

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. The core goals of the Biology Department are to help our majors develop:

- **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.

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-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 designed for non-majors.

Requirements for the Major

Core

Introductory Courses: ¹		
BIO-111	General Biology I	1
BIO-112	General Biology II	1
Genetics and Cell Biology: ²		
BIO-211	Genetics	1
BIO-212	Cell Biology	1
Ecology: ³		
BIO-213	Ecology	1
Organismal Biology: ⁴		

Select one from the following:		
BIO-221	Comp Anatomy & Embry	1
BIO-222	Biol of Invertebrates	
BIO-224	Vascular Plants	
BIO-225	Microbiology	
BIO-226	Parasitology	
Senior Seminar: ⁵		
BIO-401	Senior Seminar	1
Biology Electives		2
Total Credits		9

Collateral Requirements

PHY-109	Motion and Waves or PHY-110 Fluids and Fields or PHY-111 General Physics I	1
CHE-111	General Chemistry	1
CHE-221	Organic Chemistry I	1
Total Credits		3

- ¹ These courses should be completed during the freshman year.
- ² Should be completed during the sophomore year.
- ³ Normally completed during the first semester of either the junior or senior year
- ⁴ To be completed before taking comprehensive exams
- ⁵ 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:

BIO-221	Comp Anatomy & Embry	1
BIO-222	Biol of Invertebrates	1
BIO-224	Vascular Plants	1
BIO-225	Microbiology	1
BIO-226	Parasitology	1
BIO-311	Molecular Genetics	1
BIO-313	Advanced Ecology	1
BIO-314	Developmental Biology	1
BIO-315	Organismal Physiology	1
BIO-316	Evolution of Dev. Mechanisms	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-221 Comp Anatomy & Embry, BIO-222 Biol of Invertebrates, BIO-224 Vascular Plants, BIO-225 Microbiology, BIO-226 Parasitology, BIO-311 Molecular Genetics, BIO-313 Advanced Ecology, BIO-314 Developmental Biology, BIO-315 Organismal Physiology, BIO-316 Evolution of Dev. Mechanisms, 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, 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 Motion and Waves, PHY-110 Fluids and Fields, or PHY-111 General Physics I 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 and CHE-211 Chemical Structure & Reactivity are taken during the sophomore year; and Physics and CHE-221 Organic Chemistry I and CHE-321 Organic Chemistry II are typically 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-211 Chemical Structure & Reactivity, CHE-321 Organic Chemistry II, and CHE-331 Adv Analytical Chem 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 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 better 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

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-221	Comp Anatomy & Embry	
BIO-222	Biol of Invertebrates	
BIO-224	Vascular Plants	
BIO-225	Microbiology	
BIO-226	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, 112.

Prerequisites: none

Corequisites: BIO-101L

Credit: 1

Distribution: Science Lab, Natural Science/Mathematics

BIO-102 Plants & Human Affairs

This non-majors course will explore the interface between humankind and the plant world. Through lectures/discussion, ancillary readings, and local field trips, students will study the impact that plants have had on the development of human culture. Some topics to be covered include plant morphology, economically important plants, plant biotechnology, and plant-derived drugs. Attention will be given to modes of inquiry in the plant sciences. BIO 102 does not count toward the laboratory science distribution requirement. Offered in the fall semester of odd-numbered years.

Prerequisites: BIO-101

Corequisites: BIO-102L

Credit: 1

Distribution: Natural Science/Mathematics

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, Natural Science/Mathematics

Equated Courses: APCR

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, Natural Science/Mathematics

Equated Courses: CR

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 offered in the spring semester of even-numbered years.

Prerequisites: BIO 101 or 111

Credit: 1

Distribution: Natural Science/Mathematics

BIO-177 Special Topics (without Lab)

A special topics course with laboratory for non-majors. A more detailed course description will be posted in advance of pre-registration when the course is offered.

Prerequisites: none

Credit: 1

Distribution: Natural Science/Mathematics

BIO-178 Special Topics (with Lab.)

A special topics course with laboratory for non-majors. A more detailed course description will be posted in advance of pre-registration when the course is offered.

Prerequisites: none

Corequisites: BIO-178L

Credit: 1

Distribution: Science Lab

BIO-187 Independent Study

Enrollment through Instructor and Department Chair approval.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

BIO-188 Independent Study

Enrollment through Instructor and Department Chair approval.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

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 112

Corequisites: BIO-202L

Credits: 0.5

Distribution: Natural Science/Mathematics

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: Natural Science/Mathematics, Science Lab

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 213

Corequisites: BIO-212L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab

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: Natural Science/Mathematics, Science Lab

BIO-221 Comp Anatomy & Embry

This is a course presenting a broad evolutionary theme of the vertebrates using the facts of comparative anatomy, embryology, and paleobiology. It is offered in the spring semester of odd-numbered years.

Prerequisites: BIO-112

Corequisites: BIO-221L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab

BIO-222 Biol 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

Distribution: Natural Science/Mathematics

BIO-224 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-224L

Credit: 1

Distribution: Natural Science/Mathematics

BIO-225 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-225L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab,

BIO-226 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 of even-numbered years.

Prerequisites: BIO-112

Corequisites: BIO-226L

Credit: 1

Distribution: Natural Science/Mathematics,

BIO-287 Independent Study

Enrollment through Instructor and Department Chair approval.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

BIO-288 Independent Study

Enrollment through Instructor and Department Chair approval.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

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. This course is offered in the spring semester of odd-numbered years.

Prerequisites: BIO-211

Corequisites: BIO-311L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab

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: Natural Science/Mathematics

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. This course is offered in the spring semester of even-numbered years.

Prerequisites: BIO-211

Corequisites: BIO-314L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab

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: PRE-Req BIO-212

Corequisites: BIO-315L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab

BIO-316 Evolution of Dev. 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. Offered in the spring semester of even-numbered years.

Prerequisites: BIO-211

Credit: 1

Distribution: Natural Science/Mathematics

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

Distribution: Natural Science/Mathematics

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

Distribution: Natural Science/Mathematics

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

Distribution: Natural Science/Mathematics, Science Lab

BIO-388 Independent Study

Students may pursue individual research on selected problems. Although only one-half course credit is to be counted toward the nine credit major, these courses may be repeated and credit received for graduation. Students should make arrangements with individual faculty members during the semester preceding their enrollment in the course. Enrollment through Instructor and Department Chair approval.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics, Science Lab

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

Distribution: Natural Science/Mathematics

BIO-487 Independent Study

Enrollment through Instructor and Department Chair approval.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

BIO-488 Independent Study

Enrollment through Instructor and Department Chair approval.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

BIO-IND Independent Study

Students may enroll in independent study courses for 0.5 or 1 course credit(s), with the approval of a supervising faculty member, the appropriate department/program chair, and the student's advisor. Registration forms for independent study are available in the Registrar's Office. Enrollment through Instructor and Department Chair approval.

Prerequisites: none

Credits: 0.5-1

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Erika Sorensen-Kamakian

Heidi Walsh

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Secondary Licensure Program

The Department of Education Studies offers a minor in Education Studies, and an additional licensure preparation program for students interested in becoming licensed to teach at the secondary level (middle and high school grades 5-12). With a major in this department and a minor in Education Studies, students may also choose to complete the licensure preparation program by applying in the spring of the junior year. For more information about the licensure program, students are advised to meet with faculty in the Department of Education Studies. Requirements for the minor and licensure preparation program are outlined in the Department of Education Studies section of the Academic Bulletin.