BIO 624. Hormones and Behavior. (3 h)
Exploration of the mechanisms of hormonal influences on behavior.

BIO 627. Mycology: Biology of Fungi. (4 h)
Introduces fungi, their evolution and natural taxonomy; cell and molecular biology; genetics, mating and development; primary and secondary biochemistry; and their interactions with other organisms and the environment. Lab introduces culturing, microscopic and molecular techniques.

BIO 630. Land and Natural-Resources Management. (3 h)
Provides a fundamental understanding of land and resource management. The major focus is on federal oversight and policies but state, local, non-profit, and international aspects are included.

BIO 632. Microbiology. (4 h)
Overview of the biology of microorganisms with emphasis on prokaryotes. Topics include cell structure and function, genetics and evolution, metabolic and ecological diversity, and medical microbiology. Lab emphasizes inquiry-based study of environmental microorganisms through a blend of classical and modern techniques.

BIO 634. Parasitology. (4 h)
Survey of protozoan, helminth, and arthropod parasites with a focus on cellular biology, life cycles, host-parasite relationships, and public health implications. Laboratory emphasizes microscropy-based techniques for examining parasite morphology and intracellular structures.

BIO 636. Development. (3 h)
A study of the molecular, cellular, and anatomical aspects of embryonic development of invertebrate and vertebrate organisms.

BIO 636L. Development Lab. (1 h)
Laboratory study of the molecular, cellular, and anatomical aspects of embryonic development of invertebrate and vertebrate animals. P or C-BIO 636.

BIO 639. Animal Cognition. (3 h)
A survey of learning, reasoning and social cognition in animals, with an emphasis on species other than widely-used models such as rodents or primates. Classes are initially mostly lecture, and then mostly discussion of empirical studies from the primary literature.

BIO 640. Ecology. (4 h)
Interrelationships among living systems and their environments, structure and dynamics of major ecosystem types, contemporary problems in ecology. Weigl.

BIO 641. Marine Biology. (3 h)
Introduction to marine organismal and habitat diversity and marine ecological processes.

BIO 641L. Marine Biology Lab. (1 h)
Develops practical knowledge of marine environments through extensive field work. P or C-BIO 641.

BIO 642. Oceanography. (4 h)
Introduces the geological, physical, chemical, and biological processes that govern the global oceans and their role in climate change. Lab focus is on tools and research questions pertinent to the field of biological oceanography and includes a five-day trip over Fall Break.

BIO 646. Neurobiology. (3 h)
Introduces the structure and function of the nervous system including the neural basis of behavior.

BIO 646L. Neurobiology Lab. (1 h)
Laboratory emphasizing electrophysiological techniques with experiments from the cellular to the behavioral level. Students will design and complete their own projects. P or C-BIO 646.

BIO 648. Physiological Plant Ecology. (3 h)
Provides a fundamental understanding of how plants have adapted to the stresses of their habits, particularly in harsh or extreme environments such as deserts, the alpine, the arctic tundra, and tropical rain forests.

BIO 648L. Physiological Plant Ecology Lab. (1 h)
Physiological plant ecology lab. P or C-BIO 648.

BIO 649. Tropical Biodiversity of the Amazon and Andes. (4 h)
Intensive field course in tropical biodiversity focusing on ecosystems, natural resource management, and conversation. Students will travel to major tropical biomes in the vast tropical wildernesses of Andean and Amazonian Peru. Lectures emphasize the basic ecological principles important in each ecosystem. Field-based labs focus on student-designed projects. Offered in the summer only. POI required.

BIO 652. Developmental Neuroscience. (4 h)
Examines the development of neural structures and the plasticity of the mature nervous system. Laboratory covers the basics of embryology, immunocytochemistry, and primary neuron culture.

BIO 653. Functional Neuroanatomy. (3 h)
Focuses on the functional organization of the vertebrate central nervous system, including regions, systems, and circuits, with emphasis on application to current topics, neuropathology, and clinical cases.

BIO 656. Ecology and Resource Management of Southeast Australia. (4 h)
Intensive field-oriented course focusing on ecosystems, natural resource management and enviromental conservation of southeastern Australia. Students travel to major biomes including sub-tropical rainforests, coral reefs, and the Australian urban environment. Labs are field-based with some consisting of study-designed field projects. Taught only in summers in Australia.

BIO 660. Metabolic Diseases. (3 h)
Explores genetic and biochemical pathways in the context of inborn errors of metabolism.

BIO 662. Immunology. (3 h)
Study of the components and protective mechanisms of the human immune system, including innate and acquired immunity.

BIO 663. Sensory Biology. (3 h)
Lecture course that examines a variety of sensory systems. Emphasis is on sensory physiology, although other aspects of sensory systems, e.g. molecular biology and anatomy, are also covered. Silver.

BIO 663L. Sensory Biology Lab. (1 h)
Laboratory emphasizing electrophysiological and behavioral techniques to examine sensory systems. Students will design and complete their own projects. P or C-BIO 663.

BIO 665. Biology of the Cell. (3 h)
Lecture and lab course on recent advances in cell biology. Lectures emphasize analysis and interpretation of experimental data in the primary literature, focusing on topics such as the large scale architecture of the cell, targeting of macromolecules, cell-cell communication, cell signaling, and the control of cell division. The labs introduce basic techniques in cell biology and leads to an independent project. Tague.

BIO 665L. Biology of the Cell Lab. (1 h)
Laboratory course introducing basic techniques in cell biology, leading to an independent project. P or C-BIO 665.

BIO 667. Virology. (3 h)
Designed to introduce students to viruses, viral/host interactions, pathogenicity, methods of control and their use in molecular biology, including gene therapy. Curran, Lord.

BIO 669. Cancer Biology. (3 h)
Analysis of molecular and cellular mechanisms that transform normal cells, trigger abnormal proliferation, and lead to tumor formation. Emphasis is on the biological basis of cancer, with some exploration of clinical and social consequences.

BIO 670. Biochemistry: Macromolecules and Metabolism. (3 h)
Lecture course introducing the principles of biochemistry, with an emphasis on the experimental approaches that elucidated these principles. Major topics include structure, function, and biosynthesis of biological molecules, analysis of enzyme function and activity, bioenergetics, and regulation of metabolic pathways. Muday.

BIO 670L. Biochemistry Lab. (1 h)
Overview of biochemical approaches to study structure and function of macromolecules. Cannot receive credit for both BiO 670L and 671L. P or C-BIO 670.

BIO 671L. Advanced Biochemistry Lab. (1 h)
Emphasizes approaches for insolation and analysis of enzymes. Cannot receive credit for both BIO 670L and 671L. P or C-BIO 671.

BIO 672. Advanced Molecular Biology. (3 h)
Presents molecular mechanisms by which stored genetic information is expressed including the mechanisms for and regulation of gene expression, protein synthesis, and genome editing. Emphasizes analysis and interpretation of experimental data from the primary literature.

BIO 672L. Advanced Molecular Biology Lab. (1 h)
Introduces modern methods of molecular biology to analyze and manipulate expression of genes and function of gene products. P or C-BIO 672.

BIO 674. Neuropharmacology. (3 h)
An introduction to how pharmacological agents affect cellular and molecular functions in the nervous system of normal and disease states. Lecture and case studies will be used to examine topics including drugs targeting mood and emotion, memory and dementia, and movement disorders. Drugs of abuse and the neurological basis of addiction will also be evaluated.

BIO 679. Introduction to Geographic Information Systems (GIS). (4 h)
Lecture and laboratory course that introduces the concepts and uses of GIS as a mapping and analytical tool. Lectures cover the history of GIS, GIS data structures and sources of data, map projections, GIS tools, applications, and resources. Exercises include example of GIS applications in environmental modeling, socio-demographic change and site suitability analyses.

BIO 680. Biostatistics. (3 h)
Introduction to inferential methods in biology. Focuses on recognizing, quantifying, and communicating uncertainty in biological data. Topics include summarizing data, making predictions, and testing hypotheses. Special emphasis on communicating statistics to scientific and general audiences.

BIO 681. Epigenetics. (3 h)
Studies the molecular mechanisms for inheritance of genome modifications. Uses primary literature to explore the environmental and developmental signals that influence epigenetic controls of gene expression and disease.

BIO 681L. Epigenetics Lab. (1 h)
Provides hands-on experiences with genome editing and molecular genetics to address the function and expression of genes. P or C-BIO 681.

BIO 682. Molecular Signaling. (3 h)
Examines the molecular and biochemical mechanisms by which hormones, neurotransmitters, and other signaling molecules act to change growth, development, and physiological and behavioral responses of organisms with a focus on discussion of primary literature.

BIO 683. Genomics. (3 h)
Examines the architecture, expression, and evolution of genomes. Uses current primary literature to examine the functional and evolutionary dynamics of genomes and the modern analytic techniques used to investigate genome-wide phenomena.

BIO 683L. Genomics Lab. (1 h)
Introduces analytic methods and interpretation of genome wide data through practical tutorials. P or C-BIO 683.

BIO 685. Bioinformatics. (3 h)
Introduction to computational approaches essential to modern biological inquiry. Approaches may include large biological dataset analyses, sequence similarity and motif searches, and analysis of high-throughput genomic technologies. Emphasizes interdisciplinary interaction and communication. Also listed as CSC 685 and PHY 685.

BIO 686. Genetics & African Diaspora. (3 h)
Study of modern human population divergence from a genomic perspective, focusing on the role of parasites in driving evolutionary adaptations. Explores the intersection of genetic diversity, health and disease in humans of the African diaspora.

BIO 687. Computational Systems Biology. (3 h)
Introduction of concepts and development of skills for comprehension of systems biology problems, including both biological and computational aspects. Topics may include genome-wide transcriptomic analysis, protein interaction networks, large-scale proteomics experiments, and computational approaches for modeling, storing, and analyzing the resulting data sets. Emphasizes interdisciplinary interaction and communication.

BIO 688. Methods in Molecular Genetics. (4 h)
Hybrid lecture/laboratory course gives students a hands-on introduction to a diverse array of techniques commonly used in molecular genetics laboratories.

BIO 701. Topics in Biology. (1-4 h)
Seminar courses in selected topics, some involving laboratory intstruction. At least one offered each semester. Staff.

BIO 702. Topics in Biology. (1-4 h)
Seminar courses in selected topics, some involving laboratory intstruction. At least one offered each semester. Staff.

BIO 703. Topics in Biology. (1-4 h)
Seminar courses in selected topics, some involving laboratory intstruction. At least one offered each semester. Staff.

BIO 704. Topics in Biology. (1-4 h)
Seminar courses in selected topics, some involving laboratory intstruction. At least one offered each semester. Staff.

BIO 705. Topics in Biology. (1-4 h)
Seminar courses in selected topics, some involving laboratory intstruction. At least one offered each semester. Staff.

BIO 706. Topics in Biology. (1-4 h)
Seminar courses in selected topics, some involving laboratory intstruction. At least one offered each semester. Staff.

BIO 707. Topics in Biology. (1-4 h)
Seminar courses in selected topics, some involving laboratory intstruction. At least one offered each semester. Staff.

BIO 708. Topics in Biology. (1-4 h)
Seminar courses in selected topics, some involving laboratory intstruction. At least one offered each semester. Staff.

BIO 711. Directed Study in Biology. (1 h)
Reading and/or laboratory problems carried out under and by permission of a faculty member. Staff.

BIO 712. Directed Study in Biology. (1 h)
Reading and/or laboratory problems carried out under and by permission of a faculty member. Staff.

BIO 715. Foundations of Physiology. (1-4 h)
Covers classical and current topics and techniques in comparative physiology. Format varies from seminar to a full laboratory course. Staff.

BIO 716. Signal Transduction. (2 h)
Focuses on the mechanisms of inter- and intra-cellular communications. Topics range from receptors to signaling molecules to physiological responses. Largely based on the primary literature and requires student presentation of primary research articles. C. Browne, Muday, Tague.

BIO 717. Developmental Mechanism. (2 h)
Seminar course examining the molecular, biochemical, and cellular mechanisms of animal and/or plant development. Relevant topics selected from the current literature are discussed in lecture and presentation formats. C. Browne, Tague, Muday.

BIO 718. Gene Expression. (2 h)
Seminar covers gene expression in eukaryotic and prokaryotic eystems. Topics range from transcription to translation to other aspects of gene regulation. Emphasis is on the experimental basis of understanding the mechanisms of gene expression. Students present, in seminar format, appropriate papers from literature. All students participate in discussion and evaluation of presentations. Tague, C. Browne, Curran, Muday.

BIO 720. Integrative Biology I. (3 h)
Inquiry into the fundamentals of scientific thought and practice in the biological sciences. Course will emphasize key biological theories and contemporary techniques in the context of current literature. Each semester will be based on three thematic areas chosen by a committee of faculty and students to encompass a breadth of areas of biological knowledge and integrate biological subdisciplines.

BIO 721. Integrative Biology II. (3 h)
Inquiry into the fundamentals of scientific thought and practice in the biological sciences. Course will emphasize key biological theories and contemporary techniques in the context of current literature. Each semester will be based on three thematic areas chosen by a committee of faculty and students to encompass a breadth of areas of biological knowledge and integrate biological subdisciplines.

BIO 725. Plant Genetics. (1, 2 h)
Covers various aspects of plant genetics in a seminar format. Topics range from classical Mendelian genetics to genomics and bioinformatics, depending on the interests of the students. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentation. Muday, Tague.

BIO 726. Plant Physiology. (1, 2 h)
Covers various aspects of plant physiology and hormones in a seminar format. Topics range from auxin transport to properties of light within the leaf. Students present the results, conclusions, and sgnificance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations. Muday, Smith.

BIO 727. Plant Evolution. (1, 2 h)
Covers various aspects of plant evolution in a seminar format. Topics range from problems in phylogeny reconstruction and patterns of diversity to major evolutionary innovations in various plant groups. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations. Kron, Silman.

BIO 728. Plant Ecology. (1, 2 h)
Covers various aspects of plant ecology in a seminar format. Topics vary depending on graduate student interest. Students present the results, conclusions, and significance of appropriate papers from the literature. All students participate in discussion and evaluation of presentations. Silman, Smith.

BIO 735. Foundations of Evolutionary Genetics. (2 h)
Inquiry into the fundamental concepts in genetic evolution through discussion of foundational primary literature. Topics explored include population genetic processes, speciation and extinction.

BIO 740. Physiological Ecolgy. (4 h)
Introduction to evolutionary/ecological physiology, with emphasis on the interactions between organisms and major abiotic factors of the environment including water balance-hydration, gaseous exchange-respiration, temperature tolerance-thermal physiology. Dimock.

BIO 757. Techniques in Mathematical Biology. (3 h)
Offers students a framework for understanding the use of mathematics in both biological theory and empirical research. Emphasis is on practical applications of mathematical techniques, and learning by doing. A central goal is to give students tools to use in their own research. Topics covered include continuous and discrete population models, matrix models, stochastic models, life-history theory, and fitting models for data. Mathematical skills are taught and refreshed, but knowledge of basic calculus is required. Silman, Anderson, Baxley.

BIO 767. Foundations of Ecology. (3 h)
A graduate seminar focusing on understanding the seminal developments in the field of ecology and then tracing their intellectual impacts on the modern literature.

BIO 775. Microscopy for the Biological Sciences. (4 h)
An introduction to the various types of light, confocal, and electron microscopy. Students will learn technical and theoretical aspects of microscopy, methods of sample preparation, digital image acquisition and analysis and the preparation of publicaion quality images. The course will emphasize practical applications of microscopy, microscopy experimental design, and hands-on use of microscopes and digital imaging systems. Students will be expected to design and conduct a microscopy project and present their results to the class. Additionally, students will be expected to participate in class discussions regarding newly emerging microscopy techniques in various biological disciplines.

BIO 778. Advanced Ecology. (4 h)
Covers current research in the field of ecology with a focus at the community level. Experimental deisgn, data analysis, and interpretation are emphasized. Silman.

BIO 781. Statistical Models and Data in R. (4 h)
Provides an introduction to statistical modeling and data management in the R computer language. The course objectives are to introduce student to: (i) methodologies for the design and analysis of ecological and organismal experiments, (ii) programming with an emphasis on good coding and data management habits, and (iii) producing figures and reproducible workflows for publication.

BIO 783. Teaching Skills & Instructional Development. (3 h)
Introduction to teaching college-level science courses. Emphasis is on: defining and achieving realistic course goals; mechanics of selecting, developing and refining topics for lecture or laboratory; effective presentation strategies; and creating an active learning environment. Students develop a teaching portfolio containing course syllabi, lecture outlines, and student-ready laboratory materials. Format combines didactic lectures, individual projects, and group discussions and critiques. Course meets for two, 2-hour periods each week. D. Johnson.

BIO 785. Teacher-Scholar Professional Development I. (1 h)
Training in professional skills for early-career biological scientists through interactive discussion and exercises. Topics include scientific ethics and professional practices, scientific publishing, and scientific communication.

BIO 786. Teacher-Scholar Professional Development II. (1 h)
Training in professional skills for early-career biological scientists through interactive discussion and exercises. Topics include grant preparation and submission, professional bias and discrimination in the sciences, career paths, and job interviewing.

BIO 789. Research Seminar. (1 h)
Introduction to scientific presentation skills through active participation in scientific seminars and symposiums, discussion, and exercises. May be repeated for credit.

BIO 791. Thesis Research I. (1-9 h)
Staff.

BIO 792. Thesis Research II. (1-9 h)
Staff.

BIO 891. Dissertation Research I. (1-9 h)
Staff.

BIO 892. Dissertation Research II. (1-9 h)
Staff.