

Biology

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Program Description

The Biology curriculum offers a wide variety of courses and laboratory experiences, combining a strong foundation in basic biological concepts and principles with opportunities to specialize in students' areas of interest.

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The broad curriculum encompasses cell biology, genetics, physiology, microbiology, immunobiology, developmental biology, neurobiology, animal behavior, ecology, and evolution, among other fields.

[Student research](#) in collaboration with a faculty mentor is a central part of the learning experience.

Students who conduct research often co-author papers with faculty and present their work to the campus or at scientific meetings. This hands-on engagement with the practice of science provides invaluable preparation for graduate school and careers in biology and related fields.

Modern scientific instrumentation supports all study and research in biology. Students use the same tools that practicing scientists use, such as electron and other specialized microscopes, ultracentrifuges and other molecular equipment, a greenhouse, environmental chambers, and other [facilities and resources](#).

Gettysburg biology majors have an outstanding record of success in the nation's leading graduate and professional schools, in medicine, in science-related careers, and in many other fields.

Program Requirements

Students who major in biology may pursue a Bachelor of Arts degree or a Bachelor of Science degree.

All courses taken to satisfy the requirements for the B.A. or B.S. degree or for the minor must be taken using the A-F grading system (except for Bio 461 which can be taken Satisfactory/Unsatisfactory).

Requirements for the Bachelor of Arts (B.A.) in Biology

- **Nine courses in Biology**, which include:
 - The four-course core sequence: Biology 111, 112, 211, and 212
 - One course from each of these three areas:
 - Cellular/Molecular (Biology 114, 215, 230, 251, 320, 332, 334, 335, 340, 351)
 - Organismal (Biology 202, 204, 217, 218, 223, 224, 227, 228)
 - Population/Community (Biology 205, 225, 240, 306, 307, 314, 316, 361, 390; ES 211, 350)
 - Two additional elective courses, selected from the areas listed above or in Research Methodology

(Biology 260*, 460, and 461)

Bio 111 (or 110, starting Fall '11) and 112 are prerequisites for all upper level Biology courses.

Bio 113 can substitute for Bio 111 (or Bio 110)

Bio 110 is intended as a prerequisite to Bio 112 for non-Biology majors.

• **Four courses in related departments, to include:**

- Chemistry 107 (or 105) and 108 - to be typically taken in the first year
- A mathematics course, selected from: Biology 260*; Mathematics 105-106, 107, 111, 112
- One elective, selected from: Chemistry 203, 204; Chem/Phy 246; Computer Science 111 (or 107); Environmental Studies 223; Physics 103, 104 or 109; 110, 111, or 112; Psychology 236, 237, or 238

*Note: If Biology 260 is chosen to meet the mathematics course requirement, it may not also count as a biology elective course.

- **A Capstone Experience** - Fulfilled by Biology 307, 314, 320, 334, 340, 351, 460, or 461. All of these courses require independent research as well as a research or review paper.
- **Interdisciplinary Course Cluster** - Fulfilled by the successful completion of Chemistry 108 and Biology 212 or other student-proposed course combinations.

Requirements for the Bachelor of Science (B.S.) in Biology

Students seeking the B.S. in Biology must fulfill all of the requirements listed for the B.A., plus the following:

- **One additional elective biology course** (for a total of 10 biology courses)
- **One additional course in a related department** (from the above list for a total of five courses in related departments - only one of the CS courses can count for the Biology major)

For those considering graduate or medical school

Students applying to some graduate school or medical school programs are required to complete two years of Chemistry (105 or 107, 108, 203, 204), one year of Physics (103-104 or 109-110 or 111-112), and one course in Mathematics (105-106, or 111). Students who complete these courses only need 5 Biology electives for the B.S., or 4 Biology electives for the B. A.

Requirements for the Minor in Biology

Students qualify for a minor in Biology by completing six courses in Biology:

- Biology 111 (or 110, starting Fall '11) and 112. Both courses with at least a C- grade.
- Four additional Biology courses that count toward the major.

Students selecting upper-level courses to meet the requirements for the minor must also fulfill any prerequisites that may be required for those courses

Course Listing

Course level:

100 | 200 | 300 | 400

BIO-101 Basic Biological Concepts

Course covers basic topics in cell biology, bioenergetics, gene expression, and patterns of inheritance with a focus on important topical issues. Designed for nonscience majors. Laboratory emphasizes the experimental nature of biological investigation. Three class hours and laboratory. Students may not receive credit for both BIO 101 and BIO 110.

BIO-102 Contemporary Topics in Biology: Biological Basis of Disease

Designed for nonscience majors. Course covers selected biological topics related to human diseases and focuses on contemporary problems and their possible solutions. Three class hours and laboratory.

BIO-103 Contemporary Topics in Biology: Plants and Society

Designed for nonscience majors. Course covers selected biological topics related to the importance of plants to humans.

BIO-110 Introductory Biology: Molecules, Genes & Cells

Introduction to cell biology, bioenergetics, gene expression, and patterns of inheritance with a focus on important topical issues. Laboratory emphasizes the experimental nature of biological investigation. Students not majoring in biology but who are interested in the health professions may, with a grade of C- or better in Biology 110, enroll in Biology 112. Three class hours and laboratory. Students may not receive credit for both BIO 101 and BIO 110.

BIO-111 Introduction To Ecology and Evolution

Designed to introduce students to general biological principles, with a focus on ecology and evolution. Topics include adaptation, nutrient cycling and energy flow, population growth and species interactions, Mendelian and population genetics, speciation, and the history of life. Laboratory emphasizes the experimental nature of biological investigation. Designed for science majors with a high school background in biology, chemistry, and mathematics. Three class hours and laboratory.

BIO-112 Form and Function in Living Organisms

Designed for science majors. Morphology and physiology of plants and animals are emphasized. Lecture and laboratory topics include nutrition, energetics, internal regulation, neural and hormonal integration,

and reproduction. Prerequisite: Bio 111, or 101 (prior to Fall 11), Bio 110 (starting Fall 11), with a C- or better. Three class hours and laboratory.

BIO-113 Introduction to Phage Biology

Designed to introduce potential science majors to general biological principles – cell biology, gene expression, inheritance, ecology and evolution. Laboratory emphasizes the experimental nature of biological investigation using the biology of viruses (bacteriophages) and their bacterial hosts as a model. Six lecture/laboratory hours, and two discussion hours.

BIO-114 Phage Genomics

Covers basic topics in genome science, focusing on describing and annotating a newly sequenced phage genome obtained by students in the previous fall semester. Designed for science majors. Laboratory emphasizes the experimental nature of biological investigation. Three lecture/computer laboratory class hours. Pre-requisite Bio 113.

BIO-118 The Chemistry of Life

Taught in coordination with CHEM 118, this class covers the fundamental principles of chemical reactivity and explores how those principles enlighten our understanding of modern biological processes, with an emphasis on the physiological function of the major organ systems. Both lectures and labs integrate chemistry and biology to convey a holistic view of how these subjects interrelate to resolve current questions in science. Students must take BIO 118 and CHEM 118 concurrently. Equivalent to BIO 112.

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BIO-202 Structural Plant Development

Anatomical approach to the study of higher plant structures. The origin and differentiation of tissues and organs, environmental aspects of development, and plant anomalies are studied. Six hours in class-laboratory work.

BIO-204 Biology of Flowering Plants

Identification, classification, structural diversity, ecology, and evolutionary relationships of the angiosperms. Course includes field work for collection and identification of local flora. Three class hours and laboratory-field work.

BIO-205 Ecology

Principles of ecology, with emphasis on three levels of the biological hierarchy-organisms, populations, and communities-that are needed to understand the factors that determine the abundance and distribution of any species. Course includes a number of field trips. Three class hours and laboratory-field work. Credit cannot be received for both this course and Environmental Studies 211.

BIO-211 Genetics

Overview of principles of genetics. Topics include chemical nature of genes, Mendelian and non-Mendelian inheritance, gene regulation, genetic engineering, molecular evolution, and population genetics. Three class hours and laboratory. Prerequisite: Bio 112 with a grade of C- or better and Chem 107.

BIO-212 Cell Biology

Structure and function of eukaryotic cells. Topics include protein structure, enzyme function, membrane structure and transport, protein sorting, energy transduction by mitochondria and chloroplasts, chromosome structure, cell division and cell-cycle control, cell communication, cell motility, and cell biology of cancer. Three class hours and laboratory. Prerequisite: Bio 112 and Chem 108 with a grade of C- or better in both courses.

BIO-215 Electron Microscopy

Introduction to basic theory and practice of transmission and scanning electron microscopy, techniques of tissue preparation, and introduction to interpretation of animal and plant ultrastructure. Each student is required to complete an independent project. Six hours in class-laboratory work. Prerequisite: Permission of instructor.

BIO-217 An Evolutionary Survey of the Plant Kingdom

Synopsis of embryo-producing plants, primarily liverworts, mosses, fern allies, ferns, and seed plants. Emphasis is on comparative morphology or vegetative and reproductive characters, unique features, and evolutionary trends in plants. Six hours in class-laboratory work.

BIO-218 Biology of Algae and Fungi

Study of algae (phycology) and fungi (mycology) in aquatic and terrestrial ecosystems with emphasis on their role in primary production and decomposition. Topics include identification, morphology,

reproduction, ecology, and phylogeny of these organisms. Culture techniques and principles of plant pathology and medical mycology are also considered. Six hours in class-laboratory work.

BIO-221 Symbiosis

Exploration of common themes in symbiotic associations between organisms, techniques used to investigate these relationships, and future trends of this increasingly important field of biology. Topics include components of animal behavior, development, genomics, evolution, and ecology. Primarily a lecture format although will also include in-class demonstrations, and projects on a local salamander-algal symbiotic association. These projects will occasionally require a greater time commitment than the scheduled class meetings. Prerequisite: Biology 112.

BIO-223 Parasitology

Introduction to the general principles of parasitism, with emphasis on the epidemiology, taxonomy, morphology, and physiology of the major groups of protozoan, helminth, and arthropod parasites of humans and other animals. Three class hours and laboratory.

BIO-224 Vertebrate Zoology

Introduction to systematics, distribution, reproduction, and population dynamics of vertebrates. Field and laboratory emphasis on natural history, collection, and identification. Optional trip to North Carolina. Six hours in class, laboratory, and field work.

BIO-225 Animal Behavior

Study of animal behavior through readings, discussions, and field and laboratory observations. Phenomena considered range from simple reflex response to complex social organization. Role of behavioral adaptations in the biology of animal species is emphasized. Three class hours and laboratory.

BIO-227 Invertebrate Zoology

Study of the structure, physiology, and behavior of the major groups of animals representing 99 percent of the animal kingdom. Focus is on functional morphology and evolutionary adaptation. Course includes individual or group research projects. Six hours in class-laboratory work.

BIO-228 Tropical Marine Biology

Biology of tropical marine organisms and study of the geological, chemical and physical processes in

tropical marine ecosystems. Course requires a 2-week summer field/lab program at a marine research station in the Bahamas (additional costs). In the field, the students snorkel to observe diverse marine organisms in habitats such as coral reefs and rocky/sandy intertidal zones. Prerequisite: Permission of the instructor.

BIO-230 Microbiology

Biology of viruses and bacteria, with emphasis on morphology, metabolism, taxonomy, reproduction, and ecology. Laboratory includes isolation, culture, environmental influences, identification, and biochemical characterization of bacteria and their viruses. Three class hours and laboratory.

BIO-240 Paleobiology

Paleobiology. Diversity, biology and ecology of ancient life; the major biological and geological changes that had a significant impact on our evolutionary history and the key geological and physical processes that shaped our earth during its 4.5 billion year history. Laboratory component introduces students to the techniques required for the proper collection, preservation, identification and cataloging of fossils; and involves visits to local fossil collection sites and museums. Students are required to develop a personal fossil collection during this course.

BIO-251 Introduction to Bioinformatics

Introduction to the emerging field of bioinformatics, where biology and computer science intersect to interpret and use the rapidly expanding volume of biological information produced by genome sequencing and proteomic exploration of life processes. Application of bioinformatic software tools to the analysis of gene sequences and protein structures is emphasized. Students undertake a laboratory project combining in silico and in vitro approaches to isolate and then analyze a segment of their own DNA. An introduction to computer algorithms used in bioinformatic software is provided. Three class hours and laboratory. Biology 251 and CS 251 are cross-listed.

BIO-260 Biostatistics

Designed for students in biology who plan to engage in individualized study and/or research. Topics include the nature of biological data and the statistical procedures to analyze them. Special attention given to experimental design and hypothesis testing. Three class hours and one hour discussion. Credit cannot be received for both this course and Health Science 232, Mathematics 107, Psychology 205, or Economics 241.

BIO-290 Mentored Research Internship

Quarter credit internship graded S/U.

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BIO-306 Marine Ecology

Analysis of the ecology of marine systems. The open ocean, estuaries, salt marshes, beaches, mud and sand flats, seagrass beds, rocky shores, coral reefs, and deep sea are examined. Problems of pollution, beach erosion, and the management of declining fisheries is also presented. Quantitative field work in a variety of coastal habitats is conducted on a required field trip to Duke University Marine Laboratory and the Outer Banks barrier island chain. Three class hours and laboratory-field work. Alternate years.

Prerequisite: ES 211.

BIO-307 Freshwater Biology

Study of the physical, chemical, and biological characteristics of inland waters. Topics include nutrient cycling, biological interactions, and effects of human activities. Course includes individual research projects and a number of field trips. Six hours in class, laboratory, and field work. Capstone Course.

Prerequisite: Junior or Senior Standing.

BIO-314 Evolution

Study of the transformation and diversification of populations through time. Topics include history of life, adaptation, selection and population genetics, speciation and extinction, evolutionary innovations, and patterns of diversity. Three class hours and laboratory. Capstone course. Prerequisite: Bio 211.

BIO-316 Conservation Biology

A discipline comprising pure and applied science, which focuses on the preservation of biological diversity. Focus implicitly recognizes that preserving the genetic and ecological features of a species requires preservation of that species' niche. Topics include food web organization, spatial heterogeneity and disturbance, consequences of small population size and inbreeding, captive propagation, demographics of population growth, and species reintroduction and management. Prerequisite:

Environmental Studies 211.

BIO-320 Development Biology

Survey of the phenomena and principles of animal development. Major attention is given to the genetic and cellular mechanisms that control cell differentiation and the development of form in several model

organisms. Vertebrates are emphasized in the study of organ development. Three class hours and laboratory. Capstone course. Prerequisite: Bio 211 and 212.

BIO-332 Immunobiology

Introduction to the vertebrate immune system at the molecular, cellular, and organismal levels. Antibody structure, antigen-antibody interaction, the genetics of antibody diversity, the immune response, and the bases of self/non-self discrimination are emphasized. Three class hours. Prerequisite: Bio 211 and Bio 212.

BIO-334 Biochemistry II

Detailed survey of the primary and secondary metabolic processes in living cells. Topics discussed include the overall organization of metabolic pathways, carbohydrate and fatty acid metabolism, biological oxidation and reduction and energy production. Special attention is given to regulation, hormone action, metabolic disorders and disease. Laboratory work includes an independent research project. Three lecture hours and one laboratory afternoon. Capstone course for Biology majors. Prerequisite: for Chemistry majors Chem 333; for Biology majors Bio 212 and Chem 204 or permission of the instructor.

BIO-335 Neurobiology

An exploration of the biological basis of brain function, including: electrical and chemical signaling of nerve cells; modulation and plasticity of signaling occurring in different behavioral states or during learning; and the structure, function, and development of circuits of interconnected nerve cells involved in sensory perception and motor coordination. Emphasis is placed on the behavioral and clinical aspects of modern neurobiology: how particular properties of the brain underlie specific behaviors, and how malfunctions of neural mechanisms lead to various neurological disorders. Prerequisite: Bio 212 with a C- or better or Bio 112 and Psych 236 both with a C- or better.

BIO-340 Comparative Animal Physiology

Regulation of basic physiological processes in animals. Unifying principles are studied using a comparative approach. Three class hours and laboratory. Credit cannot be received for both this course and HES 210. Capstone course. Prerequisite: grade of C or better in Bio 212.

BIO-351 Molecular Genetics

Study of the basic mechanisms of information storage and retrieval from DNA and RNA. Topics include

genome organization and the regulation of gene expression in prokaryotes and eukaryotes; DNA replication and repair; molecular genetics of cancer and human-inherited disorders; and recombinant DNA technology. Three class hours and laboratory. Capstone course. Prerequisite: Bio 211 and 212.

BIO-361 Evolutionary Medicine

Study of the application of evolutionary thinking to human health issues. Topics to be covered include evolution of pathogens and virulence; mal-adaptations to modern lifestyles; genetic conflicts associated with reproduction including pregnancy; evolution of aging and age-related diseases. Seminar will address if and when medical treatment or public health policies benefit from incorporating an evolutionary perspective. Prerequisite: Bio 211 and Bio 212.

BIO-390 Ecology, Evolution, and Molecular Biology of Viruses

Viruses are the most diverse group of organisms on the planet. This course will introduce students to this diversity with respect to both virus structure and virus/host interactions. In addition it will integrate this systematic knowledge with an understanding of the processes that generate and maintain viral diversity. The laboratory component of the course will introduce students to the techniques required for the isolation and culture of viruses in the laboratory, the visualization of viruses via transmission electron microscopy, and the bioinformatic analysis of viral nucleic acid sequences. Prerequisite: Bio 211 and Bio 212.

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BIO-450 Individualized Study-Tutorial

Individualized tutorial counting toward the minimum requirements in a major or minor, graded A-F

BIO-451 Individualized Study-Tutorial

Individualized tutorial counting toward the minimum requirements in a major or minor, graded S/U

BIO-452 Individualized Study-Tutorial

Individualized tutorial not counting in the minimum requirements in a major or minor, graded A-F

BIO-453 Individualized Study-Tutorial

Independent investigation of a topic of special interest, directed by a faculty member familiar with the general field of study. May be used as preparation for enrollment in Biology 460. Prerequisite: Approval

of directing faculty member.

BIO-460 Individualized Study-Research

Independent investigation of a topic of special interest, normally including both literature and laboratory research. Directed by a faculty member. Results of investigation are presented to the department. Open to juniors and seniors. Capstone course Prerequisite: Approval of both the directing faculty member and department.

BIO-461 Individualized Study-Research

Individualized research counting toward the minimum requirements in a major or minor, graded S/U
Capstone course

BIO-462 Individualized Study-Research

Individualized research not counting in the minimum requirements in a major or minor, graded A-F

BIO-463 Individualized Study-Research

Individualized research not counting in the minimum requirements in a major or minor graded S/U

BIO-470 Individualized Study-Internship

Internship counting toward the minimum requirements in a major or minor, graded A-F

BIO-471 Individualized Study-Internship

Internship counting toward the minimum requirements in a major or minor, graded S/U

BIO-472 Individualized Study-Intern

Internship not counting in the minimum requirements in a major or minor, graded A-F

BIO-473 Individualized Study-Intern

Independent internship experience under the direct supervision of professional personnel in a variety of biology-related areas. Internship may be arranged by the department or the student. Must combine practical work experience with an academic dimension. Library research paper on a subject related to the

experience is required. Prerequisite: Approval of both supervisor and department. Contact Center for Career Development for application and further assistance.

BIO-474 Summer Internship

Summer Internship graded A-F, counting in the minimum requirements for a major or minor only with written permission filed in the Registrar's Office.

BIO-475 Summer Internship

Summer Internship graded S/U, counting in the minimum requirements for a major or minor only with written permission filed in the Registrar's Office

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