

# Biology

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\**Sabbatical: Fall 2008*

\*\**Sabbatical: Spring 2009*

## General Education Requirements

All students must satisfy a general education requirement consisting of eleven (11) courses outside of the major department (see page 52). The General Education Goal 7 (Life Science) and laboratory requirement are satisfied through the completion of the Biology major.

## Course Prerequisites

Courses may have specified conditions for enrollment, such as prior completion of less advanced courses, permission of the instructor, or appropriate placement test scores. Students should refer to course descriptions in the department listings for prerequisite requirements.

## Biology Major

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### Departmental Requirements

Biology majors must complete twelve (12) core requirements as well as additional requirements for the particular concentration chosen (see below).

A. The following twelve (12) Biology core requirements are required of Biology majors in all concentrations:

#### Biology Core:

BIOL 160	Introduction to Organismal Biology
BIOL 161	Introduction to Cellular and Molecular Biology
BIOL 260	Cell Biology
BIOL 301	Genetics
BIOL 402	Processes of Organic Evolution
BIOL 406	Methods in Biological Research I *
BIOL 407	Methods in Biological Research II * <b>OR</b> BIOL 495 Internship in Biology
CHEM 107	Principles of Chemistry (Gen.Ed. Goal 6)
CHEM 108	Principles of Chemistry and Quantitative Analysis
CHEM 207	Organic Chemistry I
MATH 200	Precalculus (Gen.Ed. Goal 2)**
MATH 208	Biostatistics

\*An original research project is required of all Biology majors, generally begun during the spring semester of the student's junior year and completed in the summer and/or fall semesters. Prior to enrollment in these courses, the student should meet with her/his advisor and with other Biology faculty to tailor the research project to the student's interests and career goals.

\*\*Students proficient at the precalculus level should enroll in MATH 219 Calculus I to satisfy the Gen. Ed. Goal 2 requirement.

B. Additional courses are required of Biology majors in all concentrations. Biology electives are listed below in groups labeled "A-E". The number and distribution of electives required for completion of a Biology major varies according to the concentration selected by the student.

#### Group A: Cellular and Molecular Biology Electives

BIOL 307	Microbiology
BIOL 340	Immunology
BIOL 371	Medical Microbiology
BIOL 409	Developmental Biology

BIOL 411	Food Microbiology
BIOL 435	Recombinant DNA Technology

**Group B: Organismal Diversity Electives**

BIOL 203	Plants and Society (may not be used as a required plant course)
BIOL 220	Animal Behavior
BIOL 226	Neighborhood Botany (may not be used as a required plant course)
BIOL 232	Invertebrate Zoology
BIOL 250	Horticulture (may not be used as a required plant course)
BIOL 251	Vascular Plant Taxonomy
BIOL 252	Biology of Non-Vascular Plants
BIOL 305	Cetacean Biology and Conservation
BIOL 336	Ornithology
BIOL 338	Ichthyology
BIOL 350	Vascular Plant Anatomy and Morphogenesis

**Group C: Physiology Electives**

*BIOL 234	Comparative Vertebrate Physiology
*BIOL 272	Human Anatomy and Physiology I
BIOL 273	Human Anatomy and Physiology II
*BIOL 333	Principles of Human Physiology
BIOL 325	Neurobiology
BIOL 451	Plant Physiology
BIOL 417	Endocrinology
INTD 225	Biopsychology

*\* Only one of these courses may be taken in order to receive biology credit.*

**Group D: Ecology and Environmental Biology Electives**

BIOL 200	Introduction to Environmental Science
BIOL 316	Wetlands: Hydrology, Ecology, Restoration
BIOL 335	Principles of Wildlife Biology
BIOL 341	Marine Biology
BIOL 348	Ecology
BIOL 457	Quantitative Plant Ecology

**Group E: Advanced Biology Electives**

BIOL 490	Independent Study in Biology
BIOL 495/496	Internship in Biology

For students who plan to pursue an advanced degree in Biology, the following courses are strongly recommended:

CHEM 301	Biochemistry I
MATH 219	Calculus I
PHYS 201	Introductory Physics or both
PHYS 211	Physics I and
PHYS 212	Physics II

**Concentrations****General Biology (UBIG):**

Biology majors may elect to take a broad spectrum of courses covering the major areas of biology: cellular and molecular biology, organismal biology, physiology, and ecology and evolutionary biology, possibly combined with a minor according to the student's interests. This curriculum prepares students for the advanced Graduate Record Examination in Biology, a prerequisite for admission to many graduate programs in biology. In addition to entering graduate school, students graduating with a bachelors of science in biology are employed as laboratory technologists in academic and industrial settings, sales representatives for pharmaceutical and biotechnology companies, scientific illustrators, and technical writers.

Students must take an additional six (6) biology electives (one of these courses must focus on plants and one on animals):

One (1) course from Group A

One (1) course from Group B

One (1) from the following Group C courses:

- \*BIOL 234 Comparative Vertebrate Physiology
- \*BIOL 272 Human Anatomy and Physiology I
- \*BIOL 333 Principles of Human Physiology
- BIOL 451 Plant Physiology

\*Only one of these courses may be taken in order to receive Biology credit.

One (1) from the following Group D courses:

- BIOL 348 Ecology
- BIOL 457 Quantitative Plant Ecology

Two (2) additional courses from Group A-E

For students who plan to attend graduate school, it is recommended that they take CHEM 301 Biochemistry I and PHYS 201 Introductory Physics, or elect a more in-depth study of physics by taking PHYS 211 Principles of Physics I and PHYS 212 Principles of Physics II. (Note: MATH 219 Calculus I is a pre-requisite for Principles of Physics I.)

### Wildlife and Environmental Biology (UBIW):

Requirements for the concentration in wildlife and environmental biology include courses in wildlife biology or environmental science, both animal and plant systems, ecology, and policy/communication. Upon graduation, students will have completed the majority of curriculum requirements for certification as a Wildlife Biologist by the Wildlife Society. Graduates of this program are prepared for graduate studies or careers as wildlife biologists, wildlife managers, conservation biologists, environmental consultants, park rangers, and zookeepers.

Students must take seven (7) additional courses:

- BIOL 200 Introduction to Environmental Science **OR**  
BIOL 335 Principles of Wildlife Biology
- BIOL 234 Comparative Vertebrate Physiology
- BIOL 251 Vascular Plant Taxonomy
- BIOL 348 Ecology **OR**  
BIOL 457 Quantitative Plant Ecology

Must choose one course from each of the following biology elective groups:

- One (1) course from Group A
- One (1) course from Group B
- One (1) course from Group D

Other courses that are not required but would be useful for students in this concentration include the following:

- CHEM 301 Biochemistry I
- EASC 246 Oceanography
- INTD 301 Water Resources Planning and Management
- INTD 302 Coastal Issues: Science and Policy
- GEOG 216 Introduction to Geographical Information Systems (GIS)
- GEOG 235 Environmental Law and Policy
- GEOG 375 Resource Management
- PHYS 201 Introductory Physics\*
- POSC 329 Public Policy Analysis

\*Required for Wildlife Certification by Wildlife Society

### Biotechnology and Biomedical Science (UBIM):

Students may elect a curriculum that emphasizes cellular and molecular biology. Courses covering microbiology, immunology, genetics, Recombinant DNA Technology, and cell culture are appropriate for those interested in research positions in the biotechnology industry, medical centers, and government agencies. Graduates of the program are also prepared for careers in diverse areas of the pharmaceutical industry such as product development, sales and marketing, quality control, and technical training.

Students must take an additional six (6) biology electives (One of these six courses must focus on plants and one on animals):

Three (3) courses from Group A:

One (1) course from Group B

Two (2) courses from Group C - which must include one of the following:

- \*BIOL 234 Comparative Vertebrate Physiology
- \*BIOL 272 Human Anatomy and Physiology I
- \*BIOL 333 Principles of Human Physiology
- BIOL 451 Plant Physiology

*\*Biology credit will be given to only one of these courses.*

All students in this concentration are advised to take CHEM 208 Organic Chemistry II; those with a career goal in plant-oriented biotechnology are advised to take BIOL 451 Plant Physiology. For students who plan to attend graduate school, it is recommended that they take CHEM 301 Biochemistry I, PHYS 201 Introductory Physics, or elect a more in-depth study of physics by taking PHYS 211 Principles of Physics I and PHYS 212 Principles of Physics II. (Note: MATH 219 Calculus I is a prerequisite for PHYS 211 Principles of Physics I.)

### Biology Secondary Education Teaching Program (UBIT):

Students who plan to teach at the middle school or high school level will fulfill the Commonwealth's requirements for secondary education certification in biology by completing a program similar to the general biology concentration. Students must also complete the requirements for a Secondary Education Minor.

Students must take the following additional courses:

- BIOL 333 Principles of Human Physiology **OR BOTH**  
BIOL 272 Human Anatomy and Physiology I **AND**  
BIOL 273 Human Anatomy and Physiology II
- BIOL 307 Microbiology
- BIOL 348 Ecology
- PHYS 201 Introductory Physics

One (1) of the following courses relating to plants:

- BIOL 251 Vascular Plant Taxonomy
- BIOL 252 Biology of Non-Vascular Plants
- BIOL 451 Plant Physiology

Eight (8) additional courses are also required for a Secondary Education Minor (see Education section of the College catalog).

It is recommended that students take GEOL 231 Physical Geology.

Note: Before registering for EDUC 315 Professional Preparation and Field Study II - High School or EDUC 316 Professional Preparation and Field Study II - Middle School, students must have completed ten (10) of the eleven (11) Biology core requirements (all courses, except for BIOL 407 Methods in Biological Research II or BIOL 496 Internship in Biology) and five (5) of the six (6) Biology Secondary Teaching Program requirements; those remaining courses may be taken concurrently. Before enrolling in EDUC 410-11 Student Teaching Seminar and Practicum I-II - High School or EDUC 414-15 Student Teaching Practicum and Seminar I-II - Middle School, students must have completed all courses in the major and EDUC 315 or EDUC 316.

### Pre-professional Program (UBIP):

This concentration is designed for Biology majors who plan to attend medical school, dental school, veterinary school, or pursue a career in either human or animal health. Though specific programs may have additional or slightly varying requirements, these basic courses are required by the majority of professional schools. Students are strongly advised to meet the pre-professional advisor early in their coursework.

Students must take eight (8) courses, depending upon their interest in either veterinary or human studies respectively:

One (1) course from Group A

Three (3) courses from Group B and/or Group C, which must include:

- BIOL 234 Comparative Vertebrate Physiology (recommended for veterinary studies) **OR**  
 BIOL 272 Human Anatomy & Physiology I **AND**  
 BIOL 273 Human Anatomy & Physiology II (recommended for human studies)

The following four (4) courses are also required:

- CHEM 208 Organic Chemistry II  
 MATH 219 Calculus I  
 PHYS 211 Principles of Physics I  
 PHYS 212 Principles of Physics II

## The Marine Studies Consortium

The Biology Department has fostered an ongoing collaboration with the Marine Studies Consortium. The Consortium is an association of colleges, universities, museums, and marine research institutions in Massachusetts; its mission is to educate students in the disciplines of marine science and policy. A series of courses are offered on an annual or rotating schedule. Classes and laboratories usually are held in the evenings at facilities of member institutions (typically, Brandeis University and The New England Aquarium, Boston). Saturday field trips to local coastal sites are common. For more information about the program and the courses offered visit the Consortium's web site (<http://www.brandeis.edu/marinestudies/schedule-location.html>).

The collaboration with the Marine Studies Consortium allows students who have interests in specific oceanographic topics to explore them through courses not routinely offered by the College. Courses offered by the Consortium that are available for credit at the College include: BIOL 210, BIOL 305, BIOL 316, HIST 307, INTD 300, INTD 301, and INTD 302. See the campus representative (Dr. Richard Beckwitt, Biology Department) to learn more about the program and the application procedure. Application to the campus representative must be made one semester prior to participation in the course. Additional course fees apply as posted in the most recent master schedule of day division courses.

## Minor in Biology (5 Courses):

An introductory biology laboratory course, a chemistry laboratory course and a minimum of three (3) biology courses which must be 200-level and above. A minimum of two (2) must have a laboratory. All courses must be chosen under the guidance of a member of the Biology Department. If college credit is received for either an examination or advanced placement, the introductory course requirement shall be waived. At least three (3) of the courses must be taken on the Framingham State College campus.

## Minor in Neuroscience (5 Courses)

(See Page 48)

## Biology Courses Appropriate for General Education (Gen. Ed.)

Courses:	Goal
BIOL 101 Biological Concepts	7, Lab
BIOL 103 Ecological Implications of Conservation	7
BIOL 112 Biology of Marine Organisms	7, Lab
BIOL 114 A Human Perspective on Genetics	7
BIOL 142 Introduction to Human Biology	7, Lab
BIOL 200 Intro. to Environmental Science	7
BIOL 203 Plants and Society	7

## Biology Course Descriptions

Subject Code	Course Number	Course Description
Introductory Courses (Not suitable for Art majors):		
BIOL	101	<p><b>Biological Concepts (Gen. Ed. Goal 7, Lab)</b>            An approach to the study of biology that emphasizes conceptual understanding of biological systems. These areas include evolution and the origin of life, cellular processes, Mendelian and molecular genetics, ecology, behavioral science, and basic physiological systems. The interrelationship of these areas and their effect on human biology are stressed. <b>Laboratory.</b> This course is not open to Biology majors. <i>Prerequisite: MATH 095 General Mathematics or a satisfactory score on the mathematics placement exam.</i></p>
BIOL	103	<p><b>Ecological Implications of Conservation (Gen. Ed. Goal 7)</b>            An introduction to the scientific principles on which conservation should be based. Methods of conservation practice are stressed. The course includes a discussion of the development and future of the conservation movement. Occasional field trips. No laboratory. This course is not open to Biology majors.</p>
BIOL	112	<p><b>Biology of Marine Organisms (Gen. Ed. Goal 7, Lab)</b>            An introduction to life in the oceans, including basic principles of ecology, a description of the important organisms, and the impact of humans on marine life. <b>Laboratory.</b> This course is not open to Biology majors.</p>
BIOL	114	<p><b>A Human Perspective on Genetics (Gen. Ed. Goal 7)</b>            An exploration of the field of genetics from the rediscovery of Mendel's work in 1900 up to the present. Once the fundamentals of the discipline are established, the emphasis is on genetics and its human ramifications. Topics include the efforts to create a DNA blueprint for humans, the prenatal diagnosis of some genetic disorders, the cloning of genes whose products are used as pharmaceuticals, and the ability to alter the genetic properties of important crop plants. No laboratory. This course is not open to Biology majors.</p>
BIOL	142	<p><b>Introduction to Human Biology (Gen. Ed. Goal 7, Lab)</b>            An exploration of the functional aspects of the human body at the molecular, cellular, organ, and systems levels. Emphasis is on the development and evolution of homeostatic mechanisms that allow the body to respond and adapt to physical and emotional stresses under changing environmental conditions. <b>Laboratory.</b> This course is not open to Biology or Food and Nutrition majors, except for students in the Applied Nutrition concentration.</p>
BIOL	160	<p><b>Introduction to Organismal Biology</b>            An introduction to the organismal, population, community, and ecosystem levels of biological organization for students intending to major in Biology. The course examines the processes of evolution, the diversity of the biological world, and the interactions of organisms and their environment. <b>Laboratory</b> periods concentrate on developing basic skills of observation, measuring and interpreting data, and the reading and reporting of experimental work. Offered Fall semester only. Note: Students cannot receive credit for both BIOL 108 Biology II and BIOL 160 Introduction to Organismal Biology. <i>Prerequisite: MATH 095 General Mathematics or a satisfactory score on the mathematics placement exam.</i></p>

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BIOL	161	<b>Introduction to Cell and Molecular Biology</b> An introduction to the molecular, cellular, and physiological levels of biological organization. The course examines the processes of energy release, photosynthesis, heredity, molecular control of cells, and selected topics in physiology. <b>Laboratory</b> periods concentrate on developing basic skills of observation, measuring and interpreting data, and the reading and reporting of experimental work. Offered Spring semester only. Note: Students cannot receive credit for both BIOL 107 Biology I and BIOL 161 Introduction to Cell and Molecular Biology. <i>Prerequisite: MATH 095 General Mathematics or a satisfactory score on the mathematics placement exam.</i>
BIOL	200	<b>Introduction to Environmental Science (Gen. Ed. Goal 7)</b> A comprehensive survey of the environmental principles concerning the interactions of humans and world resources. The role of technology in meeting the problems of growth, pollution, energy, and agriculture is examined in the context of present capabilities and the prospects for future development. No laboratory.
BIOL	203	<b>Plants and Society (Gen. Ed. Goal 7)</b> An exploration of the dependency of humans on plants and plant products. The beginning of agriculture and its consequences for human evolution are discussed. The origins, dispersals, improvements, and uses of economically valuable plants are considered along with their relationships to the world's economy. Occasional field trips. No laboratory. This course is acceptable for majors as a biology elective, but not in place of a required plant course.
BIOL	210	<b>Introduction to Marine Mammals</b> An exploration of the biology and natural history of marine mammals in the North Atlantic, including whales, dolphins, and seals. Topics include evolution, anatomy, behavior, field identification, and the history of whaling and contemporary conservation issues. Demonstration laboratory work focuses on smaller marine mammals. There is one Saturday field trip on Massachusetts Bay. This course is not open to Biology majors. Additional course fees apply. <i>Prerequisite: One college biology course. Application to campus representative of the Marine Studies Consortium must be made one semester prior to experience.</i>
BIOL	220	<b>Animal Behavior</b> A study of the influence of natural selection on the behavior of animals. This course emphasizes the distinction between the immediate causes of behavior, including external stimuli and internal physiological mechanisms, and the ultimate consequences or survival value of behavior. Topics such as learning and instinct, aggression, territoriality, communication, and social behavior are discussed. <b>Laboratory.</b> <i>Prerequisite: BIOL 160 Introduction to Organismal Biology or BIOL 101 Biological Concepts or permission of the instructor.</i>
BIOL	226	<b>Neighborhood Botany</b> Designed to acquaint the student with the tools for identifying the flowering plants and conifers in the local flora. The course will include vegetative and floral morphology, use and construction of botanical keys and collecting techniques. No laboratory. This course is acceptable for majors as a biology elective, but not in place of a required plant course. Note: students may not receive credit for both BIOL 456 Neighborhood Botany and BIOL 226 Neighborhood Botany.

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BIOL	232	<b>Invertebrate Zoology</b> A comparative study of the invertebrate animal phyla with emphasis on marine forms. The course stresses functional morphology, development, behavior, and ecological and evolutionary relationships among the various groups. Students study live specimens whenever possible. <b>Laboratory</b> exercises include field trips to collect and study invertebrates of the region. <i>Prerequisite: BIOL 101 Biological Concepts or both BIOL 160 Introduction to Organismal Biology and BIOL 161 Introduction to Cell and Molecular Biology or permission of the instructor.</i>
BIOL	234	<b>Comparative Vertebrate Physiology</b> An introduction to the functions and relationships of vertebrate organs and organ systems. The course emphasizes physiological adaptations and mechanisms by which vertebrates compensate for environmental variations. <b>Laboratory.</b> Note: Students may receive credit for only one of the following courses: BIOL 234 Comparative Vertebrate Physiology, BIOL 272 Human Anatomy and Physiology I, or BIOL 333 Principles of Human Physiology. <i>Prerequisites: CHEM 107 Principles of Chemistry; BIOL 101 Biological Concepts or both BIOL 160 Introduction to Organismal Biology and BIOL 161 Introduction to Cell and Molecular Biology or permission of the instructor.</i>
BIOL	250	<b>Horticulture</b> Designed as an introduction to basic horticultural principles and practices. The course emphasizes the basic structure, growth, and development of plants, and gives the student an opportunity to develop skills in the care, propagation, and identification of horticultural plants. No laboratory. This course is acceptable for majors as a free elective, but not in place of a required plant course.
BIOL	251	<b>Vascular Plant Taxonomy</b> An historical view of plant classification; concepts of nomenclature, goals of phylogenetic and biosystematic investigations; anatomical and morphological characteristics important in classification; key characteristics of important temperate plant families; collection and identification techniques; and introduction to the local flora. <b>Laboratory.</b> <i>Prerequisite: BIOL 101 Biological Concepts or BIOL 160 Introduction to Organismal Biology.</i>
BIOL	252	<b>Biology of Non-Vascular Plants</b> An examination of structure, life histories, physiology, taxonomy, evolution, and economics of the non-vascular plants. Special attention is given to the algae and the fungi. Laboratories, in addition to morphological studies, introduce the student to the methods of collecting, culturing and identifying these organisms. <b>Laboratory.</b> <i>Prerequisite: BIOL 101 Biological Concepts or BIOL 160 Introduction to Organismal Biology and BIOL 161 Introduction to Cell and Molecular Biology.</i>
BIOL	260	<b>Cell Biology</b> A study of the structure and function of cells and their major organelles. Topics covered include the nucleus, mitochondria, Golgi, lysosome, endoplasmic reticulum, protein trafficking, signal transduction, cellular energetics, and gene expression. <b>Laboratory</b> exercises are mostly experimental. <i>Prerequisites: CHEM 107 Principles of Chemistry; BIOL 161 Introduction to Cell and Molecular Biology or BIOL 101 Biological Concepts.</i>

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BIOL	272	<b>Human Anatomy and Physiology I</b> A study of the functional systems in the human body and the maintenance of homeostasis. Systems covered in this course include: endocrine, cardiovascular, renal (urinary), digestive and reproductive. <b>Laboratory.</b> Course offered Fall semester. Note: Students may receive credit for only one of the following courses: BIOL 234 Comparative Vertebrate Physiology, BIOL 272 Human Anatomy and Physiology I, or BIOL 333 Principles of Human Physiology. <i>Prerequisites: An introductory biology course with laboratory and an introductory chemistry course with laboratory.</i>
BIOL	273	<b>Human Anatomy and Physiology II</b> A continuation of BIOL 272 Human Anatomy and Physiology I. This course focuses on tissues in the body, joints, skeletal and muscular anatomy. In addition, the nervous and respiratory systems are studied. This course is designed for students interested in pursuing a career in medical science. <b>Laboratory.</b> Course offered Spring semester. <i>Prerequisite: BIOL 272 Human Anatomy and Physiology I or permission of instructor.</i>
BIOL	301	<b>Genetics</b> A study of the principles governing heredity in all living things, including microorganisms, plants, and animals. Topics covered include Mendelian inheritance, molecular genetics, cytogenetics, human hereditary disease, and population genetics. <b>Laboratory.</b> <i>Prerequisites: BIOL 260 Cell Biology or permission of the instructor.</i>
BIOL	303	<b>Exercise Physiology</b> An advanced examination of the effects of aerobic and anaerobic exercise on functions of the human body. Relationships among bodily functions, exercise, neural, hormonal and nutritional factors are discussed. Structural and functional aspects of the skeletomuscular, cardiovascular and respiratory systems are emphasized. <b>Laboratory.</b> <i>Prerequisite: A grade of C- (1.70) or higher in BIOL 273 Human Anatomy and Physiology II</i>
BIOL	305	<b>Cetacean Biology and Conservation</b> An examination of the biology and conservation of cetaceans: whales, dolphins, and porpoises. Topics include physiology, population biology and life history analysis, molecular genetics, morphology, distributional ecology, and social behavior. Early lectures focus on the biology of cetaceans and how they are adapted to the marine environment. Later lectures use case studies to review how biological principles can be applied to the conservation of a wide range of cetacean species. Additional course fees apply. <i>Prerequisites: One year of general biology and two upper level biology courses. Application to campus representative of the Marine Studies Consortium must be made one semester prior to experience.</i>
BIOL	307	<b>Microbiology</b> An introduction to the structure, reproduction, physiology and taxonomy of microorganisms. Special attention is given to bacteria and viruses. Emphasis is placed on aspects of microbiology of significance to humankind, including pathogenesis, immunity, microbial ecology, pollution control, food microbiology, and biotechnology. <b>Laboratory</b> exercises introduce the student to standard techniques of cultivation and identification of microorganisms, food microbiology, DNA purification and analysis, immunological assays, as well as encourage independent investigations. <i>Prerequisites: CHEM 107 Principles of Chemistry; BIOL 101 Biological Concepts or BIOL 161 Introduction to Cell and Molecular Biology.</i>

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BIOL	316	<b>Wetlands: Hydrology, Ecology, Restoration</b> A study of wetlands and their role in the hydrology and ecology of global landscapes. Course topics include the function of inland and coastal marshes, swamps and bogs in water and nutrient cycles, and the role of wetlands in the support of biodiversity, from microbes to vertebrates. The biological links between wetlands and human activities, such as agriculture, coastal development, and fisheries, and the legal framework for the protection and restoration of endangered wetlands are also examined. Additional course fees apply. <i>Prerequisites:</i> One year of introductory science (e.g. biology, geology, chemistry, or engineering) and two upper level (elective) science courses. Application to campus representative of the Marine Studies Consortium must be made one semester prior to experience.
BIOL	325	<b>Neurobiology</b> An advanced examination of the development, structure and function of the central and peripheral nervous systems. Topics covered include synaptic communication, neurotransmission, sensory and motor processing, reflexes and cellular processes of learning and memory. It is designed for biology or psychology majors with an interest in neurophysiology. <b>Laboratory.</b> <i>Prerequisite:</i> BIOL 272 Human Anatomy and Physiology I or BIOL 234 Comparative Vertebrate Physiology or permission of the instructor
BIOL	333	<b>Principles of Human Physiology</b> An overview of the functional anatomy of the human body and its physiology. Basic concepts concerning the skeletal, muscular, nervous, respiratory, cardiovascular, digestive, urinary, endocrine, and reproductive systems are studied. <b>Laboratory.</b> Note: Students may receive credit for only one of the following courses: BIOL 234 Comparative Vertebrate Physiology, BIOL 272 Human Anatomy and Physiology I, or BIOL 333 Principles of Human Physiology. <i>Prerequisites:</i> An introductory biology course with laboratory and an introductory chemistry course with laboratory.
BIOL	335	<b>Principles of Wildlife Biology</b> A study of the distribution of major wildlife groups in the United States. The principles of wildlife management and evaluation of land and water habitats are stressed, as well as population growth dynamics and field procedures. <b>Laboratory.</b> <i>Prerequisites:</i> CHEM 107 Principles of Chemistry; BIOL 101 Biological Concepts or BIOL 160 Introduction to Organismal Biology.
BIOL	336	<b>Ornithology</b> An introduction to the biology of birds, including anatomy, physiology, behavior, ecology, field identification, and conservation. Students become familiar with the techniques and tools necessary to identify bird species by sight and/or sound, as well as with basic research techniques. <b>Laboratory</b> includes field trips. <i>Prerequisite:</i> A biology or zoology course at the 100-level or permission of the instructor.
BIOL	338	<b>Ichthyology</b> A study of freshwater and marine fishes with particular emphasis on those species occurring in the northeastern states. <b>Laboratory.</b> <i>Prerequisite:</i> BIOL 160 Introduction to Organismal Biology and BIOL 161 Introduction to Cell and Molecular Biology or BIOL 101 Biological Concepts or permission of the instructor.

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<b>BIOL</b>	<b>340</b>	<b>Immunology</b> A study of the principles of immunology and its application to diseases and health. The course examines the molecular and cellular components of the immune system relevant to infectious diseases, genetic- and infection-associated immunodeficiency, cancer, hypersensitivity, autoimmunity, and transplantation. <b>Laboratory.</b> <i>Prerequisite: BIOL 307 Microbiology or permission of instructor.</i>
<b>BIOL</b>	<b>341</b>	<b>Marine Biology</b> An introduction to the variety of marine environments and the biological and physical factors which contribute to the productivity of these areas. Oceanic habitats are compared to other ecosystems including tropical and temperate estuaries, coral reefs and salt marshes. Problems of human interaction with the marine environment are emphasized. <b>Laboratory.</b> <i>Prerequisite: BIOL 101 Biological Concepts or BIOL 160 Introduction to Organismal Biology and BIOL 161 Introduction to Cell and Molecular Biology.</i>
<b>BIOL</b>	<b>348</b>	<b>Ecology</b> An advanced course that synthesizes knowledge gained in other courses and applies it to ecological problems. Emphasis is placed on the interactions between the organism and its biological and physical environments. Concepts covered include soil, climate, trophic systems, life history trade offs, behavioral ecology, biodiversity, and human impact. <b>Laboratory</b> includes field trips. Students may not receive credit for both BIOL 348 Ecology and BIOL 408 Ecology. <i>Prerequisites: CHEM 107 Principles of Chemistry and two (2) biology courses (200 level or above) or permission of the instructor.</i>
<b>BIOL</b>	<b>371</b>	<b>Medical Microbiology</b> An overview of human infectious diseases caused by viruses, bacteria, and fungi. Emphasis will be placed on current diagnostic techniques and microbial pathogenic mechanisms, and on contemporary issues that include newly emerging infectious diseases, vaccines, and bio-terrorism. <b>Laboratory</b> exercises focus on state-of-the-art procedures for the isolation and identification of pathogenic microbes and for the determination of their susceptibility to chemotherapeutic drugs. <i>Prerequisite: BIOL 307 Microbiology.</i>
<b>BIOL</b>	<b>381</b>	<b>Theories of Infectious Disease</b> An introduction to human infectious disease with emphasis on microbial pathogenic mechanisms and contemporary diagnostic techniques. Learning goals are centered on a series of case studies involving the most common infectious diseases affecting mankind. No Laboratory. This course cannot be used as a required Biology elective for the completion of a major in Biology. <i>Prerequisite: BIOL 307 Microbiology, an equivalent introductory course in microbiology, or permission of the instructor. Note: Students cannot receive credit for both BIOL 371 Medical Microbiology and BIOL 381 Theories of Infectious Disease.</i>
<b>BIOL</b>	<b>406</b>	<b>Methods in Biological Research I</b> Designed to develop a working appreciation of methods of scientific inquiry through development of an original research proposal. Topics included are: problem definition, literature survey, resource bibliography, and research design, including proposed data analysis. Normally taken in the spring term of the junior year, this course is open only to Biology majors. <i>Prerequisite: MATH 208 Biostatistics, CHEM 108 Principles of Chemistry and Quantitative Analysis or equivalent, at least four biology courses at the 200-level or above and a minimum cumulative QPA of 1.70 in all Biology courses.</i>

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<b>BIOL</b>	<b>407</b>	<b>Methods in Biological Research II</b> A continuation of Methods I (BIOL 406) in which the students implement their research design under the supervision of a department faculty member. The research may be conducted off-campus with approval of course coordinator. Open only to Biology majors. <i>Prerequisite: Completion of BIOL 406 Methods in Biological Research I with a minimum grade of C- (1.70) or better.</i>
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<b>BIOL</b>	<b>409</b>	<b>Developmental Biology</b> A study of the fundamental principles that regulate animal development from sperm and egg formation through the mechanisms by which the basic organization of the embryo arises from the fertilized zygote. Topics covered include fertilization, nuclear cytoplasmic interactions, gastrulation, animal cloning, cell-cell interactions, formation of the nervous system, and sex differentiation. <b>Laboratory</b> exercises include both descriptive and experimental embryology. <i>Prerequisite: BIOL 301 Genetics or permission of the instructor.</i>
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<b>BIOL</b>	<b>411</b>	<b>Food Microbiology</b> A focus on those microorganisms involved in food production, food spoilage, and the transmission of diseases through foods. The effect of various methods of food preservation is evaluated in terms of public health, food spoilage, food quality, and nutritional value of foods. <b>Laboratory.</b> <i>Prerequisite: BIOL 307 Microbiology.</i>
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<b>BIOL</b>	<b>417</b>	<b>Endocrinology</b> A study of endocrine glands, the hormones they secrete, and the effects these hormones have on their target tissues. The course examines the mechanisms of the action of hormones at the molecular, cellular, organ, and physiological levels, as well as their effects on development of the individual. Topics covered include the role of hormones in male and female reproduction, pregnancy, parturition, lactation, growth, diabetes, and exercise. In the <b>laboratory</b> , students perform experiments involving small animal surgery and injection of hormones. <i>Prerequisites: CHEM 107 Principles of Chemistry and one of the following biology courses: BIOL 234 Comparative Vertebrate Physiology, BIOL 272 Human Anatomy and Physiology I, BIOL 260 Cell Biology; or permission of the instructor.</i>
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<b>BIOL</b>	<b>435</b>	<b>Recombinant DNA Technology</b> An introduction to the principles and applications of recombinant DNA technology. Emphasis is placed on the structure, handling and manipulation of nucleic acids. A historical perspective on the emergence of recombinant DNA technology along with current topics such as transgenic organisms and human gene therapy are presented. <b>Laboratory</b> investigations include the isolation and analysis of DNA; the use of restriction endonucleases and plasmid cloning vectors; amplification of DNA; and bioinformatics. <i>Prerequisites: BIOL 260 Cell Biology and either BIOL 307 Microbiology or BIOL 301 Genetics; or permission of the instructor.</i>

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<b>BIOL</b>	<b>451</b>	<b>Plant Physiology</b> An introduction to basic processes that regulate plant growth and development. Photosynthesis, photomorphogenesis, hormonal control, and mineral acquisition are emphasized. The <b>laboratory</b> has an open-ended design with an emphasis on repeatability of experimental results. <i>Prerequisites:</i> CHEM 107 Principles of Chemistry; BIOL 160 Introduction to Organismal Biology and BIOL 161 Introduction to Cell and Molecular Biology or BIOL 101 Biological Concepts.
<b>BIOL</b>	<b>457</b>	<b>Quantitative Plant Ecology</b> An introduction to the principles and techniques of ecology as they apply to plants in terrestrial and aquatic habitats. The course covers physiological ecology, as well as population- and community-level processes. <b>Laboratory</b> emphasizes techniques for quantitative sampling and analysis. Occasional field trips. <i>Prerequisite:</i> BIOL 251 Vascular Plant Taxonomy or permission of the instructor.
<b>BIOL</b>	<b>490</b>	<b>Independent Study in Biology</b> An opportunity for the Biology major to work independently in an area relevant to the student's special interests. Each student's experience is planned in cooperation with a department member. Progress reports and final written and oral reports are required. <i>Prerequisites:</i> Biology major of junior or senior standing, two semesters completed at Framingham State College, overall QPA of 2.50, and approval of the department chair. The independent study option is reserved for those students who have previously demonstrated sufficient motivation and self-discipline to work independently.
<b>BIOL</b>	<b>495/496</b>	<b>Internship in Biology</b> A supervised field study in the area of the student's interest that complements formal course work. The internship program is offered through cooperation of participating institutions that provide guidance for the interns. A minimum of 160 on-site hours is necessary to complete the internship in Biology. The 160 hours must be completed within one semester. The internship in Biology may be taken for one (1) course credit in the major as a free elective. A student may not enroll in an internship more than twice (two course credits). Any student interested in participating in an internship must consult with the Biology Department chair prior to the middle of the semester preceding the semester of the desired internship. <i>Prerequisites:</i> Biology majors of senior standing, two semesters completed at Framingham State College, overall QPA of 2.50 with a 2.75 average in courses for the major, and approval of the department chair.

*The following course also carries credit as a biology elective:*

<b>INTD</b>	<b>225</b>	<b>Biopsychology</b> An overview of the biological foundations of behavior and mental processes. Topics covered include the biological underpinnings or various domains in psychology such as emotion, motivation, perception, cognitive function, psychopharmacology, and hormone effects on the brain and behavior. No Laboratory. <i>Prerequisite:</i> PSYC 101 General Psychology and one of the following biology courses: BIOL 101 Biology Concepts, BIOL 142 Human Biology, or BIOL 161 Cellular and Molecular Biology; or permission of instructor.
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