

# BIOLOGY

The curriculum of the Biology Department is designed to introduce the student to the breadth of the discipline of biology and to provide the foundation for further study in biology. A core sequence of courses introduces the student to genetics, cell biology, organismal biology, and ecology. The student may then choose elective courses in areas relevant to his career interests. The biology major is designed to prepare the student for graduate or professional work in biology, as well as other careers such as law or business. We emphasize the process of biological science through course content, laboratory and field work, independent study, and summer research with faculty. The capstone course, BIO-401 Senior Seminar, immerses the student in the primary literature in biology and hones the skills needed for critical analysis of new information in biology.

For the non-major, we offer a number of opportunities to study biology and to gain experience with the process of scientific inquiry. For the student looking for a laboratory course for distribution, BIO-101 Human Biology introduces the basic concepts of biology by examining the biology of humans. This course can also be used as an entry point for additional work in biology since it is a prerequisite for several courses in the department. BIO-102 Plants & Human Affairs, BIO-103 Environmental Science, BIO-151 Intro to Evolution, and irregularly offered special topics courses at the 100 level (BIO-177 Special Topics (without Lab) or BIO-178 Special Topics (with Lab) are also appropriate for non-majors.

## Student Learning Goals

**Content Knowledge and Conceptual Understanding:** Provide all biology majors with a broad body of knowledge in the general field of biology, with some experience in cell and molecular biology, genetics, ecology, and an area of organismal biology, as well as foundational coursework in chemistry and physics. A student may choose to further specialize in a biological subdiscipline of his choice.

**Critical Thinking & Analytical Skills:** Help students learn how to think and investigate like a biologist.

**Science Communication Skills:** Teach students to know how to best communicate their 'content and process' knowledge.

**Professional Training:** Prepare majors for careers in science, particularly those demanding advanced training.

**Attitudes and Habits of Mind:** Model and cultivate in students an intellectual curiosity about biology and its role in our larger society. Develop a sense of community among biology majors.

## Requirements for the Major

Code	Title	Credits
<b>Core</b>		
Introductory Courses: <sup>1</sup>		
BIO-111	General Biology I	1
BIO-112	General Biology II	1
Genetics and Cell Biology: <sup>2</sup>		
BIO-211	Genetics	1
BIO-212	Cell Biology	1
Ecology: <sup>3</sup>		
BIO-213	Ecology	1
Organismal Biology (select one from the following): <sup>4</sup>		
		1

BIO-321	Comparative Anatomy & Embryology	
BIO-322	Biology of Invertebrates	
BIO-324	Vascular Plants	
BIO-325	Microbiology	
BIO-326	Parasitology	
Senior Seminar: <sup>5</sup>		
BIO-401	Senior Seminar	1
Biology Electives		2
<b>Total Credits</b>		<b>9</b>

Code	Title	Credits
<b>Collateral Requirements</b>		
PHY-109	Physics I - Algebra or PHY-110 Physics II - Algebra or PHY-111 Physics I - Calculus	1
CHE-111	General Chemistry	1
CHE-221	Organic Chemistry I	1
<b>Total Credits</b>		<b>3</b>

<sup>1</sup> These courses should be completed during the freshman year.

<sup>2</sup> Should be completed during the sophomore year.

<sup>3</sup> Normally completed during the first semester of either the junior or senior year

<sup>4</sup> To be completed before taking comprehensive exams

<sup>5</sup> Usually, BIO-401 Senior Seminar is taken during the fall semester of the senior year. Students who will be off-campus during the first semester of their senior year should take BIO-401 Senior Seminar during the fall semester of their junior year.

## Supporting the Biology Curriculum

Biology majors must complete 2 additional course credits for a total of nine course credits in biology. These credits may be compiled from the following:

Code	Title	Credits
BIO-311	Molecular Genetics	1
BIO-313	Advanced Ecology	1
BIO-314	Developmental Biology	1
BIO-315	Organismal Physiology	1
BIO-316	Evolution of Developmental Mechanisms	1
BIO-321	Comparative Anatomy & Embryology	1
BIO-322	Biology of Invertebrates	1
BIO-324	Vascular Plants	1
BIO-325	Microbiology	1
BIO-326	Parasitology	1
BIO-351	Evolution of Populations	1
BIO-387	Independent Study	0.5
BIO-388	Independent Study	0.5

Because most of these courses (BIO-311 Molecular Genetics, BIO-313 Advanced Ecology, BIO-314 Developmental Biology, BIO-315 Organismal Physiology, BIO-316 Evolution of Developmental Mechanisms, BIO-321, BIO-322, BIO-324, BIO-325, BIO-326, BIO-351 Evolution of Populations) are offered in alternate years, students must carefully plan their curriculum (in consultation with a Biology Department faculty member). In some years, one or more special topics courses (BIO-371 Special Topics) may

be offered and may be used to complete the major. Descriptions of these courses will be provided to students and advisors before pre-registration.

Students interested in biological research are encouraged to undertake independent study (BIO-387 Independent Study, or BIO-388 Independent Study) during their junior or senior year. Well-prepared students may begin Biology independent study before their junior year.

Beyond the nine course credits required for the biology major, students may include two additional biology course credits to satisfy graduation requirements. Students interested in graduate school in biology are encouraged to consider this option.

### Supporting Physics, Chemistry, and Mathematics/Computer Science Curricula

PHY-109 Physics I - Algebra, PHY-110 Physics II - Algebra, or PHY-111 Physics I - Calculus, and CHE-111 General Chemistry and CHE-221 Organic Chemistry I, are required for Biology majors. **Biology majors may not use the CC/NC option for these co-requisites.**

Usually CHE-111 General Chemistry is taken during the sophomore year, and the physics course, CHE-221 Organic Chemistry I and CHE-321 Organic Chemistry II are taken during the junior year. Students intending to proceed to a professional or a graduate school should plan to include MAT-110 Calc I With Pre-Calc Review or MAT-111 Calculus I, a second physics course, and CHE-221 Organic Chemistry I CHE-321 Organic Chemistry II, and CHE-331 Analytical Chemistry or CHE-361 Biochemistry (depending on interests) in their curriculum.

MAT-112 Calculus II, CSC-111 Intro to Programming, and a statistics course (MAT-254 Statistical Models or DV3-252 Stats Soc Sciences) may be important support courses for some Biology majors. Students are encouraged to consult with an academic advisor or the Biology department chair to determine the appropriate plan of study.

### Comprehensive Exam in Biology

Students must pass a two-day written comprehensive exam in biology. On the first day, students write on a series of recent papers from the primary literature, drawing upon the breadth and depth of their knowledge of biology. On the second day, they answer a series of questions on specific courses. Students must complete BIO-211 Genetics, BIO-212 Cell Biology, BIO-213 Ecology and their organismal biology course on campus before the spring of their senior year.

### Off-Campus Study

Students who wish to take biology courses at other institutions to be credited towards graduation should first discuss their options with their advisor and then *obtain permission from the Biology department chair.*

### Summer Field Study

Scholarship funds are available through the Lucy B. Graves Fund as scholarships for students to study at marine biological laboratories. The Robert O. Petty Fund and the E.W. Olive Fund support internships in field biology. Interested students should talk with the department chair.

### AP Credit

Students who scored a 5 on the Biology AP exam may be eligible to receive credit for an introductory biology course. Interested students should meet with the Department Chair to complete the necessary steps. In general, students planning to major in Biology or Biochemistry will be asked to take a comprehensive final exam for BIO-111 and submit a lab report from an experiment conducted in high school. A student

earning 85% or better on each of these may initiate the Biology major (or the Biology requirements for the Biochemistry major) by taking BIO-211 as his first Biology course. A student earning a grade of B- or higher in BIO-211 will then earn back credit for BIO-111. (He will need to enroll in BIO-112 the following semester to continue in the Biology or Biochemistry major.)

## Requirements for the Minor

Code	Title	Credits
BIO-111	General Biology I	1
BIO-112	General Biology II	1
Three additional course credits in Biology		3
At least one of these courses must be a course in organismal biology from the following:		
BIO-321	Comparative Anatomy & Embryology	
BIO-322	Biology of Invertebrates	
BIO-324	Vascular Plants	
BIO-325	Microbiology	
BIO-326	Parasitology	

**Total Credits** **5**

Students who wish to initiate a biology minor via the BIO-101 Human Biology course will complete four additional courses, including an organismal course.

#### BIO-101 Human Biology

A one-semester course offered primarily for majors in the social sciences and the humanities. This course will emphasize reproduction and development, structure/function, genetics, and evolution. The ethical implications of biological knowledge also will be considered. In the laboratory, students will investigate biological problems related to humans. Three lecture/discussions and one laboratory period weekly. A student who decides, on the basis of his experience in BIO-101, to major in biology can enroll in the appropriate semester of BIO-111 or 112.

**Prerequisites:** none

**Corequisites:** BIO-101L

**Credit:** 1

**Distribution:** Science Lab

#### BIO-102 Plants & Human Affairs

This lab science course is intended primarily for students not planning to major in the natural sciences. The course will provide an introduction to botany and will use that foundation to explore the emerging evidence on how plant phenology, physiology, and diversity may be affected by climate change. The laboratory portion of the course will include field and lab work, providing opportunities to hone students' observational skills and familiarity with experimental design and implementation. Laboratory and in-class exercises will give students practice in analyzing and interpreting data.

**Prerequisites:** none

**Corequisites:** BIO-102L

**Credit:** 1

**Distribution:** Science Lab

**BIO-103 Environmental Science**

This course surveys major environmental issues and the role of scientific inquiry in understanding and mitigating these problems. The course will explore specific topics including energy generation and use, water quality, agriculture, biodiversity, and climate change. For each topic, students will (1) learn about the causes and consequences of the problem in the context of basic biology and other natural sciences, (2) participate in and critically evaluate the collection and interpretation of data on the problem, and (3) discuss and critique potential responses to the problem. Laboratory activities will include collecting and analyzing environmental samples, exploring data available in public repositories, and visiting local sites to observe environmentally related activities in the area.

**Prerequisites:** none

**Corequisites:** BIO-103L

**Credit:** 1

**Distribution:** Science Lab,

**Equated Courses:** GHL-103

**BIO-111 General Biology I**

First semester of a two-course sequence in the concepts of biology for biology majors. This course is a prerequisite for all advanced courses in biology. BIO 111 covers biomolecules, cell biology, genetics, and evolution. Three lectures and one laboratory period weekly. Offered in the fall semester.

**Prerequisites:** none

**Corequisites:** BIO-111L

**Credit:** 1

**Distribution:** Science Lab, Quantitative Literacy

**BIO-112 General Biology II**

This is the second semester of a two-course sequence in the concepts of biology for biology majors. This course is a prerequisite for most advanced courses in biology. BIO 112 covers animal and plant structure/function relationships and evolution and diversity. Three lectures and one laboratory period weekly. This course is offered in the spring semester.

**Prerequisites:** BIO-111

**Corequisites:** BIO-112L

**Credit:** 1

**Distribution:** Science Lab

**BIO-151 Intro to Evolution**

This is a course designed to provide a basic introduction to the processes of evolutionary change and the pattern of biological diversity. Lecture/discussion will focus on the evidence for evolution, including case studies from a variety of organisms. This course is designed for students not planning to major in Biology and will not count toward the requirements for the Biology major, but it may count toward the Biology minor. This course is typically offered in the spring semester of even-numbered years.

**Prerequisites:** BIO-101 or BIO-111

**Credit:** 1

**BIO-177 Special Topics (without Lab)**

A special topics course with laboratory for non-majors. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

**Prerequisites:** none

**Credit:** 1

**BIO-178 Special Topics (with Lab)**

A special topics course with laboratory for non-majors. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings.

**Prerequisites:** none

**Corequisites:** BIO-178L

**Credit:** 1

**BIO-187 Independent Study**

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

**Prerequisites:** none

**Credits:** 0.5

**BIO-188 Independent Study**

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

**Prerequisites:** none

**Credits:** 0.5

**BIO-202 Electron Microscopy**

A laboratory course covering specimen preparation, microtomy, staining, operation of the transmission and scanning electron microscope, and darkroom methods.

**Prerequisites:** BIO-101 or BIO-112

**Corequisites:** BIO-202L

**Credits:** 0.5

**BIO-211 Genetics**

This is a course designed to introduce the modern concepts of the gene. The lectures stress the theory and experimental evidence relating to transmission, molecular, and developmental genetics. The laboratory is investigative in nature. This course should be taken during the sophomore year and is offered in the fall semester.

**Prerequisites:** BIO-112

**Corequisites:** BIO-211L

**Credit:** 1

**Distribution:** Science Lab, Quantitative Literacy

**BIO-212 Cell Biology**

The primary emphasis of this course is the structure and function of the eukaryotic cell. Lectures, readings, and discussions will cover cellular organelles, types, metabolism, interactions, and regulation of activities. The laboratory focuses on cellular structure and function through the techniques of modern cell biology. This course should be taken during the sophomore year and is offered in the spring semester.

**Prerequisites:** BIO-211 or BIO-213

**Corequisites:** BIO-212L

**Credit:** 1

**Distribution:** Science Lab, Quantitative Literacy

**BIO-213 Ecology**

This course is an introduction to the interrelations of plants and animals with their environment. Terrestrial and aquatic ecosystems are considered. Some weekend field trips may be included. This course is offered in the fall semester.

**Prerequisites:** BIO-112

**Corequisites:** BIO-213L

**Credit:** 1

**Distribution:** Science Lab, Quantitative Literacy

**BIO-287 Independent Study**

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

**Prerequisites:** none

**Credits:** 0.5

**BIO-288 Independent Study**

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

**Prerequisites:** none

**Credits:** 0.5

**BIO-311 Molecular Genetics**

This is a course designed to explore in detail the molecular biology of the gene. Lecture/discussion will focus on areas of current interest and will include analysis of experimental evidence which underpins our understanding of gene structure and function. The laboratory is investigative in nature and provides primary experience with recombinant DNA technology, genomics, and bioinformatics.

**Prerequisites:** BIO-211

**Corequisites:** BIO-311L

**Credit:** 1

**BIO-313 Advanced Ecology**

This course emphasizes the investigative approach to ecology including experimental design and data analysis. Lectures/discussions focus on areas of current interest in ecosystem, community, and population ecology. Several field trips and an independent investigation are required. This course is offered in the spring semester of even-numbered years.

**Prerequisites:** BIO-213

**Corequisites:** BIO-313L

**Credit:** 1

**Distribution:** Science Lab

**BIO-314 Developmental Biology**

Through lectures, current readings, and discussions, this course considers the principles of development with emphasis on experimental evidence for underlying mechanisms. The laboratory work includes molecular, cellular, and supracellular approaches to the investigation of developmental questions in animals and plants.

**Prerequisites:** BIO-211

**Corequisites:** BIO-314L

**Credit:** 1

**BIO-315 Organismal Physiology**

The major physiological systems (nutrition, transport, gas exchange, elimination of wastes, coordination, and defense) are considered from the adaptational perspective in this course. The emphasis is on the physiological system as it is related to the survival of vertebrates in their natural environments. The laboratory focuses on physiological techniques and methods of analysis. This course is offered fall semester of even-numbered years.

**Prerequisites:** BIO-212

**Credit:** 1

**BIO-316 Evolution of Developmental Mechanisms**

Research into embryogenesis has illuminated the molecular mechanism of development for a select few organisms in exquisite detail. The field of Evolutionary Developmental Biology compares the developmental mechanisms of these model systems to distinct, understudied taxa. Using this comparative approach, we can infer the characteristics of the common ancestors of these organisms. In this course, we will explore how molecular, paleontological and evolutionary techniques can yield insights into animals that existed half a billion years ago. Evaluations will be based on discussion of primary literature and several short papers.

**Prerequisites:** BIO-211

**Credit:** 1

**BIO-321 Comparative Anatomy & Embryology**

This is a course presenting a broad evolutionary theme of the vertebrates using the facts of comparative anatomy, embryology, and paleobiology.

**Prerequisites:** BIO-112

**Corequisites:** BIO-321L

**Credit:** 1

**Equated Courses:** BIO-221

**BIO-322 Biology of Invertebrates**

This is a course designed to provide students with an introduction to the diversity of invertebrate organisms through lectures, reading and discussion of primary literature, student presentations, and laboratory work. Emphasis is placed on structure, functional morphology, physiology, ecology, and evolution. A field trip during spring break has been included in the past few years. This course is offered in the spring semester of odd-numbered years.

**Prerequisites:** BIO-112

**Credit:** 1

**Equated Courses:** BIO-222

**BIO-324 Vascular Plants**

This course is an introduction to the science of botany. A strong emphasis will be placed on the evolutionary trends in the vascular plants, with additional coverage of developmental biology, plant breeding systems, and some of the physiological adaptations plants have evolved in the transition to life in terrestrial environments. The laboratories will be primarily observational (in the field or the lab), with a broad exposure to plant diversity and taxonomy. This course is offered in the spring semester of even-numbered years.

**Prerequisites:** BIO-112

**Corequisites:** BIO-324L

**Credit:** 1

**Equated Courses:** BIO-224

**BIO-325 Microbiology**

This course is designed to introduce the student to the lifestyles and impact of the smallest organisms known. Lecture/discussion will examine topics such as microbial cell structure and function, growth and nutrition, genetics, antibiotics and pathogenesis, and microbial diversity. The laboratory is organized around an investigative, discovery driven project.

**Prerequisites:** BIO-211

**Corequisites:** BIO-325L

**Credit:** 1

**Distribution:** Science Lab

**Equated Courses:** BIO-225

**BIO-326 Parasitology**

This is a course designed to introduce students to the major groups of animal parasites. Emphasis in lectures and discussion of primary literature is placed on general principles, including diversity, morphology, transmission biology, and the ecology and evolution of the different parasite taxa. The laboratory work includes the detailed consideration of particular parasite species as representatives of larger groups, as well as an independent research project on the parasites of a selected host species. This course is offered in the fall semester.

**Prerequisites:** BIO-112

**Corequisites:** BIO-326L

**Credit:** 1

**Equated Courses:** BIO-226

**BIO-351 Evolution of Populations**

This course will provide an in-depth examination of the population-level effects of evolutionary processes. The first half of the semester will focus on examining advances in evolutionary biology, centered around a quantitative approach to understanding the principles of population genetics. The second half of the semester will involve close reading of primary literature focused on a narrow topic in population biology. Offered in the spring semester of odd-numbered years.

**Prerequisites:** BIO-211

**Credit:** 1

**BIO-371 Special Topics**

These are innovative courses and special programs in library research. Descriptions of special topics courses will be posted at the time of advance registration. Students desiring a special library research project should make the appropriate arrangements with individual faculty members. Refer to the Course Descriptions document on the Registrar's webpage for Topics and Descriptions of current offerings.

**Prerequisites:** BIO-212

**Credits:** 0.5-1

**BIO-387 Independent Study**

Students may pursue independent research on selected problems. Students should make arrangements with individual faculty members during the semester preceding their enrollment in the course to determine their research focus and to discuss expectations. Students are typically expected to produce a final research paper and to present the work at an on- or off-campus colloquium. Students may repeat BIO 387 and/or BIO 388, but only 1 credit total of Introduction to Research may be counted toward the major. Enrollment through Instructor and Department Chair approval.

**Prerequisites:** none

**Credits:** 0.5

**BIO-388 Independent Study**

Students may pursue independent research on selected problems. Students should make arrangements with individual faculty members during the semester preceding their enrollment in the course to determine their research focus and to discuss expectations. Students are typically expected to produce a final research paper and to present the work at an on- or off-campus colloquium. Students may repeat BIO 387 and/or BIO 388, but only 1 credit total of Introduction to Research may be counted toward the major. Enrollment through Instructor and Department Chair approval.

**Prerequisites:** none

**Credits:** 0.5

**BIO-401 Senior Seminar**

This is a seminar course required of all majors. Critical reading of primary literature, oral expression, and experimental design are emphasized. Students intending to be off-campus during the first semester of their senior year should take this course during their junior year. This course is offered in the fall semester.

**Prerequisites:** none

**Credit:** 1

**BIO-487 Independent Study**

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

**Prerequisites:** none

**Credits:** 0.5

**BIO-488 Independent Study**

Individual research projects. The manner of study will be determined by the student in consultation with the instructor. Students must receive written approval of their project proposal from a department Chair before registering for the course.

**Prerequisites:** none

**Credits:** 0.5

## Biology Faculty

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