# Biological Sciences

The major and minor in biological sciences are administered by the Department of Biological Sciences: Professors Barry, Fink, S. Gruber, Knight (*chair*), Rachootin, Woodard; Associate Professors Bacon, Brodie, Frary, Gillis, Stranford; Assistant Professor Hoopes; Visiting Assistant Professors Jarvinen, Pope, Pratt.

## Contact Persons

Nancy Lech, *senior administrative assistant*
Ellie Perrier, *administrative assistant*
Jeffrey Knight, *chair*

Our major provides many ways of looking at living things. Core courses introduce complementary perspectives on life. Advanced courses bring students to the edge of what we know, and provide a foundation for original work.

## Requirements for the Major

### Credits

- A minimum of 32 credits in biological sciences

### Courses

Required courses in biological sciences:

- Biology:
- 145, Introductory Biology (various types) or
- 160, Integrated Introduction to Biology and Chemistry
- 200, Introductory Biology II (prereq. Biology 145 or 160)
- 210, Genetics and Molecular Biology (prereq. Biology 200; Chemistry 101; Chemistry 101 may be taken concurrently with Biology 210)
- 220, Cell Biology (prereq. Biology 200, Chemistry 201; Chemistry 201 may be taken concurrently with Biology 220)
- 223, Ecology (prereq. Biology 145 or Environmental Studies 100, one semester of college or high school calculus or statistics) or
- 226, Evolution (prereq. Biology 210 or 223)
- Three additional courses (12 credits) at the 300-level in biology. At least two of these (8 credits) must be taken at Mount Holyoke, and at least two must have labs.
- Biology 295 or 395 does not count toward the minimum 32 credits in the major.

Required courses outside of biological sciences:

- General Chemistry 101 and 201
- Calculus or Statistics

Recommended courses outside of biological sciences:

- Organic Chemistry 202 and 302
- Physics
- Computer Science

## Requirements for the Minor

### Credits

- A minimum of 16 credits at the 200- and/or 300-level

## Teacher Licensure

Students interested in pursuing licensure in the field of biological sciences can combine their course work in biological sciences with a minor in education. In some instances course work in the major coincides with course work required for licensure; in other cases, it does not. For specific course requirements for licensure within the major of biological sciences, please consult your advisor or the chair of the biological sciences department. For information about the requirements for the minor in education, please consult "Teacher Licensure" in the Other Degree and Certificate Programs chapter and Ms. Lawrence in the psychology and education department. Licensure also requires a formal application as well as passing scores on the Massachusetts Test of Educator Licensure (MTEL) in both the literacy component and the subject matter component. Copies of

the test objectives for the MTEL are available in the biological sciences department and in the Department of Psychology and Education. Licensure application information and materials are available in the Department of Psychology and Education.

## Facilities

The department's facilities include transmission, scanning electron, fluorescence, and confocal microscopes, image capture and processing equipment, a tissue culture room, a greenhouse, controlled environment chambers, molecular biology equipment, and several computer-equipped teaching laboratories.

Research interests of the faculty include animal behavior, anatomy, human physiology, biochemistry, biomechanics, development, ecology, evolution, immunology, microbial genetics, microbiology, neurobiology, invertebrates, plant diversity, and plant genetics.

## Math and Science II-B Distribution Credit in Biology

Departmental courses with laboratories satisfy the Group II-B distribution requirement. Any off-campus biology course taken to satisfy the Group II-B requirement must have a laboratory component; courses that are introductions to professional specialties dependent on biology (e.g., nutrition or horticulture), or are addressed to technical certification (e.g., emergency medical technician), do not carry Group II-B credit.

## Course Offerings

The department offers introductory biology in two different forms. The Biology 145 courses are a liberal arts introduction to biology in a small-class atmosphere. Different sections emphasize different topics. Biology 160, which must be taken concurrently with Chemistry 160, offers an integrated introduction to biology and chemistry. Either one is an appropriate choice for students who are considering a major in biology, biochemistry, environmental studies, or neuroscience and behavior. Completion of any of these courses will allow a student to enroll in Biology 200. Students are welcome to email the instructors to find out more about any of the introductory courses.

**145fs Introductory Biology**

*Fall 2009*

*145f(01) Nature Harmoniously Confus'd*
(First-year seminar) Most organisms are notably unlike ourselves—a tapestry of bacteria, protozoans, algae, and, off by themselves, the plants, fungi, and other animals. We will survey the whole range of organisms, especially those in the ponds and forests of our campus. Labs will start in the field, offering many opportunities for wet or muddy work. The class is addressed to students intrigued by natural history; it might be useful for students interested in further study of the environment.
*Meets Science and Math II-B requirement*
*S. Rachootin*
*Prereq. fy; 4 credits*

*145f(02) Diversity of Life*
We will survey the great diversity of life on earth from the archaebacteria that live in hot sulfur springs to giant sequoia trees to singing birds. Labs will explore biological diversity via collecting trips around campus as well as laboratory experiments and will introduce students to data collection, manipulation, and analysis.
*Meets Science and Math II-B requirement*
*S. Barry*
*Prereq. fy or permission of instructor; 4 credits*

*145f(03) A Green World*
(First-year seminar) This course examines the plant life in the woods and fields around us, the exotic plants in our greenhouses, and the plants we depend on for food. We will study plants living in surprising circumstances, settling into winter, escaping from gardens, reclaiming farmland, cooperating with fungi and insects, and fighting for their lives. We will find that plants challenge some conventional, animal-based assumptions about what matters to living things. In labs, students will seek to answer their questions about how plants grow in nature, by studying plant structure and function, ecology, and evolution.
*Meets Science and Math II-B requirement*

*A. Frary*
*Prereq. fy; 4 credits*

*145f(04) Physiological Ecology*
As our climate changes on global scales, we need to explore how such changes will affect living things. This course will explore how physiological functions (such as metabolism, photosynthesis, and temperature regulation) drive the behavior (such as habitat selection and foraging) and ecology (such as competition and predator/prey interactions) of plants and animals in the context of their environment. Through laboratory sessions, research projects, and other oral and written assignments, students will gain experience with experimental design, data analysis and interpretation, and presentation of scientific results.
*Meets Science and Math II-B requirement*
*M. Pratt*
*Prereq. fy; 4 credits*

**145f(05) Organismal Biology*
This course encompasses a broad range of concepts central to our understanding of how organisms function and evolve. We will investigate important biological processes, such as photosynthesis and metabolism, and of systems, such as the cardiovascular and immune systems. We will also take a holistic view of biology and use our newly acquired knowledge to explore such diverse topics as: the evolution of infectious diseases, the consequences of development and design on the evolution of organisms, and how the physiology and behavior of animals might affect their responses to global climate change.
*Meets Science and Math II-B requirement*
*R. Brodie*
*Prereq. fy; 4 credits*

*Spring 2010*

*145s(01) Foundations of Animal Behavior: Evolution, Physiology, and Ecology*
(First-year seminar) This course covers some fundamental biological concepts with the ultimate aim of understanding how and why animals behave the way they do. We study the principles of evolution by natural selection, how neurons and muscles work at the cellular level, how hormones influence development and behavior, and how individual animals fit into their larger populations and communities. We will bring these principles together to understand how behavior allows animals to find food, avoid predators, and attract mates. Field and laboratory exercises will include quantitative analysis, observation, and experimentation.
*Meets Science and Math II-B requirement*
*D. Pope*
*Prereq. fy; 4 credits*

**145s(02) Biology in the Age of the Human Genome Project*
(First-year seminar; writing-intensive course) The Human Genome Project is leading to great advances in our understanding of the human body and in our ability to manipulate our own genetic information. We will focus on the science behind the Human Genome Project, and the ways in which it will change our lives. This course will also serve as a general introductory biology course for biology majors as well as nonmajors. We will read articles and books, and make use of the World Wide Web.
*Meets Science and Math II-B requirement*
*C. Woodard*
*4 credits*

**145(12) Animal Bodies, Animal Functions*
(First-year seminar; writing-intensive course) How are animal bodies built to deal with living on earth? In this course we will study the function of cells, organs, and organ systems that have evolved to help animals make their way through the physical and chemical environment. We'll consider the common needs of animals—needs such as feeding, breathing, and reproducing—and the diverse solutions they have devised. A range of life, from unicellular organisms to animals with backbones (including mammals) will be considered.
*Meets Science and Math II-B requirement*
*S. Bacon*
*Prereq. fy or permission of instructor; 4 credits*

**145(13) Patterns and Principles of Life*
(First-year seminar; writing-intensive course) This course offers an introduction to the central concepts and patterns underlying much of modern biology, including the basic principles of cell biology, genetics, evolution, and energetics. We will examine several "model

organisms," such as *E. coli*, baker's yeast, *Arabidopsis*, maize, the roundworm, and the mouse to see how and why experimental results in these systems can have such general importance and broad applicability.
*Meets Science and Math II-B requirement*
*J. Knight*
*Prereq. fy or permission of instructor; 4 credits*

**160f Integrated Introduction to Biology and Chemistry**
This 8-credit course serves as a gateway to both the biology and chemistry core curricula. The course introduces and develops fundamental concepts in chemistry while also exploring the diverse range of strategies adopted by living systems to survive in different environments. This course prepares students for further study in chemistry (Chemistry 201) and/or biology (Biology 200). Students must register for both Biology 160 and Chemistry 160 as well as a single lab section (listed under Chemistry 160). Recommended for students interested in completing pre-health requirements or advanced study in biochemistry or neuroscience.
*Meets Science and Math II-B requirement*
*D. Cotter, D. Pope*
*Students must enroll in Biology 160 and Chemistry 160 for a total of 8 credits; 3 lectures (50 minutes), and 1 lab (4 hours) per week.; 4 credits*

**200s Introductory Biology II: How Organisms Develop**
An overview of cells to tissues to organisms. Cellular components, the role of the nucleus, cell reproduction, and meiosis will be examined as part of our study of gamete production, fertilization, embryology, and development in an invertebrate (sea urchins), a vertebrate (chick), a fern, and a flowering plant. The basic molecular biology of DNA, RNA, and protein synthesis will be presented and examined in the context of building a fly embryo and a flower.
*Meets Science and Math II-B requirement*
*A. Frary, R. Fink*
*Prereq. Biological Sciences 145 or 160; 4 credits*

**206s Local Flora**
Offers plant identification and natural history, emphasizing trees, native and introduced, and wildflowers. On- and off-campus field trips.
*Does not meet a distribution requirement*
*A. Frary*
*Prereq. 4 credits in department or permission of instructor; 1 meeting (3 hours), with field trips; 2 credits*

**210f Genetics and Molecular Biology**
A comprehensive study of the fundamental principles of classical and molecular genetics. Major topics include transmission genetics, gene linkage and mapping, molecular approaches to genetic analysis, genetic engineering, gene therapy, developmental genetics, quantitative inheritance.
*Meets Science and Math II-B requirement*
*C. Woodard, J. Knight*
*Prereq. Biological Sciences 200; Chemistry 101 must be taken prior to or as a corequisite to this course.; 4 credits*

**220s Cell Biology**
This course undertakes an integrated study of the processes and structures that define life at the cellular level. We will consider the molecular and supramolecular organization of membranes, cytoskeleton, and organelles in the context of the physical and chemical principles governing their assembly, and their participation in phenomena such as the capture and transformation of energy, catalysis, transport, motility, signal transduction, and maintenance of cytoplasmic organization. The laboratory portion of this course illustrates and analyzes these phenomena through selected optical and biochemical approaches.
*Meets Science and Math II-B requirement*
*S. Stranford, L. Jarvinen*
*Prereq. Biological Sciences 200, Chemistry 201 (can be taken concurrently); 4 credits*

**223f Ecology**
This course will cover the fundamental factors controlling the distribution and abundance of organisms, including interactions with the abiotic environment, fitness and natural selection, population growth and dynamics, species interactions, community dynamics, and diversity. We will address variation across space and time. The course will combine observational, experimental, and mathematical approaches to some of the applications of ecological theory, including

conservation, disease dynamics, and biological control.
*Meets Science and Math II-B requirement*
*M. Hoopes*
*Prereq. An MHC Biology class or Environmental Studies 200 and a minimum of one semester of high school or college calculus or statistics; Biology 223 and/or Biology 226 must be taken for the Biology major.; 4 credits*

**226s Evolution**
The mechanisms of evolutionary change within populations and between species; patterns of change in space, time and form; and the origin of adaptations. These approaches make sense of the diversity of life; then we turn to the evolution of developmental pathways, as a way of approaching the unity of life.
*Meets Science and Math II-B requirement*
*S. Rachootin*
*Prereq. Biology 210 or 223; seniors may only take lab on Friday; sophomores and juniors on either Tuesday, Wednesday or Thursday only; 4 credits*

**295fs Independent Study**
*Does not meet a distribution requirement*
*The department*
*Prereq. soph, permission of instructor; Note: Any student conducting an independent laboratory research project for course credit in a department, program, or laboratory covered by the College's chemical hygiene plan must participate in a safety training session before beginning research.; 1-4 credits*

**301s Animal Cloning, Stem Cells and Regenerative Medicine: Past, Present, and Future**
(Speaking-intensive course) This course will look at the current state of mammalian cloning and the debates about human stem cell research, reading from primary literature. We will study adult, embryonic, and induced pluripotent stem cells. We will discuss the legal, ethical, and moral implications of using these cells in medical therapies, and each member of the class will participate in a staged debate on these issues for an introductory biology class. Pending funding, we may attend a conference on stem cell biology in Connecticut, or travel to Washington, D.C.
*Does not meet a distribution requirement*
*R. Fink*
*Prereq. per instructor only; email rfink; 2 credits*

**302f Molecular Evolution**
This course examines the dynamics of evolutionary change at the molecular level, the effects of various molecular mechanisms on the structure and function of genes and genomes, and the methodology involved in dealing with molecular data from an evolutionary perspective. Lab work will be devoted to learning ways to analyze DNA sequence data and to create and evaluate trees that use molecular data.
*Meets Science and Math II-B requirement*
*A. Frary*
*Prereq. Biological Sciences 210 and 226; 4 credits*

**305f Cellular and Molecular Aspects of Development**
(Speaking-intensive course) Examines the roles of cellular movement and cellular interaction in the development of multicellular organisms. Topics include cell recognition and adhesion during morphogenesis, the importance of extracellular matrices, and current theories of embryonic pattern formation. Self-designed laboratories include techniques such as microsurgery and time-lapse video microscopy using a wide variety of embryos and cell types. Pending funding, we will attend a conference on sea urchin development at the Marine Biological Laboratory in Woods Hole, Massachusetts.
*Meets Science and Math II-B requirement*
*R. Fink*
*Prereq. Biological Sciences 200, 210, and 220, or permission of instructor; 4 credits*

**308s Darwin**
(Writing-intensive course; Same as History 361s(02)) This course looks at the scientific content and intellectual context of Darwin's theory of evolution - his facts, metaphors, hypotheses, and philosophical assumptions. Readings from Darwin and his sources, and examination of the organisms he studied. A background in eighteenth- and nineteenth-century history or whole organism biology is recommended.
*Meets Humanities I-B requirement*
*S. Rachootin*

*Prereq. Biological Sciences 226 or 4 credits in history; 4 credits*

**310f Invertebrate Zoology**
This course looks at the evolutionary relations of the profoundly different groups of animals in light of their structure, development, and fossil history. Emphasizes exceptional organisms that prove - and disprove - biological rules. Themes include coloniality, asexual reproduction, metamorphosis, and making skeletons.
*Meets Science and Math II-B requirement*
*S. Rachootin*
*Prereq. Biological Sciences 226; 4 credits*

**311f Protein Biochemistry and Cellular Metabolism**
(Same as Biochemistry 311f; Chemistry 311f)
*Meets Science and Math II-B requirement*
*L. Hsu*
*Prereq. Biological Sciences 210, Chemistry 302; 4 credits*

**314s Nucleic Acids Biochemistry and Molecular Biology**
(Same as Biochemistry 314s, Chemistry 314s) This course is an in-depth examination of DNA and RNA structures and how these structures support their respective functions during replication, transcription, and translation of the genetic material. Emphasis is on the detailed mechanisms associated with each step of gene expression. Discussions incorporate many recent advances brought about by recombinant DNA technology.
*Meets Science and Math II-B requirement*
*K. Mix*
*Prereq. Biological Sciences 210, Chemistry 302, Biochemistry 311, or permission of instructor; Please sign up for this course as Biochemistry 314; 4 credits*

**315s Behavioral Ecology**
(Writing-intensive course) In this course, students learn to view and understand animal behavior within an evolutionary context. The mechanistic side of behavior is investigated and students explore how behavioral traits originate and evolve over time. Students will integrate their knowledge of how organisms work with an appreciation of why they work the way they do. At the end of the course, students will understand basic concepts in behavioral biology and know many of the experiments that have facilitated our understanding of this field. They will be able to construct hypotheses and design experiments that address behavioral phenomena. The laboratory portion of this course is based on individual projects.
*Meets Science and Math II-B requirement*
*R. Brodie*
*Prereq. 8 credits of biology at the 200 level with 223 or 226 strongly recommended; 4 credits*

**316f Scanning Electron Microscopy**
(Same as Geology 316f) Includes theory and operation of the scanning electron microscope and preparation of biological and geological materials for observation. The versatile use of the microscope will be emphasized and will include low magnification, high resolution, and back scattered (reflected) electron modes of operation as well as operation at different pressures. Energy dispersive X-ray microanalysis will be introduced.
*Does not meet a distribution requirement*
*M. Rice*
*Prereq. 4 credits of biological sciences or geology course at the 200 level; 2 credits*

**319f Immunology**
This course will cover the cells, organs, and biochemical signals that constitute the immune system, as well as immune mechanisms for the identification and removal of foreign pathogens. Additional topics may include: autoimmunity, allergy, vaccination, transplantation, immune deficiency, and pathogen evasion strategies. Special emphasis will be placed on the human immune response, with the addition of clinical case studies and independent laboratory projects to reinforce these ideas.
*Meets Science and Math II-B requirement*
*S. Bakkour, S. Stranford*
*Prereq. Biological Sciences 210 and 220; 4 credits*

**320f Introduction to Transmission Electron Microscopy**
Basic principles of transmission electron microscopy (TEM) and potential uses in biological studies. Each student selects a project and learns the fundamentals of specimen preparation, operation of the TEM, and image ac-

quisition. Assessment and interpretation of the resulting electron micrographs culminate in an individual portfolio. Students wishing to extend their experience in other courses, including Biological Sciences 295 and 395, may enroll in this course concurrently.
*Does not meet a distribution requirement*
*M. Rice, S. Lancelle*
*Prereq. Biological Sciences 220; 2 credits*

**321fs Conference Course**
Selected topics for areas emphasized in the department according to needs of particular students. Study in small groups or by individual.

*Fall 2009*

*321f(01) The Neurobiology of Art and Music*
Art and music are a part of all human cultures. Is there something about the human brain that drives us to paint and sing? We will examine how the brain simultaneously processes different aspects of a visual object, such as shape, color, and depth, and ask how this processing may affect the way we draw and paint. We will ask whether musical dissonance and consonance are biologically or culturally determined and whether or not different parts of the brain process different aspects of music such as pitch, melody, harmony, rhythm, and the emotional content of a musical piece.
*S. Barry*
*Prereq. seniors with at least 8 credits at the 200 level in biology, neuroscience and behavior, studio art, art history, or music; 2 credits*

**321f(06) Extreme Life*
This course will focus on biological systems that push the limits of structural and physiological possibility. For example, midges flap their wings at up to 1000 Hz; bar-headed geese migrate over Mount Everest; deep-sea fish withstand pressures near 300 atmospheres; certain frogs can allow their body temperatures to drop below 0 degrees C. We will explore the diverse mechanisms that underlie how organisms reach extreme levels of performance and survive in extreme environments through readings and discussions.
*G. Gillis*
*Prereq. jr, sr or permission of instructor; 2 credits*

*Spring 2010*

*321s(01) Principles of Animal Communication*
(Speaking- and writing-intensive course)
This seminar course will focus on current research in animal communication through readings and discussion of primary literature. Topics covered will include: honesty and deception in animal signals; the diverse sensory modalities used in animal signals, including those beyond the range of human capabilities, such as infrasound, ultrasound, ultraviolet and electrical signals; the physiological bases of signal production and perception; and environmental selection pressures on signals, including those caused by human impacts.
*D. Pope*
*Prereq. Biological Sciences 315 or Psychology 251 or permission of instructor; 2 credits*

*321s(02) Invasion Biology: Brave New Species in a Brave New World*
(Speaking-intensive course) How do species move from one continent to another, and what happens when they get to the new environment? The invasion process has been part of species interactions since organisms first evolved, but humans have altered species invasions so that we are creating newly homogeneous sets of species across continents. What are the consequences of species invasions? What makes some species more successful invaders and some sites more invaded? We will explore the mechanisms behind successful invasions, examine how species adapt to their new environments, and explore ways to assess and manage the impacts of these new colonists through primary literature readings and discussions.
*M. Hoopes*
*Prereq. Biological Sciences 223 and 4 other credits above Biol-200; 2 credits*

**321s(05) Marine Conservation Biology*
(Speaking- and writing-intensive course)
This seminar course will be based entirely on published research related to issues in marine conservation biology. It will focus primarily on the most recent data on global climate change, but the course will also address other topics such as waste disposal, the management of fisheries, and invasive species. A se-

mester-long group project will be conducted by the class, in which students will research and defend a stakeholder's position in a current environmental affair, submit a position paper, and engage in a debate near the end of the semester. Students taking this course will have in-depth, up-to-date knowledge of the research that informs our understanding of global environmental change.
*R. Brodie*
*Prereq. Biological Sciences 223 or 226; 2 credits*

**321s(10) Emerging Infectious Diseases*
(Speaking-intensive course) What is the current state of infectious disease in the world? What are the important factors that favor the emmergence or reemergence of specific infectious agents? In this course the primary literature will be used as a foundation for discussing global emerging and re-emerging infectious diseases. As a group we will discuss the science behind these diseases and their therapies as well as some of the social aspects relevant to the present day spread of infectious disease. Students will be expected to work in collaborative groups to present background material and original research findings relevant to these pathogens and the diseases they cause.
*S. Stranford*
*Prereq. Biological Sciences 319, or permission of instructor; 4 credits*

***322s Comparative Biomechanics**
(Same as Physics 222) The main objective of this course is to explore organismal structure and function via an examination of the basic physical principles that guide how living things are constructed and how organisms interact with their environment. We will use the combined approaches of the biologist and engineer to study the impact of size on biological systems, address the implications of solid and fluid mechanics for animal design, survey different modes of animal locomotion, and learn how biologists working in diverse areas (e.g., ecology, development, evolution, and physiology) gain insight through biomechanical analyses.
*Meets Science and Math II-B requirement*
*G. Gillis*
*Prereq. any two courses above Biology 200 or permission of instructor; 4 credits*

***323f Plant Growth and Development**
This course is a study of the higher plant, its structure, organization, and development. Examines both endogenous and environmental factors influencing plant growth and reproduction. Topics include anatomy, hormones and their mode of action, tropisms, photomorphogenesis, and flowering.
*Meets Science and Math II-B requirement*
*A. Frary*
*Prereq. Biology 150, 200, 210 or permission of instructor; 4 credits*

***325f Plant Diversity and Evolution**
This course explores the tremendous diversity of the plant kingdom, emphasizing the local flora. Evolutionary relationships are discussed on the basis of comparisons of reproductive biology, morphology, anatomy, cell structure, and molecular biology.
*Meets Science and Math II-B requirement*
*A. Frary*
*Prereq. two of Biological Sciences 200, 210, 223 or 226, or permission of instructor; offered alternate years; 4 credits*

**327s Microbiology**
This course is a general study of microorganisms and their activities, including form and structure; biochemical processes of growth, metabolism, and energy storage; distribution in nature and relationships to other organisms; cycles of matter; beneficial and detrimental effects on humans; and physical and chemical effects microorganisms make in their environment.
*Meets Science and Math II-B requirement*
*J. Knight*
*Prereq. Biological Sciences 220 or 311 and either 210 or 223; 4 credits*

**328s Regulatory and Integrative Human Physiology**
We will investigate the fundamental processes by which human body systems function, and how they can be modified to enable the individual to live in a changing environment. We will pay particular attention to how different body systems are integrated with one another, and to the cellular and molecular mechanisms which make this functional integration possible.
*Meets Science and Math II-B requirement*
*S. Bacon*

*Prereq. Biological Sciences 220 or Biochemistry 311; 4 credits*

**331s Theory and Application of Conservation Biology**
This course focuses on advanced ecological theory applied to conservation. Class will combine lectures and discussions of primary scientific literature. Labs will include field trips to collect observational and experimental data and indoor exercises to explore the concepts of rarity, coexistence, and population viability with mathematical models. A community-based learning aspect is possible for the final project in this class.
*Meets Science and Math II-B requirement*
*M. Hoopes*
*Prereq. Biology 223 or permission of instructor; 4 credits*

***332f Macroevolution**
This course presents the science of biological form and its relation to adaptation, development, and the modes of evolutionary change. Emphases include primary theoretical literature, whole organisms, the emerging field of evolutionary developmental biology, and major transitions in vertebrate evolution.
*Meets Science and Math II-B requirement*
*S. Rachootin*
*Prereq. Biological Sciences 226 and permission of instructor; 4 credits*

**333s Neurobiology**
We will study the electrical and chemical signals underlying the generation of the nerve impulse and synaptic transmission. We will then explore neuronal circuits underlying learning and memory, movement, and sensory perception.
*Meets Science and Math II-B requirement*
*S. Barry*
*Prereq. Biological Sciences 200, 220 and 4 credits in chemistry or physics; preference given to seniors; 4 credits*

**334f Chemical Communication in Vertebrates**
(Speaking-intensive course) How is information about physiological states coded in chemical information passed between animals? How is this information passed between organs in the body? In this course we'll read and discuss the primary literature in biology to look in depth at the nature of chemical communication in vertebrates. We will study hormones, pheromones, and neurotransmitters, the neuroendocrine mechanisms which mediate their functions in the body, and the social and physical contexts in which these signalling mechanisms operate.
*Does not meet a distribution requirement*
*S. Bacon*
*Prereq. Biological Sciences 220, 223 or 226; 4 credits*

**335s Mammalian Anatomy**
This course will examine the fundamental structural organization of the mammalian body. The lecture portion of the class will focus largely on humans, and students will gain practical insight into other mammalian systems in the laboratory.
*Meets Science and Math II-B requirement*
*G. Gillis*
*Prereq. any two courses above Biological Sciences 200; course open to 12 juniors and 12 seniors; 4 credits*

***340s Eukaryotic Molecular Genetics**
In this course we will examine the role of molecular genetic analysis in the study of phenomena such as human disease (e.g., breast cancer), animal development, and gene regulation. We will also study genetic engineering of plants and animals. There will be group discussions of original research articles and review articles.
*Meets Science and Math II-B requirement*
*C. Woodard*
*Prereq. Biological Sciences 200 and 210; 4 credits*

**344s Biogeochemistry of Northern Ecosystems**
(Speaking- and writing-intensive course; Same as Environmental Studies 344s) Global climate models and recent evidence show that ecosystems in the northern latitudes are extremely sensitive to climate change. This interdisciplinary science course examines boreal, subarctic, and arctic ecosystems through the study of nutrient cycling, plant ecology, hydrology, soil processes, and biosphere-atmosphere interactions. Topics include fundamentals of biogeochemical elements such as carbon and nitrogen at scales from the microscopic to global, sensitivity, feedbacks to

climate change, and disturbance processes such as fire and permafrost degradation.
*Does not meet a distribution requirement*
*J. Bubier*
*Prereq. At least two semesters of biology, chemistry, or environmental science, and permission of the instructor; Please sign up for this course as Environmental Studies 344; 4 credits*

**395fs Independent Study**
*Does not meet a distribution requirement*
*The department*
*Prereq. jr, sr, and permission of department; submit application in biological sciences office or via the department's Web site; NOTE: See safety training restrictions in description of Biological Sciences 295; 1-8 credits*

## Biological Sciences/Postbaccalaureate Studies Program

**146f Postbaccalaureate Introductory Biology**
This course is designed for students beginning the Postbaccalaureate Studies program in preparation for pursuing graduate-level study in the health professions. Topics include basic principles of biodiversity and taxonomy, genetics, basic biochemical principles, cell structure and function, and organ systems. Laboratory exercises compliment lecture material, and are intended to help students develop strong skills in microscopy, familiarity with using a variety of lab equipment, experimental design and data collection and analysis, and scientific writing. This course is open only to postbaccalaureate students.
*Does not meet a distribution requirement*
*D. Gardner*
*Prereq. Postbaccalaureate students only; 4 credits; enrollment limited to 15; 3 meetings (50 minutes), 1 lab (3 hours)*