

# Biology (BIOL)

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## **BIOL 100 Biology and Human Affairs (Lab) (4)**

A general course that studies the biological nature of people and their role in the biosphere. This course has a laboratory component and may count toward fulfilling the college's laboratory science requirement. It cannot be taken for credit if the student has already received credit for BIOL 105.

## **BIOL 105 Biology and People (4)**

An exploration of the biological nature of people and their role in the biosphere that includes such topics as anatomy; physiology; and the genetic, nutritional, infectious, and environmental aspects of diseases. This course may count toward fulfilling the college's requirement for a non-laboratory science course. It cannot be taken for credit if the student has already received credit for BIOL 100.

## **BIOL 107 People and the Environment (4)**

An exploration of how human activities such as food and energy production, resource extraction and waste disposal affect our natural environment and other organisms living in it. Students learn about earth systems, human activities stressing these systems and strategies for dealing with environmental challenges. Specific topics include biodiversity loss and conservation, agriculture and biotechnology, toxicology and environmental health, air and water pollution, and climate change. This course cannot be taken for credit if the student has already received credit for BIOL 130. Non-laboratory course.

## **BIOL 109 Food and Hunger: Contemplation and Action (4)**

A study of food and hunger from a biological perspective. The interactions among scientific, ethical, and cultural aspects of hunger are also examined. The readings, lectures, and discussions in the course are supplemented with work with local aid organizations and exploration of the contemplative practices that motivate and sustain many of those who work with the hungry. This course cannot be used in fulfillment of any general education requirement.

## **BIOL 113 Great Ideas of Science (4)**

An historical and philosophical approach to selected scientific ideas that have had a profound impact on the development of Western civilization. Emphasis will be on the evidence supporting the ideas and controversies that arose during their introduction into our general store of knowledge. Class discussion will be encouraged. Non-laboratory course.

## **BIOL 114 Introduction to Botany (4)**

Phylogenetic survey of the plant kingdom and a study of flowering plant structures and functions with emphasis on the role plants play in human life. Non-laboratory course.

## **BIOL 115 Conservation Biology (4)**

A study of the natural processes that control patterns of biological diversity in evolutionary and ecological time and a comprehensive examination of how human activity has resulted in the loss of biodiversity both regionally and globally. Non-laboratory course.

## **BIOL 118 Current Issues in Biology (4)**

This course focuses on timely and controversial topics presented in popular media. Topics vary with each offering but range from those having to do with human health and well-being to those having to do with survival and the future. This course cannot be taken for credit by students who have already completed BIOL 100, BIOL 105, or any biology course numbered 130 or higher and cannot be counted in the biology major.

## **BIOL 119 The Human Mind: Artistic and Scientific Creativity (4)**

The course examines brain anatomy and physiology, investigates the contributions of artificial intelligence and neural networking in understanding brain function, and explores an interdisciplinary approach to understanding human creativity. This course cannot be used in fulfillment of any general education requirement.

## **BIOL 130 Field Investigations in Biology (4)**

A study of ecology, evolution and biological diversity, with an emphasis on scientific investigations in the natural areas in and around the university. The course, which is scheduled for one afternoon each week, meets the general education requirement for a natural science course but does not fulfill the requirement for a laboratory science course.

## **BIOL 133 Introductory Molecular Biology and Genetics (4)**

This course is an introductory study of the molecular and cellular basis of life, of the structure and function of cells, and of molecular genetics. BIOL 130 is not a prerequisite. Non-laboratory course. *Open only to first-year students and sophomores.*

## **BIOL 144 Directed Research (2 or 4)**

Supervised field or laboratory investigation in biology. This course may be taken more than once for credit and is open only to freshmen and sophomores. It is given only on a pass/fail basis, and, therefore, cannot count in fulfillment of requirements for any major or minor. *Open only to first-year students and sophomores. Prerequisite: Instructor prerequisite override required.*

## **BIOL 180 Principles of Human Nutrition (4)**

This course provides an introduction to nutrition and focuses on the relationship between diet and health. Topics include physiological requirements and functions of protein, energy, and the major vitamins and minerals that are determinants of health and diseases in human populations. These basic concepts are applied to societal issues, including the role of diet in malnutrition, heart disease, cancer, and diabetes. Community engagement.

**BIOL 200 Entomology (4)**

A study of insects and related arthropods, with special emphasis on the role of insects in forest and freshwater ecosystems. Lecture topics also include environmental, physiological, medical, veterinary, and agricultural entomology. Life history, ecology, and behavior are studied through field trips. Functional morphology and taxonomy are studied through laboratory exercises. Non-laboratory course.

*Prerequisite: BIOL 130.*

**BIOL 201 Ornithology (Lab) (4)**

A comprehensive examination of avian biology. Lectures will include student presentations on readings from the scientific literature. Laboratory will emphasize field methods used to study wild birds. A field research project is required. This course cannot be taken for credit by students who have already completed BIOL 108. Laboratory course. *Prerequisite: BIOL 130.*

**BIOL 202 Invertebrate Zoology (Lab) (4)**

A survey of the invertebrate phyla with an emphasis on natural history, functional morphology, embryology, ecology, and phylogenetic relationships. This course has a laboratory component, which will require experimental and field observation, a semester project, and a field trip to a marine laboratory. Laboratory course. *Prerequisite: BIOL 130.*

**BIOL 203 Comparative Vertebrate Anatomy (Lab) (4)**

This course is a study of the anatomy of the Craniata, including the Hagfishes, and Vertebrates (jawless and jawed fishes, and the tetrapods). It emphasizes the evolution of homologous structures, and relates structure to function where applicable. This course also relates structures to adaptations for life in aquatic and terrestrial environments, and puts these changes into an evolutionary perspective. Laboratory course; studio laboratory. *Prerequisite: One course in biology.*

**BIOL 206 Plant Ecology (Lab) (4)**

A study of plants and their interaction with the environment, with other plants, and with animals will emphasize how plant populations change in size and spatial distribution, how they respond to herbivores and pollinators, and the ecological and evolutionary consequences of plant traits. Laboratories will focus on methods for analyzing population and community dynamics. Laboratory course.

*Prerequisite: One course in biology.*

**BIOL 208 Neurobiology (4)**

A comprehensive study of the vertebrate nervous system covering its overall organization and development, function, control of homeostatic systems, and mechanisms of sensory perception. Non-laboratory course. *Prerequisite: One course in biology or one course in psychology.*

**BIOL 209 Advanced Conservation Biology (4)**

A study of the scientific basis for conservation of biological diversity. A case-study approach will be used to address problems relating to species decline, habitat loss, and ecosystem degradation at local, regional, and global scales. Course will emphasize population modeling and GIS applications. Non-laboratory course. *Prerequisite: BIOL 130.*

**BIOL 210 Ecology (Lab) (4)**

A survey of the principles and applications of ecological science. Lecture will cover the ecology of individuals, populations, communities, and ecosystems. Lab will emphasize field experimentation in the local environment. Laboratory course. *Prerequisite: BIOL 130.*

**BIOL 211 Biodiversity: Pattern and Process (Lab) (4)**

A study of the diversity of life forms. The course examines major events in the evolution of life, the shape of the evolutionary tree of life, and the processes that underlie the origins of biological diversity. Laboratory, field, and statistical methods of biodiversity analysis are emphasized. Laboratory course. *Prerequisite: BIOL 130 and BIOL 133.*

**BIOL 212 Entomology (Lab) (4)**

A study of insects and related arthropods, with special emphasis on the role of insects in natural and human-altered systems. Lecture topics also include environmental, physiological, medical, veterinary, and agricultural aspects of entomology. Life history, ecology, and behavior are studied through field trips and student projects. Functional morphology and taxonomy are examined through laboratory exercises and by assembling an insect collection. This course cannot be taken for credit by students who have already completed BIOL 200. Laboratory course. *Prerequisite: BIOL 130.*

**BIOL 213 Evolutionary Biology (4)**

A study of the evolutionary changes that have taken place in biological populations and the mechanisms that underlie these changes. Emphasis will be placed on the integration of data with evolutionary ideas and theory, and the application of evolutionary thought to other areas of biology. Non-laboratory course. *Prerequisite: BIOL 130.*

**BIOL 215 Fungi (2)**

A survey of the characteristics, classification, economic, and biological importance of these organisms together with lichens and slime molds. This course counts as a non-laboratory half-course, but includes some field and laboratory work. This half course may be used in combination with BIOL 216 to constitute a full course in partial fulfillment of the general education requirement in natural science.

**BIOL 216 Algae and Bryophytes (2)**

A survey of these groups of organisms emphasizes their distinguishing features, evolutionary trends, and economic and biological importance. This course counts as a non-laboratory half-course, but includes some field and laboratory work. This half course may be used in combination with BIOL 215 to constitute a full course in partial fulfillment of the general education requirement in natural science.

**BIOL 218 Principles of Animal Nutrition and Metabolism (4)**

Emphasizing the connection between diet and health across the animal kingdom, this course focuses on the application of biochemical principles and concepts to nutrition. Topics include physiological requirements; functions of macronutrients, vitamins, and minerals; and the relationship between those nutrients and disease. *Prerequisite: BIOL 133.*

**BIOL 220 Reading the Landscape (Lab) (4)**

A study of how patterns in the current biological and physical landscape of the Cumberland Plateau can be explained by historical human land use and natural disturbances. Landscape change is examined through field investigation of specific places on the Domain conducted in combination with the analysis of aerial imagery and other geospatial data resources. The course also addresses how disturbance history can influence one's aesthetic valuation of the landscape and guide landscape-level conservation efforts. *Prerequisite: BIOL 130.*

**BIOL 221 Environmental Physiology of Plants (Lab) (4)**

A study of plant physiological processes and how adaptations shared by plant functional groups are shaped by environment. The course covers energy and carbon balance, water and nutrient relations, and interactions with other organisms and physiological responses to environmental stress. Labs focus on instrumentation and field methods used to test ecophysiological hypotheses. *Prerequisite: BIOL 130.*

**BIOL 222 Advanced Conservation Biology (Lab) (4)**

An examination of the negative impact of human activity on biological diversity and an exploration of how conservation science can be used to ameliorate that impact. Case studies are used to investigate such issues as deforestation, exotic species invasions, habitat fragmentation, endangered species protection, natural area management, and habitat restoration. Students examine critically the role of science in public policy decision-making as it relates to the protection of biodiversity in the United States. The course involves student-led discussions, guest speakers, field trips and independent research. Laboratory exercises explore the use of field techniques, GIS analysis, and population modeling as problem-solving tools in conservation biology. This course cannot be taken for credit if the student has already received credit for BIOL 209. Laboratory course. *Prerequisite: BIOL 130.*

**BIOL 223 Genetics (Lab) (4)**

A study of fundamental principles of heredity including molecular aspects and evolutionary implications of these concepts. *Prerequisite: BIOL 133.*

**BIOL 224 Genetics (4)**

A study of fundamental principles of heredity including molecular aspects and evolutionary implications of these concepts. *Prerequisite: BIOL 133.*

**BIOL 229 Biology of Human Reproduction (4)**

This course focuses on understanding the complex mechanisms that allow life to create life. Primarily focusing on human reproduction, it ontogenetically tracks the progression from developing a sexual phenotype, attaining fertility, achieving fecundity, providing postnatal care, and senescence of fertility. This course integrates many biological fields including anatomy, physiology, endocrinology, neurology, cell biology, and behavioral studies to paint a comprehensive view of sexual reproduction. *Prerequisite: BIOL 133.*

**BIOL 232 Human Health and the Environment (Lab) (4)**

A course integrating concepts in ecology and public health through the study of environmental threats to human health. Topics include population growth and food security, toxicity and toxins, food borne illness, emerging disease, waste and wastewater, air pollution and climate change. Students explore the interaction of poverty, environmental degradation and disease through projects examining local environmental health issues. Laboratory course. *Prerequisite: BIOL 130.*

**BIOL 233 Molecular Cell Biology (4)**

An extension of topics introduced in BIOL 133, this course is a study of the molecular and cellular basis of life, of the structure and function of cells, and of molecular genetics at an intermediate level. This course may not be taken for credit by students who have completed BIOL 321. *Prerequisite: BIOL 133. Prerequisite or Corequisite: CHEM 120 or CHEM 150.*

**BIOL 236 Biochemistry (4)**

A one semester survey of biochemistry. The following topics will be addressed: biochemical primary literature and internet resources, bioenergetics, acid-base balance, protein structure and function, enzyme function and kinetics, metabolism, topics in physiological biochemistry, and topics in molecular biology. Non-laboratory course. *Prerequisite: BIOL 133 and CHEM 201.*

**BIOL 237 Freshwater Biology (Lab) (4)**

A study of the biology of freshwater ecosystems. Students examine interactions between freshwater species and their aquatic environments, as well as among one another, in the context of physical and chemical limitations associated with freshwater habitats. Laboratory emphasizes common techniques for inquiry, and a field research project is required. Laboratory course. *Prerequisite: BIOL 130.*

**BIOL 241 Rainforests and Coral Reefs (2)**

This course provides a fundamental understanding of the ecology and natural history of coral reef and tropical rainforest systems using Belize as a case study. Students examine specific environmental problems associated with these systems. Designed to be a companion to BIOL 251. BIOL 241 and BIOL 251 taken together count as one full lab course in biology. *Prerequisite: Only open to students admitted to the Field Study in Belize program. Corequisite: BIOL 251.*

**BIOL 243 Molecular Methods (Lab) (4)**

This course focuses on close readings of the primary and secondary literature in the field of cellular and molecular biology. Experimental methodologies are a primary focus of this course as they pertain to design and analysis of techniques in the molecular biology field. Both in lecture and in laboratory, analysis of writing style and rationale for experimental design is evaluated. *Prerequisite: BIOL 133 and (CHEM 120 or CHEM 150).*

**BIOL 250 Molecular Evolution (4)**

An examination of the evolution of nuclear, viral, and organellar genomes and of protein structure and function. Topics covered will include that origin of life, the evolution of globin and other families of proteins encoded by nuclear genes, evolution of mitochondrial and chloroplast DNA, and molecular phylogenetic analysis. Use of computer algorithms for analyzing both nucleic acid and protein sequences will be introduced in the classroom. Non-laboratory course. *Prerequisite: BIOL 133.*

**BIOL 251 Field Study in Belize (Lab) (2)**

A field immersion into two of the most biologically diverse ecosystems on earth: coral reefs and tropical rainforests. Students live in remote field stations in Belize and explore the ecology and natural history of these two systems through field observation and research. BIOL 241 and BIOL 251 taken together count as one full lab course in biology. *Prerequisite: Only open to students admitted to the Field Study in Belize program. Corequisite: BIOL 241.*

**BIOL 255 Herpetology (Lab) (4)**

A comprehensive examination of the diversity, ecology, and evolution of amphibians and reptiles. Students examine the systematics, biogeography, morphology, physiology, behavior, ecology, and conservation of amphibians and reptiles. Laboratory emphasizes survey and monitoring techniques. A field research project is required. *Prerequisite: BIOL 130.*

**BIOL 260 Cave Biology (4)**

An examination of the biology of caves and other subterranean habitats. The course focuses on the structure and function of cave ecosystems and the evolutionary biology of cave animals. It also involves field trips to caves in the area. *Prerequisite: BIOL 210 or BIOL 213.*

**BIOL 270 Human Anatomy (Lab) (4)**

This course focuses on basic anatomical structures of the human body and how distinct organ systems are organized at the tissue and cellular levels. Emphasis is placed on understanding structure-function relationships in the human body, how they interact in a network, and how those relationships are perturbed in the development of human disease. The laboratory component addresses practical considerations relating to anatomy and includes medical imaging technology emphasizing three-dimensional relationships. *Prerequisite: BIOL 133.*

**BIOL 275 Histology and Microanatomy (4)**

This course provides a hands-on understanding of the structural and functional organization of animal tissues and organs at the cellular and subcellular levels. Students apply knowledge gained from lectures in interpreting and describing structures visualized in collecting, processing, and analyzing mouse tissues. *Prerequisite: One course in biology and CHEM 120 or CHEM 150..*

**BIOL 280 Molecular Genetics (Lab) (4)**

Designed for students interested in molecular mechanisms by which cellular processes are controlled in eukaryotic cells. Topics include introduction to molecular genetic techniques and genomics, in-depth study of structures and chromosomes, transcriptional control of gene expression, signal transduction pathways relating to gene regulation, and abnormal regulatory processes that lead to disease. Laboratory course. *Prerequisite: BIOL 133.*

**BIOL 288 Biotechnology (4)**

This course provides an overview of technologies and methodologies used by biochemical engineers. It addresses topics such as how to manipulate DNA to produce genetically modified organisms, how to design viral based delivery systems for gene therapy, how to design a drug that targets a specific cell molecule, and how to determine protein interaction networks. This course cannot be taken for credit if the student has already received credit for BIOL 289. *Prerequisite: BIOL 133.*

**BIOL 289 Biotechnology (Lab) (4)**

This course provides an overview of technologies and methodologies used by biochemical engineers. It addresses topics such as how to manipulate DNA to produce genetically modified organisms, how to design viral based delivery systems for gene therapy, how to design a drug that targets a specific cell molecule, and how to determine protein interaction networks. This course cannot be taken for credit if the student has already received credit for BIOL 288. *Prerequisite: BIOL 133.*

**BIOL 300 Biology of Aging (Lab) (4)**

A study of the molecular and physiological processes that govern our longevity. This course integrates seminar and laboratory formats, using model organisms to examine the impact upon aging of dietary restriction, drugs that might induce longevity, genetics, and reproduction. Full use is made of relevant primary literature. *Prerequisite: BIOL 233.*

**BIOL 302 Plant Growth and Development (4)**

A study of growth and developmental processes in plants, especially as they are influenced by environmental factors and by hormones or plant growth substances. *Prerequisite: One college course in biology and CHEM 120.*

**BIOL 305 Plant Physiology (4)**

The principal functions of higher plants, including photosynthesis, gas exchange, water and solute relations and transport, mineral nutrition, plant hormone action, and environmental responses. *Prerequisite: One college course in biology and CHEM 120.*

**BIOL 307 Mechanistic Biochemistry (Lab) (4)**

An examination of all aspects of protein science, including protein biosynthesis, protein structure, and the mechanisms of enzyme catalysis, with particular emphasis on the biochemistry of enzyme catalysis. Lecture, three hours; laboratory, three and one-half hours. *Prerequisite: CHEM 202.*

**BIOL 310 Plant Evolution and Systematics (Lab) (4)**

A comprehensive survey of trends in vascular plant diversity and the evolutionary mechanisms underlying these trends. Laboratory course. *Prerequisite: BIOL 130.*

**BIOL 311 Behavioral Ecology (Lab) (4)**

This course studies animal behavior from an ecological and evolutionary perspective. Topics include the development of behavior, predator-prey interactions, communication, foraging strategies, cooperation, mating behavior, and parental care. Lectures include discussions of the scientific literature. Laboratories emphasize methods used to study animal behavior, including hypothesis testing, experimental design, and statistical analysis. A research project is required. Laboratory course. BIOL 210 and BIOL 213 are recommended prerequisites but not required. *Prerequisite: BIOL 130.*

**BIOL 312 General and Human Physiology (4)**

This course covers general physiological concepts such as homeostasis, control theory, and system analysis. It also takes a detailed view of how these general principles apply specifically to various physiological systems in humans and other mammals in some cases. Systems such as respiration, circulation, digestion, metabolism, thermoregulation, and excretion are studied at cellular, tissue and whole system levels. In cases where form is especially critical to function, anatomy is also covered, although there is no human dissection. This course cannot be taken for credit if the student has already received credit for BIOL 314. *Prerequisite: BIOL 233 and (CHEM 120 or CHEM 150).*

**BIOL 313 Ecosystems and Global Change (Lab) (4)**

A study of how the cycling of elements among the atmosphere, soil, water and living organisms sustains ecosystems, and how disruptions in these cycles, both natural and human-induced, bring about environmental change. In the field, students evaluate the sustainability of land use by quantifying elemental cycles in natural and human-altered ecosystems. Laboratory course. *Prerequisite: One course in chemistry and one course in biology.*

**BIOL 314 General and Human Physiology (Lab) (4)**

This course covers general physiological concepts such as homeostasis, control theory, and system analysis. It also takes a detailed view of how these general principles apply specifically to the various physiological systems in humans and, in some cases, to other mammals. Systems such as respiration, circulation, digestion, metabolism, thermoregulation, and excretion are studied at cellular, tissue, and whole system levels. In cases where form is especially critical to function, anatomy is also covered although there is no human dissection. Laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 312. *Prerequisite: BIOL 233.*

**BIOL 315 Advanced Topics in Ecology and Biodiversity (4)**

A study of advanced topics in ecology and biodiversity, with an emphasis on integrating study of the scientific literature with field research. *Open only to seniors pursuing majors in biology or ecology and biodiversity. Prerequisite: BIOL 210 or BIOL 211.*

**BIOL 316 Biochemistry of Metabolism and Molecular Biology (Lab) (4)**

A study of the biochemical reactions of eukaryotic cellular metabolism and bioenergetics, focusing on enzyme regulation and function, protein structure, nucleic acid structure and function, and selected topics in molecular biology and physiological biochemistry. Prior coursework in cell/molecular biology is recommended. Laboratory course. *Prerequisite: BIOL 233 and BIOL 243 and CHEM 202.*

**BIOL 318 Molecular Revolutions in Medicine (4)**

A survey of major molecular mechanisms of human disease, including approaches to diagnosing, preventing, treating, and curing disease conditions. This course features an overview of basic human genetics, an introduction to pharmacological methodologies in drug design and the FDA approval process and a survey of current technologies associated with gene therapy and stem cell treatments. This course cannot be taken for credit if the student has already received credit for BIOL 328.

**BIOL 319 Cancer Cell Biology (Lab) (4)**

This course is an overview of cancer development at the cellular and molecular levels. It uses a survey of primary scientific literature to cover the basic cell biology of cancer. Topics include growth control, angiogenesis, invasion, metabolism and cell signaling as they relate to the progress of cancer. Laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 320. *Prerequisite: BIOL 233.*

**BIOL 320 Cancer Cell Biology (4)**

This course is an overview of cancer development at the cellular and molecular levels. It uses a survey of primary scientific literature to cover the basic cell biology of cancer. Topics include growth control, angiogenesis, invasion, metabolism and cell signaling as they relate to the progress of cancer. Non-laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 319. *Prerequisite: BIOL 233.*

**BIOL 322 Genes and Behavior (4)**

This course focuses on our current understanding of how genes affect behavior and the interacting role of the environment. Topics include movement, foraging, social behaviors, and diseases of behavior. Lectures, including discussions of the scientific literature, focus on key issues and recent findings, as well as the experimental approaches used, in a range of animals including humans. Non-laboratory course. BIOL 213 and/or BIOL 301 are recommended but not required. *Prerequisite: BIOL 130 and BIOL 133.*



**BIOL 323 Environment and Development (4)**

An integrative study of how environment affects development, with emphasis on underlying molecular and cell signaling pathways. The course explores links between environmental conditions during development and lifetime outcomes, such as reproductive success and disease risk. Discussions address implications for human health, ecosystem function, and evolutionary patterns. BIOL 233 is recommended but not required. *Prerequisite: BIOL 133.*

**BIOL 324 Junior Seminar (2)**

A study of advanced topics in biology with emphasis critical evaluation of literature and writing. This course highlights important writing and research skills including literature searches, literature critique, and experimental design. *Open only to juniors pursuing majors in biology.*

**BIOL 325 Biology of Aging (4)**

A study of the molecular and physiological processes that govern our longevity. Seminar course focused on a careful examination of the primary literature. Demonstrations using living animals illustrate the effects of dietary restriction, potential longevity-inducing drugs, genetics, and reproduction on aging. No laboratory. *Prerequisite: BIOL 233 and (BIOL 223 or BIOL 224).*

**BIOL 328 Molecular Revolutions in Medicine (Lab) (4)**

A survey of major molecular mechanisms of human disease, which includes approaches to diagnose, prevent, treat, and cure disease conditions. This course covers an overview of basic human genetics, an introduction to pharmacological methodologies in drug design and FDA approved process, and an overview of current technologies involving gene therapy and stem cells. Laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 318. *Prerequisite: BIOL 233.*

**BIOL 330 Immunology (Lab) (4)**

An introduction to the vertebrate immune system with emphasis on molecular and cellular events. Topics include organization of the immune system, structure and function of immunoglobulins, genetics of immunoglobulin diversity, clonal selection theory, complement-mediated processes, the major histocompatibility complex, cell-mediated responses, immunization, innate immunity, autoimmunity, and immunodeficiency. Laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 331. *Prerequisite: BIOL 233 and BIOL 243.*

**BIOL 331 Immunology (4)**

An introduction to the vertebrate immune system with emphasis on molecular and cellular events. Topics include organization of the immune systems, structure and function of immunoglobulins, genetics of immunoglobulin diversity, clonal selection theory, complement-mediated processes, the major histocompatibility complex, cell-mediated responses, immunization, innate immunity, autoimmunity, and immunodeficiency. Non-laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 330. *Prerequisite: BIOL 233 and BIOL 243.*

**BIOL 333 Developmental Biology (Lab) (4)**

A study of animal development with an emphasis on gametogenesis, morphogenesis, and differentiation of the primary germ layers and their derivatives, as well as developmental mechanisms at cellular and subcellular levels. Laboratory course. *Prerequisite: BIOL 233 and (BIOL 223 or BIOL 224).*

**BIOL 334 Developmental Biology (4)**

A study of animal development with an emphasis on gametogenesis, morphogenesis, and differentiation of the primary germ layers and their derivatives, as well as developmental mechanisms at cellular and subcellular levels. Non-laboratory course. *Prerequisite: BIOL 233 and (BIOL 223 or BIOL 224).*

**BIOL 339 Studio Course in Microbiology (4)**

A survey of the structure and functions of bacteria and viruses with an emphasis on the characterization and classification, cultivation, reproduction and growth, chemical and physical control of growth, microbial metabolism, and microorganisms and disease. Other topics include microbiology of foods, soil, and wastewater. Short laboratory exercises on selected topics, such as gram staining, food microbiology, and water analysis, are conducted at the end of the appropriate lectures. Non-laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 340. *Prerequisite: BIOL 133 and (CHEM 120 or CHEM 150).*

**BIOL 340 Microbiology (Lab) (4)**

This survey of the structure and functions of bacteria/viruses and introduction to immunology will emphasize the characterization and classification, cultivation, reproduction and growth, chemical and physical control of growth, microbial metabolism, and microorganisms and disease. Other topics of discussion will include microbiology of foods, soil, and wastewater. Laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 339. *Prerequisite: BIOL 133 and (CHEM 120 or CHEM 150).*

**BIOL 350 Environmental Physiology and Biochemistry of Animals (Lab) (4)**

An examination of the interaction between an animal's environment and the animal's physiology and biochemistry. Of special interest is how environmental change causes short-term adaptation and long-term evolutionary change in physiological and biochemical traits. The types of such changes that take place, and the evolutionary mechanisms responsible for them, are studied through comparison of animals found in various moderate and extreme environments. Laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 351. *Prerequisite: BIOL 233.*

**BIOL 351 Environmental Physiology and Biochemistry of Animals (4)**

An examination of the interaction between an animal's environment and the animal's physiology and biochemistry. Of special interest is how environmental change causes short-term adaptation and long-term evolutionary change in physiological and biochemical traits. The types of such changes that take place, and the evolutionary mechanisms responsible for them, are studied through comparison of animals found in various moderate and extreme environments. This course cannot be taken for credit if the student has already received credit for BIOL 350. *Prerequisite: BIOL 233.*

**BIOL 380 Genomics (4)**

This course provides an introduction to the field of genomics. It aims to help students understand how genome-scale information (DNA sequences, genome variations, microarrays, and proteomics) can provide a systems biology perspective. Topics addressed include the structure of the human genome, strategies used to map and sequence the genome, and detailed examination of how genomic sequence information can be used in both laboratory and clinical settings. Non-laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 381. *Prerequisite: BIOL 223 or BIOL 224.*

**BIOL 381 Genomics (Lab) (4)**

This course provides an introduction to the field of genomics. It aims to help students understand how genome-scale information (DNA sequences, genome variations, microarrays, and proteomics) can provide a systems biology perspective. Topics addressed include the structure of the human genome, strategies used to map and sequence the genome, and detailed examination of how genomic sequence information can be used in both laboratory and clinical settings. The laboratory component offers students hands-on experience in running and analyzing their own DNA microarray. Laboratory course. This course cannot be taken for credit if the student has already received credit for BIOL 380. *Prerequisite: BIOL 223 or BIOL 224.*

**BIOL 388 Epigenetics (4)**

This course explores the field of epigenetics in a discussion-based format, using both primary and secondary scientific literature. Topics focus on cellular differentiation and pathologies derived from the misregulation of epigenetic systems in the cell, including imprinting during development and mutations involving DNA methylation of CpG islands during cancer progression. This course cannot be taken for credit if the student has already received credit for BIOL 389. *Prerequisite: BIOL 223 or BIOL 224 or BIOL 280.*

**BIOL 389 Epigenetics (Lab) (4)**

This course explores the field of epigenetics in a discussion-based format, using both primary and secondary scientific literature. Topics focus on cellular differentiation and pathologies derived from the misregulation of epigenetic systems in the cell, including imprinting during development and mutations involving DNA methylation of CpG islands during cancer progression. This course cannot be taken for credit if the student has already received credit for BIOL 388. *Prerequisite: BIOL 223 or BIOL 224 or BIOL 280.*

**BIOL 399 Special Topics (2 or 4)**

A seminar on a topic related to biology. May be repeated for credit when the topic differs. *Prerequisite: BIOL 130 and BIOL 133.*

**BIOL 401 Biology Tutorial (2)**

Supervised study projects involving a topical survey of existing texts and/or periodical literature. May be taken more than once for credit. *Prerequisite: Instructor prerequisite override required.*

**BIOL 424 Senior Seminar (2)**

A study of advanced topics in biology with emphasis on critical evaluation of literature and speaking. Skills for oral communication are explored through multiple formats. *Open only to seniors pursuing majors in biology. Prerequisite: BIOL 223 or BIOL 224.*

**BIOL 444 Independent Study (2 or 4)**

Supervised field or laboratory investigation. May be taken more than once for credit. *Prerequisite: Instructor prerequisite override required.*

**BIOL 490 Principles of Neuroscience (4)**

General neuroscience seminar: Lectures, readings and discussion of selected topics in neuroscience. Emphasis will be on how approaches at the molecular, cellular, physiological and organismal levels can lead to understanding of neuronal and brain function. No single individual may receive credit for both this course and either version of Neuropsychology at Sewanee (PSYC 254 and PSYC 255). Admission to the Sewanee-At-Yale Directed Research Program required. This course is only available through the Yale Directed Research Program.

**BIOL 492 History of Modern Neuroscience (4)**

Survey of classical papers that have been the foundation for the rise of modern neuroscience since the 1950s. Areas covered range from genes and proteins through cells and systems to behavior. Classes combine overviews of different areas with discussions of selected classical papers. Emphasis is on how convergence of techniques, concepts, and personalities has been the basis for major advances. Admission to the Sewanee-At-Yale Directed Research Program required. This course only available through the Yale Directed Research Program. *Prerequisite: PSYC 254.*

**BIOL 498 Research Methods Seminar (4)**

This seminar is organized around presentations of individual research projects, emphasizing detailed critique of project designs, findings, and conclusions. Students also review reports of empirical research written by other students in the seminar to develop their skills in both writing and critiquing research reports. Admission to the Sewanee-At-Yale Directed Research Program required. This course is only available through the Sewanee-At-Yale Directed Research Program. With the approval of program director and the biology department, this course may be listed as BIOL 498. *Prerequisite: An introductory psychology or introductory biology course and approval of the Sewanee-at-Yale program director..*

**BIOL 499 Directed Research (4)**

Students conduct research under the direction of a faculty member on a topic of mutual interest. Typically culminates in a written research report. Admission to the Sewanee-At-Yale Directed Research Program required. This course is only available through the Sewanee-At-Yale Directed Research Program. With the approval of program director and the biology department, this course may be listed as BIOL 499.