

BIOLOGY

Division of Natural Sciences and Mathematics

The Biology major is designed to help students develop a strong and broad background in biological science and seeks to emphasize to its majors that the discipline of biology is intimately related to many disciplines outside of the sciences. As part of the major, students will gain an appreciation of the impact of biology on history, and they will appreciate the many philosophical and ethical questions that have biological underpinnings. Students are encouraged to find additional connections—to the humanities, to the social sciences, and to the other science fields—as they pursue their education.

A strong knowledge base is essential for a biologist, but it does not alone make the scientist. Therefore, the Biology major seeks to guide students to develop the skills to ensure that, for them, biology is an inquiry-based discipline. Through ample opportunities for practice, students learn to:

- read, understand, and analyze biological literature;
- design, perform, and analyze experiments to ask questions and test hypotheses; use up-to-date techniques and equipment common in the discipline; communicate their questions and findings both orally and in writing; and
- work collaboratively on experimentation with fellow students and faculty who share a love of inquiry.

The combination of these three components of our mission—the strong knowledge base, the appreciation of the connections between biology and other academic areas, and the collaborative “doing” of biology—position students to become skilled biologists, lifelong independent learners, and citizen leaders.

Many careers are available to students who have majored in biology. Some of these careers can be accessed directly by those with a B.S. in Biology. Others require—or can be enhanced by—post-graduate education. The Biology major seeks to ensure that graduates are well prepared for careers in biology and for admission to graduate programs (M.S. and Ph.D.) and programs designed to train and license the teaching or the medical professional. Among the many examples of the latter for which our students are well trained are medical school, dental school, veterinary school, pharmacy school, and nursing school, as well as programs that train the physician assistant, the physical therapist, and the occupational therapist.

The Biology Department offers classes for students enrolled in the first-year FYS program, distribution courses for nonscience majors, introductory level courses covering the breadth of the discipline, and diverse upper-level courses for majors. Undergraduate internship and research opportunities are available in departmental laboratories during both the academic year and the summer. Students can also participate in internships sponsored by off-campus laboratories through existing programs or those proposed by the student. A chapter of Beta Beta Beta, the national biological honor society, provides supplemental activities for students.

The nearby Chester River, a major tributary to the Chesapeake Bay, and the River and Field Campus afford excellent opportunities for ecological studies in a wide variety of biological subdisciplines. Another resource is the Virginia Gent Decker Arboretum, the collection of trees and shrubs on the college campus, in which students can also study a broad range of topics. Collaborative student-faculty research is an important focus of the department, and the Toll Science Center boasts personal labs for each of the faculty and a number of shared research spaces including a set of microsuits (fluorescence microscopy, cell and tissue culture, and histology), the aquatic research facility, and a spacious research greenhouse.

- Biology Major (<https://catalog.washcoll.edu/catalog/departments-programs/biology/biology-major/>)
- Biology Minor (<https://catalog.washcoll.edu/catalog/departments-programs/biology/biology-minor/>)

Martin Connaughton, (Associate) Chair
 Jennie Rinehimer, Chair (SP25)
 Aaron Krochmal, Associate Chair (FA24)
 Katherine Hovanes
 Mala Misra
 Mindy Reynolds
 Suzanne Thuecks
 Jennifer Wanat

BIO SCE Senior Capstone Experience 2 Credits

Students enroll in the SCE course during their final year. Credits are awarded in the final semester for year-long experimental SCEs and double-majors, and during the semester of completion for single-semester, monograph-based SCEs.

Term(s) Offered: All Terms, All Years

BIO 100 Current Topics in Biology with Lab 4 Credits

An introduction to some of the fundamental principles and concepts of modern biology. Emphasis varies with the course, which might range in topic from forensic biology to toxicology to ecology and evolution. The application of biological phenomena to everyday life and the scientific method are emphasized. The laboratory explores topics introduced in lecture and exposes students to investigative learning.

Term(s) Offered: All Terms, All Years

Fees: \$25 Lab Fee

BIO 111 General Biology I with Lab 4 Credits

This course provides an introduction to living systems. Topics studied include biomolecules, cell structure and function, metabolism, genetics and molecular biology (BIO 111) and diversity of life, physiology of plants and animals, evolution, and ecology (BIO 112). The laboratory complements the lecture and also provides an introduction to experimentation and communication of experimental results. Successful completion of BIO 111, 112 requires students to enroll in the lab sections of General Biology (BIO 113, 114) independently of the lecture. These courses are designed for students with a strong interest in the biological sciences and are prerequisites for upper-level biology courses.

Requisites: Coreq: BIO 113

Term(s) Offered: Fall, All Years

Fees: \$50 Lab Fee

BIO 112 General Biology II with Lab 4 Credits

This course provides an introduction to living systems. Topics studied include biomolecules, cell structure and function, metabolism, genetics and molecular biology (BIO 111) and diversity of life, physiology of plants and animals, evolution, and ecology (BIO 112). The laboratory complements the lecture and also provides an introduction to experimentation and communication of experimental results. Successful completion of BIO 111, BIO 112 requires students to enroll in the lab sections of General Biology (BIO 113, BIO 114) independently of the lecture. These courses are designed for students with a strong interest in the biological sciences and are prerequisites for upper-level biology courses.

Term(s) Offered: Spring, All Years

Fees: \$50 Lab Fee

BIO 113 General Biology I Lab 0 Credits

This is the laboratory section corresponding to the General Biology I lecture (BIO 111). BIO 113 is a required co-requisite of BIO 111. Assessments in BIO 113 are incorporated into the final grade of BIO 111.

Term(s) Offered: Fall, All Years

BIO 114 General Biology II Lab 0 Credits

This is the laboratory section corresponding to the General Biology II lecture (BIO 112). BIO 114 is a required co-requisite of BIO 112. Assessments in BIO 114 are incorporated into the final grade of BIO 112.

Term(s) Offered: Spring, All Years

BIO 190 Biology Internship 4 Credits

An internship developed by a faculty mentor and student in close consultation with the supervisor at the internship site. A learning contract is developed prior to enrollment in the course. Evaluation of student performance is completed by the faculty mentor based on fulfillment of the contract terms and written evaluation by the internship site supervisor. Graded A-F. 45 hours per credit are required.

Term(s) Offered: All Terms, All Years

BIO 194 Special Topics 4 Credits

The study of areas in biology that are not regularly offered in the curriculum. Courses may be interdisciplinary, seminar or winter/summer field-type courses and will be designated as Category I, II or III, if there is a laboratory component.

Term(s) Offered: All Terms, All Years

BIO 202 Stem Cell Biology with Lab 4 Credits

Stem cells possess the ability to build new tissues or replenish depleted ones. This course serves as an introduction to the unique biology of stem cells and their potential clinical applications in the treatment of degenerative disorders.

Term(s) Offered: Spring, Odd Years

Fees: \$50 Lab Fee

BIO 203 Microbiology with Lab 4 Credits

A study of microorganisms (viruses, bacteria, archaea, fungi, and protists). Topics include structure/function of prokaryotic cells; microbial metabolism, growth, genetics, and diversity; epidemiology; mechanisms of pathogenicity; selected infectious diseases; and environmental microbiology. The laboratory portion of the course emphasizes microscopy, microbial culture and enumeration, microbial metabolism, and water, food, and medical microbiology.

Term(s) Offered: Fall, All Years

Fees: \$50 Lab Fee

BIO 205 Cell & Molecular Biology with Lab 4 Credits

Part of an introductory set of courses designed for biology majors. This course provides an introduction to the cellular processes common to life with central themes including metabolism, macromolecular function and the genetic basis of cellular function. We examine the composition and function of membranes, how the structure of proteins affects function, the central dogma of information transfer, and how cells communicate. This course is designed to prepare students for in-depth, upper-level work in areas related to cell biology, molecular biology, biochemistry and genetics.

Term(s) Offered: All Terms, All Years

Fees: \$50 Lab Fee

BIO 206 Ecology with Lab 4 Credits

A study of the fundamentals of ecology. Topics include the relationships between organisms and their physical environment, population growth and structure, life histories, predator-prey interactions between species, community structure and dynamics, and ecosystem structure & function. Most of the weekly laboratories involve on or off-campus field trips for the collection of data from various ecosystems, while the remaining labs involve processing, graphing and statistical analysis of field data.

Term(s) Offered: All Terms, All Years

Fees: \$50 Lab Fee

BIO 208 General Zoology with Lab 4 Credits

General Zoology topics range from taxonomy and systematics to the basic patterns of form and function that characterize the major groups of animals. Lecture and laboratory work include functional morphology, reproduction, development, evolution, and ecology from simple protozoans through complex vertebrate taxa. The course emphasizes diverse adaptations of animals to the aquatic and terrestrial habitats in which they live.

Term(s) Offered: Fall, Non Conforming

Fees: \$50 Lab Fee

BIO 209 Genetics with Lab 4 Credits

A study of heredity in cells, individuals, and populations, and of the molecular expression of genes. The course emphasizes genetic analysis in both lab and lecture. Topics in the laboratory include experiments in transmission, population, cellular, and molecular genetics using a variety of organisms as models.

Cross-listed as: BIO 305/BIO 209

Term(s) Offered: All Terms, All Years

Fees: \$50 Lab Fee

BIO 211 Plant Biology & Diversity with Lab 4 Credits

An introduction to plants emphasizing their diversity, structure, function, and ecology. The laboratory includes field trips to collect local flora and explores plant cells and tissues, physiological processes, and environmental influences on growth and metabolism.

Term(s) Offered: Fall, Non Conforming

Fees: \$50 Lab Fee

BIO 213 Tropical Ecology 4 Credits

Tropical rainforests are a center of biodiversity and are of significant ecological importance. This course immerses students in the tropical rainforests of Central America, allowing for extensive observation and explorations of topics such as animal behavior, ornithology, herpetology, ecosystem services, and biodiversity. In addition to two weeks in a lowland tropical rainforest, the course also features pre-departure and post-travel class meetings and activities.

Term(s) Offered: Winter, Even Years

BIO 221 The Bermuda Environment 4 Credits

This summer course investigates the complex marine ecology of the Bermuda Islands, the impact that human habitation and tourism have had on their natural history, and current environmental concerns and means of mitigating those concerns. Major areas of study include (but not be limited to) geology of Bermuda, biogeography and colonization, coral reef ecology, sponge and sea grass ecology, culture and history of Bermuda and its major towns, and the environmental impacts of so many people living on and visiting such a small area of islands.

Cross-listed as: BIO 221/ENV 221

Term(s) Offered: Summer, Odd Years

BIO 228 Ornithology with Lab 4 Credits

An in-depth study of birds with respect to their evolutionary history, structural and physiological adaptations, behavior, and ecology. The laboratory component of this course focuses on the identification of local species of birds and reinforcement of lecture topics in the field. The lab introduces research techniques used to study birds in the field and includes visits to the River and Field Campus (RAFC) and local wildlife areas.

Term(s) Offered: Fall, Odd Years

Fees: \$50 Lab Fee

BIO 290 Biology Internship 4 Credits

An internship developed by a faculty mentor and student in close consultation with the supervisor at the internship site. A learning contract is developed prior to enrollment in the course. Evaluation of student performance is completed by the faculty mentor based on fulfillment of the contract terms and written evaluation by the internship site supervisor. Graded A-F. 45 hours per credit are required.

Term(s) Offered: All Terms, All Years

BIO 294 Special Topics 4 Credits

The study of areas in biology that are not regularly offered in the curriculum. Courses may be interdisciplinary, seminar or winter/summer field-type courses and will be designated as Category I, II or III, if there is a laboratory component.

Term(s) Offered: All Terms, All Years

BIO 295 On Campus Research 4 Credits

A ten-week on-campus summer research project to be guided by a faculty mentor. Based on mutual interests, the student and faculty mentor develop a research project, supported by a reading list and involving theoretical, laboratory, or field investigations. Participants produce a final report detailing the findings of their research. Selection of students depends on academic background, scholastic achievement, and the results of a personal interview with the faculty mentor. 45 hours per credit required. Graded A-F

Term(s) Offered: Summer, All Years

BIO 296 Off-Campus Research 4 Credits

An individual research project chosen by the student in consultation with a faculty mentor. The project involves the design and performance of an experiment or experimental series and submission of a written report. 45 hours per credit are required. Graded A-F

Term(s) Offered: Summer, All Years

BIO 301 Integrative Human Anatomy with Lab 4 Credits

A holistic, integrative investigation into the major body systems of humans, examining human anatomy through an integrative lens. Integration occurs across levels of organization (from molecules and cells up through organ systems) as well as time (across the phylogeny of vertebrates), with emphasis placed on system structure, function, and evolutionary modification across vertebrate phylogeny. Laboratory work consists of detailed systems-level examination, interactive simulations, and guided dissection.

Term(s) Offered: Fall, All Years

Fees: \$50 Lab Fee

BIO 302 Developmental Biology with Lab 4 Credits

Developmental biology integrates concepts and practices from cell biology, genetics, anatomy, neurobiology, evolutionary biology, and beyond to examine how complex multicellular organisms arise from a single cell—the fertilized egg. This course discusses the events of development from fertilization through organ development in a range of animal systems, focusing on the cellular and molecular mechanisms that regulate cell and tissue growth and differentiation. Laboratory exercises use model organisms such as the embryonic sea urchin, fish, chick, and fruit fly to introduce common experimental techniques. Class discussions connect basic concepts from developmental biology to ethical debates related to reproductive, maternal, and fetal health.

Term(s) Offered: Fall, Non Conforming

Fees: \$50 Lab Fee

BIO 309 Marine & Estuarine Bio with Lab 4 Credits

The course examines marine and estuarine ecosystems. The course focuses on coastal communities common in the mid-Atlantic region (rocky intertidal, sandy beach, salt marsh, etc.), but also addresses more exotic marine communities (deep sea, coral reef, mangrove, etc.). Lectures focus on the biological, chemical and physical oceanographic processes influencing these ecosystems and the ecology of interacting species in these communities. Labs provide an introduction to marine invertebrate zoology for the first half of the semester and independent research projects working with marine invertebrate species during the second half of the semester. One of the labs involves a day-long trip to sandy beach, dune, maritime forest, and salt marsh communities in Lewes, DE.

Term(s) Offered: Spring, Even Years

Fees: \$50 Lab Fee

BIO 311 Neurobiology with Lab 4 Credits

An overview of the field of neurobiology. The structure and components of the nervous system are discussed. In addition, the methods of communication within the nervous system and including an overview of some of the sensory systems that relay environmental cues for processing in the CNS are examined. The purpose of this laboratory is to become familiar with neuroanatomy as well as experimental techniques used in the field of neuroscience both by hands on experience and reading/ presenting journal articles.

Term(s) Offered: Fall, Non Conforming

Fees: \$50 Lab Fee

BIO 313 Wetlands Ecology with Lab 4 Credits

Wetlands Ecology provides an in-depth examination of the function and types of wetlands with an emphasis on ecosystem services, biodiversity and conservation. Lecture includes a broad overview of the role wetlands play in larger ecosystems as well as the hydrology, geology, chemistry, trophic interactions, and species common to these unique aquatic systems. Laboratories include a large field-based component where students will learn to identify wetlands and their associated flora and fauna.

Cross-listed as: BIO 313/ENV 313

Term(s) Offered: Spring, Non Conforming

BIO 314 Biotechnology & Molecular Bio with Lab 4 Credits

This course introduces the tools and techniques of biotechnology. While the discipline of biotechnology is founded in molecular biology, its tools can be applied to tackle problems in all branches of biology from cell biology to evolution. This course provides the conceptual background for understanding the basis of biotechnology and emphasizes laboratory activities related to DNA and DNA-RNA-protein interconnections. Student learn standard techniques in DNA analysis and cloning.

Term(s) Offered: Spring, Non Conforming

BIO 315 Ecophysiology with Lab 4 Credits

This course examines how organisms' physiological responses have evolved in response to ecological challenges, such as fluctuating or extreme conditions in their environment. Discussions of physiological adaptations integrate topics from a variety of fields, including behavior, ecology, and molecular biology. Interactions between vertebrate animals and their biotic and abiotic environments are emphasized. The laboratory component of the course includes both in-lab and field activities.

Term(s) Offered: Fall, Non Conforming

Fees: \$50 Lab Fee

BIO 328 Behavioral Ecology with Lab 4 Credits

This course addresses how animal behavior has evolved in response to ecological pressures in the environment. Topics covered in the course include competition, sexual selection, parent-offspring conflict, social interactions, and game theory. Laboratory work includes discussions of primary literature, activities in the classroom, and field excursions.

Term(s) Offered: Spring, Even Years

BIO 336 Fish Physiology and Behavior with Lab 4 Credits

Fish are the oldest, largest, and most diverse group of vertebrates on Earth. Humans have 5 senses, but most fish have 6 and some have 7. The physiology, anatomy, behavior, and ecology of fishes are discussed. Topics include locomotion, feeding, sensory biology, predator/prey interactions, communication, reproduction and extreme habitats like the deep sea and polar waters. Laboratory work is split between identification of specimens to become familiar with the major fish families of the Chesapeake region and investigations of fish behavior, including a multi-week independent project. Lab includes two all-day field trips, one to the largest fish collection in the world at the Smithsonian Museum of Natural History Support Facility and one to the Baltimore Aquarium.

Term(s) Offered: Spring, Odd Years

Fees: \$50 Lab Fee

BIO 350 Introduction to Toxicology with Lab 4 Credits

An introduction to the interdisciplinary field of toxicology at the molecular, environmental, and regulatory level. Basic concepts of toxicology including the history of poisons, dose-response, routes of exposure, and mechanisms of toxicity that pertain to human health and the environment are covered. Emphasis is placed on information literacy to support problem-based and evidence-based learning and case studies are used to delve into the social, political, and global issues involved.

Term(s) Offered: Spring, Non Conforming

Fees: \$50 Lab Fee

BIO 351 Evolution with Lab 4 Credits

An in-depth examination of various components of evolutionary biology. Topics include (but are not limited to) evolutionary mechanisms, genetics, speciation, adaptation, extinction, evolutionary history, and analysis of evolutionary relationships. Laboratory exercises emphasize the discussion and analysis of primary literature articles supplemented by laboratory- and field-based observations.

Term(s) Offered: Spring, Non Conforming

Fees: \$50 Lab Fee

BIO 390 Biology Internship 4 Credits

An internship developed by a faculty mentor and student in close consultation with the supervisor at the internship site. A learning contract is developed prior to enrollment in the course. Evaluation of student performance is completed by the faculty mentor based on fulfillment of the contract terms and written evaluation by the internship site supervisor. Graded A-F. 45 hours per credit are required.

Term(s) Offered: All Terms, All Years

BIO 392 Biology Junior Seminar 0 Credits

Biology students participate with faculty in the department's weekly Biology Seminar in the spring semester of the junior year. Instruction focuses on searching the biological literature, reading of primary literature, and preparing students to be engaged in the Senior Capstone Experience. Zero credits.

Term(s) Offered: Spring, All Years

BIO 394 Special Topics 4 Credits

The study of areas in biology that are not regularly offered in the curriculum. Courses may be interdisciplinary, seminar or winter/summer field-type courses and will be designated as Category I, II or III, if there is a laboratory component.

Term(s) Offered: All Terms, All Years

Fees: \$50 Lab Fee

BIO 395 On-Campus Guided Research 4 Credits

A ten-week on-campus summer research project to be guided by a faculty mentor. Based on mutual interests, the student and faculty mentor develop a research project, supported by a reading list and involving theoretical, laboratory, or field investigations. Participants produce a final report detailing the findings of their research. Selection of students depends on academic background, scholastic achievement, and the results of a personal interview with the faculty mentor. 45 hours per credit required. Graded A-F

Term(s) Offered: All Terms, All Years

BIO 396 Off-Campus Research 4 Credits

An individual research project chosen by the student in consultation with a faculty mentor. The project involves the design and performance of an experiment or experimental series and submission of a written report. 45 hours per credit are required. Graded A-F

Term(s) Offered: Summer, All Years

BIO 397 Independent Study 4 Credits

The in-depth study of an area of particular interest to a student and faculty mentor not covered by the regular curriculum. 45 hours per credit are required. Graded A-F.

Term(s) Offered: All Terms, All Years

BIO 404 Immunology with Lab 4 Credits

An overview of host defense systems. Topics include lymphoid organs, hematopoiesis, leukocyte structure and function, innate and adaptive immunity, antigens, antibodies; lymphocyte receptors, immunogenetics, the major histocompatibility complex, complement, vaccines, and immune disorders. The laboratory focuses on antigen-antibody interactions.

Term(s) Offered: Spring, All Years

Fees: \$50 Lab Fee

BIO 409 Biochemistry with Lab 4 Credits

The chemistry and metabolism of biological molecules. Students learn about the structure, function and metabolism of proteins, carbohydrates, and fats. Thermodynamics and enzyme-mediated catalysis are addressed, with an emphasis on how reaction rates and energetics affect biological processes and pathways. A laboratory is conducted weekly to introduce students to experimental techniques and molecular modeling.

Cross-listed as: BIO 409/CHE 309

Term(s) Offered: Fall, All Years

Fees: \$50 Lab Fee

BIO 424 Integrative Human Physiology with Lab 4 Credits

A holistic, integrative investigation into the major body systems of humans, examining human physiology through an integrative lens. Topics include gas exchange, circulation, water and ion balance, and excitable cells. Laboratory work consists of hands-on explorations of physiological phenomena, research techniques and technologies, and data analysis.

Term(s) Offered: Spring, All Years

Fees: \$50 Lab Fee

BIO 490 Biology Internship 4 Credits

An internship developed by a faculty mentor and student in close consultation with the supervisor at the internship site. A learning contract is developed prior to enrollment in the course. Evaluation of student performance is completed by the faculty mentor based on fulfillment of the contract terms and written evaluation by the internship site supervisor. Graded A-F. 45 hours per credit are required.

Term(s) Offered: All Terms, All Years

BIO 494 Special Topics 4 Credits

The study of areas in biology that are not regularly offered in the curriculum. Courses may be interdisciplinary, seminar or winter/summer field-type courses and will be designated as Category I, II or III, if there is a laboratory component.

Term(s) Offered: All Terms, All Years

BIO 495 On-Campus Guided Research 4 Credits

A ten-week on-campus summer research project to be guided by a faculty mentor. Based on mutual interests, the student and faculty mentor develop a research project, supported by a reading list and involving theoretical, laboratory, or field investigations. Participants produce a final report detailing the findings of their research. Selection of students depends on academic background, scholastic achievement, and the results of a personal interview with the faculty mentor. 45 hours per credit required. Graded A-F

Term(s) Offered: All Terms, All Years

BIO 496 Off-Campus Research 4 Credits

An individual research project chosen by the student in consultation with a faculty mentor. The project involves the design and performance of an experiment or experimental series and submission of a written report. 45 hours per credit are required. Graded A-F

Term(s) Offered: All Terms, All Years

BIO 497 Independent Study 4 Credits

The in-depth study of an area of particular interest to a student and faculty mentor not covered by the regular curriculum. 45 hours per credit are required. Graded A-F.

Term(s) Offered: All Terms, All Years