

BIOLOGY (BIOL)

Faculty

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Visiting Assistant Professors: James Pearson, David Steinberg, Gwendolyn C. Williams

Lecturers: Jamie Brungard-Roseman, Alison Patterson

Laboratory Directors: Karin I. Knisely, Rebekah Stevenson, Kathryn B. Toner

Microscopy Specialist: Joseph G. Moore

Biology is the natural science that concerns itself with study of the living world. The faculty of the biology department approaches the principles of the science from the unifying perspective of the theory of evolution. Emphases include the theory and practice of the way scientific investigations are conducted as well as the more practical applications of biology.

A major in biology may serve as a sound preparation for those interested in careers in the life sciences including those who go on to graduate or medical school. Majoring in biology also adds to students' understanding of the issues concerned with health, the environment, and agriculture. In addition, Bucknell's biology majors are given the opportunity to become broadly educated "whole" scientists. They are encouraged to explore their interests within the humanities and social sciences.

Biology Majors

Two degree programs are offered through the biology program.

Bachelor of Arts

The **Bachelor of Arts major** requires eight courses in biology.

Core Sequence

BIOL 205	Introduction to Molecules and Cells ¹	1
BIOL 206	Organismal Biology ¹	1
BIOL 207	Genetics ¹	1
BIOL 208	Principles of Ecology and Evolution ¹	1
Four 300-level electives ²		
CHEM 205 or CHEM 207	Principles of Chemistry ³ Explorations in Chemistry	1
CHEM 211	Organic Chemistry I ³	1
MATH 201 or MATH 202	Calculus I Calculus II	1
MATH 216	Statistics I	1

¹ Must be completed by the end of the third year.

² One elective may be BIOL 399 Undergraduate Research, but additional 399 credit may be applied as electives beyond the courses offered for the major.

At least one elective must be in each of the three areas listed below. Two of these courses from different areas must be a laboratory or field course.

³ Must be completed by the end of the sophomore year.

Area I - Cellular/Molecular

BIOL 302	Microbiology	1
BIOL 304	Biology of Cancer	1
BIOL 322	Physiological Mechanisms	1
BIOL 323	Mammalian Histology	1

BIOL 324	Neurophysiology	1
BIOL 326	Cytogenetics	1
BIOL 327	Molecular Biology	1
BIOL 331	Genomics	1
BIOL 332	Developmental Neurobiology	1
BIOL 340	Biochemical Methods	1
BIOL 347	Virology	1
BIOL 348	Immunology	1
BIOL 352	Cell Biology	1
BIOL 363	Receptors of Biological Membranes	1
BIOL 365	Introduction to Microscopy	1
BIOL 375	Cellular and Molecular Neurobiology	1

Area II - Organismal

BIOL 309	Wildlife and Emerging Diseases	1
BIOL 312	Comparative Vertebrate Anatomy	1
BIOL 313	Mammalogy	1
BIOL 314	Amphibian Biology and Conservation	1
BIOL 316	Plant Growth and Development	1
BIOL 318	Principles of Physiology	1
BIOL 328	Endocrinology	1
BIOL 336	Anatomy and Microscopy of Plants	1
BIOL 337	Biology of Aging	1
BIOL 339	Developmental Biology	1
BIOL 342	Neuroethology	1
BIOL 357	Ornithology	1
BIOL 358	Invertebrate Zoology	1
BIOL 359	General Entomology	1
BIOL 373	Mycology	1

Area III - Ecological/Evolutionary

BIOL 307	Conservation Genetics	1
BIOL 321	Behavioral Ecology	1
BIOL 330	Plant Systematics	1
BIOL 334	Limnology	1
BIOL 341	Evolution	1
BIOL 351	Field Botany	1
BIOL 353	Ecosystem Ecology	1
BIOL 354	Tropical Ecology	1
BIOL 355	Social Insects	1
BIOL 356	Plant-Animal Interactions	1
BIOL 360	Applications of Calculus to Medicine and Biology	1
BIOL 361	Systematic Biology	1
BIOL 370	Primate Behavior and Ecology	1
BIOL 371	Field Entomology	1

Bachelor of Science

The Bachelor of Science major requires nine courses in biology. The major provisions in biology are the same as those noted above under the Bachelor of Arts major, but five rather than four 300-level electives are required, only one of which may be BIOL 399 Undergraduate Research.

The Bachelor of Science major also requires:

CHEM 205	Principles of Chemistry ⁴	1
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or CHEM 207	Explorations in Chemistry	
CHEM 211	Organic Chemistry I ⁴	1
MATH 201	Calculus I	1
or MATH 202	Calculus II	
MATH 216	Statistics I	1
PHYS 211	Classical and Modern Physics I	2
& PHYS 212	and Classical and Modern Physics II	
Select two of the following: ⁵		
BMEG 431	Biomimetic Materials	
CHEM 212	Organic Chemistry II (highly recommended)	
CHEM 231	Analytical Chemistry	
CHEM 313	Synthetic Organic Chemistry	
CHEM 314	Mechanistic Organic Chemistry	
CHEM 317	Special Topics in Organic Chemistry	
CHEM 321	Inorganic Chemistry I	
CHEM 351	Biochemistry I	
CHEM 352	Biochemistry II	
CSCI 203	Introduction to Computer Science I	
CSCI 204	Introduction to Computer Science II	
ENST 211	Environmental Pollution and Control	
ENST 215	Environmental Planning	
ENST 230	Introduction to Sustainable Design	
ENST 240	Sustainable Resource Management	
GEOG 204	Applied G.I.S.	
GEOG 345	Food and the Environment	
GEOL 107	Global Change - Past and Present	
GEOL 203	Physical/Environmental Geology	
GEOL 204	Evolution of the Earth	
GEOL 230	Environmental GIS	
GEOL 305	Introduction to Geochemistry	
GEOL 316	Geomorphology	
GEOL 317	Paleontology	
LING 225	Language and the Brain	
LING 230	Psycholinguistics	
MATH 202	Calculus II	
MATH 211	Calculus III	
MATH 217	Statistics II	
PHIL 103	Logic	
PHIL 201	Symbolic Logic	
PHIL 218	Ecology, Nature, and the Future	
PHIL 220	Philosophy of Science	
PHIL 272	Philosophy of Biology	
PSYC 203	Learning	
PSYC 204	Human Cognition	
PSYC 250	Biopsychology	
PSYC 252	Sensation and Perception	
PSYC 317	Comparative Animal Cognition	

⁴ Typically completed during the first year.

⁵ Other courses may be substituted with department approval.

Students interested in behavioral aspects of biology may wish to consider the animal behavior major; those interested in biochemistry, the cell biology/biochemistry major; those interested in environmental issues, the environmental science BA within the environmental studies program; and

those interested in neurobiology, the neuroscience program. Students planning to continue with graduate training in biology are encouraged to elect MATH 217 Statistics II and/or MATH 202 Calculus II and to consult their academic adviser or pre-health professions adviser.

The recommended sequence for the Bachelor of Science major is as follows:

First Year

First Semester	Credits	Second Semester	Credits
BIOL 205	1	BIOL 206	1
CHEM 205 or 207	1	CHEM 211	1
MATH 201 ⁶	1	MATH 216	1
Foundation Seminar	1	Elective	1
	4		4

Sophomore

First Semester	Credits	Second Semester	Credits
BIOL 207	1	BIOL 208	1
Related area course ⁷	1	Related area course	1
Elective	1	Elective	1
Elective	1	Elective	1
	4		4

Junior

First Semester	Credits	Second Semester	Credits
Elective in biology	1	Elective in biology	1
PHYS 211	1	PHYS 212	1
Elective	1	Elective	1
Elective	1	Elective	1
	4		4

Senior

First Semester	Credits	Second Semester	Credits
Two electives in biology	2	Elective in biology	1
Elective	1	Elective	1
Elective	1	Elective	1
	4		4

Total Credits: 32

⁶ If a student has placed out of MATH 201 but not received credit, MATH 202 should be taken here.

⁷ CHEM 212 is highly recommended.

College Core Curriculum – Disciplinary Depth Requirements

Students in the biology major will satisfy the writing and the information literacy requirement by completing BIOL 205 Introduction to Molecules and Cells and BIOL 206 Organismal Biology and at least two 300-level biology laboratory/field courses. They will satisfy the formal presentation requirement by completing BIOL 206 Organismal Biology as well as at least two 300-level courses in biology, which will include a required oral presentation. The Culminating Experience in Biology requirement will be fulfilled by taking one 300-level laboratory or field course from a list provided by the department in one of a student's last three semesters.

Transfer students must complete at least four courses in biology in residence at Bucknell, only one of which may be BIOL 399 Undergraduate Research.

For Bucknell students who elect to study abroad, at least three upper division courses toward the major and at least one toward the minor must be taught by Bucknell faculty.

Students who pass the BIOL 121 Biology for Non-majors-BIOL 122 Biology for Non-majors sequence with a grade of B or better in both courses may receive one core credit toward the biology major pending consultation with the department chair.

Biology Minor

A minor in biology consists of five courses.

At least two 300-level courses ¹

Select two of the following:

BIOL 205	Introduction to Molecules and Cells
BIOL 206	Organismal Biology
BIOL 207	Genetics
BIOL 208	Principles of Ecology and Evolution

¹ Cannot be BIOL 399 Undergraduate Research

Biology Department Learning Goals

(Numbers in parentheses are university-learning goals.)

I. Knowledge

Students completing the BA or BS major in Biology will:

1. Demonstrate a proficiency with the concepts and methodologies of the traditional core of biology (1, 4, 6, 8, 9)
2. Demonstrate the ability to use the scientific method (1, 8)
3. Demonstrate the ability to apply concepts from diverse sub-disciplines of biology (1, 6, 8)
4. Develop critical thinking skills to formulate and test biological questions (1, 4, 6)

In addition students completing a BS in biology will:

1. Apply and integrate other related disciplines with their knowledge of Biology (1, 2, 6)

II. Communication

Students completing the BA or BS major in Biology will:

1. Be able to write a well organized, logical and scientifically sound research paper or report (1, 7, 8)
2. Be able to present a well organized, logical and scientifically sound oral presentation on a topic in Biology (1, 7, 8)

III. Career

Students completing the BA or BS major in Biology will:

1. Be encouraged to pursue research experiences both on and off campus (1, 9)
2. Be educated about the wide variety of career paths in Biology via seminars and invited speakers

Faculty in the department will provide strong personalized advising allowing students to make informed post-graduation decisions.

Non-STEM students fulfilling their natural sciences requirements will:

1. Demonstrate a familiarity with biological principles and practices (4, 6, 8, 9)
2. Appreciate the impact of biology on society and gain confidence in their ability to understand biologically related issues (4, 6, 8, 9)

Numbers in parentheses reflect related Educational Goals of Bucknell University.

Courses

BIOL 111. Controversies in Biology. 1 Credit.

Offered Fall Semester Only; Lecture hours:3,Recitation:1

Introduction for the non-science major. Background on molecules, cells, and genetics. Required recitation will include discussions about current advances and controversies in biology. Not for pre-health students. Will not count toward the biology major. Students who take BIOL 111 may not take BIOL 121.

BIOL 120. Fight or Flight: The Biology of Stress. 1 Credit.

Offered Summer Session Only; Lecture hours:6

An exploration of biology through the lens of stress, this course will cover topics such as how stress relates to heart attacks, dwarfism, sex drive, memory loss, appetite, and aging. The course concludes with a biological-based discussion on how to effectively manage stress. Open to BCCSP.

BIOL 121. Biology for Non-majors. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Lab:3; May require dissection or live animal experimentation**

Introductory course primarily for the non-biology major. Focuses on life at the cellular and biochemical levels, genetics, and biotechnology. This course is not appropriate preparation for the majority of pre-health graduate programs. Please consult with the Pre-health Adviser for more information.

BIOL 122. Biology for Non-majors. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Lab:3; May require dissection or live animal experimentation**

Introductory course primarily for the non-biology major. Topics covered include principles of ecology, evolution, animal diversity, behavior, and structure, and function. This course is not appropriate preparation for the majority of pre-health graduate programs. Please consult with the Pre-health Adviser for more information.

BIOL 130. Health and Disease. 1 Credit.**Offered Occasionally; Lecture hours:3**

A biology course, for non-science majors, that explores the basic biological principles underlying normal health and the most common diseases of humans. Students who have taken any 200-level Biology courses are not eligible for enrollment.

BIOL 131. Biology of Food. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Other:3**

A course for non-majors that investigates fundamental concepts in biology through a focus on food and agriculture. We will debate current issues, such as genetic engineering, fad diets and our national farm policy. Lab involves hands on learning including growing and preparing food.

BIOL 137. Biology of Aging and Longevity. 1 Credit.**Offered Summer Session Only; Lecture hours:6**

This course will explore questions in the biology of aging from a physiological, genetic, and evolutionary framework.

BIOL 140. Vertebrate Biodiversity. 1 Credit.**Offered Occasionally; Lecture hours:3,Other:3**

A course for non-majors that explores the biology of mammals, reptiles, birds, amphibians and fish and their interactions within a changing environment. The course includes field trips to observe animals in their natural habitat as well as examination of museum specimens and samples collected in the field.

BIOL 149. Plants, People & the British Empire. 1 Credit.**Offered Fall Semester Only; Lecture hours:3**

The diversity and evolution of plants, fungi, and related organisms with special emphasis on flowering plants; their importance for food, fiber, medicine, and psychoactive compounds; origins of agriculture; domestication of plants; and the role of plants in the environment. Prerequisite: permission of the instructor.

BIOL 150. Plants, People, and the Environment. 1 Credit.**Offered Fall Semester Only; Lecture hours:3**

The diversity and evolution of plants, fungi, and related organisms with special emphasis on flowering plants; their importance for food, fiber, medicine, and psychoactive compounds; origins of agriculture; domestication of plants; and the role of plants in the environment.

BIOL 154. Society and the Environment. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

A biology course for non-majors only that explores society's impact on the environment and the environment's biotic and abiotic responses to various insults.

BIOL 1NT. Biology Non-traditional Study. .5-2 Credits.**Offered Fall, Spring, Summer; Lecture hours:Varies**

Non-traditional study in Biology. Prerequisite: permission of the instructor.

BIOL 205. Introduction to Molecules and Cells. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Other:4**

An introductory course which focuses on the molecular biology of cells. Basic biochemical processes, cellular and subcellular structure and function are emphasized. First core course.

BIOL 206. Organismal Biology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Other:4; May require dissection or live animal experimentation**

An introductory course for biology majors emphasizing organisms as dynamic systems by integrating structure with function. Laboratories introduce scientific method and collaborative learning. Second core course.

BIOL 207. Genetics. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Other:1**

A comprehensive survey of genetic mechanisms and methodologies, including classical genetics, recombinational analysis in bacteria, fungi, and higher eukaryotes, molecular genetics and populational and quantitative genetics. Third core course. Prerequisite: BIOL 205.

BIOL 208. Principles of Ecology and Evolution. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Lab:3**

Introduction to systematic biology, evolutionary theory, physiological ecology, behavioral ecology, population and community ecology, and ecosystem structure and function. Fourth core course. BIOL 206 and BIOL 207 strongly recommended as prerequisites.

BIOL 220. Human Anatomy. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Lab:2; May require dissection or live animal experimentation**

A course that focuses on the anatomy of and relationship between human muscles, bones, and organs. Lab involves dissection, with the cat as the primary specimen. Does not count toward the biology major. Prerequisite: permission of the instructor.

BIOL 221. Human Physiology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Lab:2**

A course that focuses on the functions of and interactions between human organ systems. Does not count toward the biology major. Prerequisite: permission of the instructor.

BIOL 231. Phage Hunters - Part I. .5 Credits.**Offered Fall Semester Only; Lecture hours:Varies,Other:4**

Students in this investigative laboratory course will isolate viruses that infect bacteria (bacteriophages) from soil samples and characterize the genome using molecular genetics techniques. Prerequisite: BIOL 205 and permission of the instructor. Corequisite: BIOL 207.

BIOL 232. Phage Hunters - Part II. .5 Credits.**Offered Spring Semester Only; Lecture hours:Varies,Other:4**

Continuation of BIOL 231. Students will learn the theory and application of bioinformatics and genomics to analyze the genome sequence of a bacteriophage isolated from soil samples. Prerequisites: BIOL 231 and permission of the instructor.

BIOL 235. Introduction to Microbiology. 1 Credit.**Offered Alternating Summers; Lecture hours:6,Lab:6**

An introduction to microbiology for non-science majors. Course will focus on the interaction between humans and microbes, not limited to disease.

BIOL 245. Tropical Marine Biology. 1 Credit.**Offered Summer Session Only; Lecture hours:10,Other:18**

A field course in marine biology of coral reefs in the Virgin Islands for non-science majors. Prerequisite: permission of the instructor.

BIOL 266. Animal Behavior. 1 Credit.**Offered Both Fall and Spring; Lecture hours:3**

A survey of important theories, issues, and empirical techniques in the interdisciplinary field of animal behavior emphasizing both proximate and ultimate mechanisms and explanations for behavior. Crosslisted as ANBE 266 and PSYC 266.

BIOL 302. Microbiology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Lab:4**

Ultra-structure, behavior, metabolism, molecular biology, and development of micro-organisms. Roles in disease and food production. Laboratory will emphasize cultivation and identification. Prerequisites: BIOL 205 and BIOL 207, and permission of the instructor. Crosslisted as BIOL 602.

BIOL 304. Biology of Cancer. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

The study of the molecular and cellular mechanisms that create cancer. Prerequisites: BIOL 205, BIOL 207, and permission of the instructor. Crosslisted as BIOL 604.

BIOL 305. Vertebrate Ecology. 1 Credit.**Offered Occasionally; Lecture hours:3,Other:3**

Using field observations, collection of specimens from the field, and museum resources, the morphology and ecology of mammals, reptiles, birds, amphibians, and fish found in local environments will be examined. We will also study the interactions of these species with each other and with their changing environments. Crosslisted as BIOL 605.

BIOL 306. Biology of Host-Microbe Interactions. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Other:2**

Through study of the primary literature, this course will investigate the relationship between animals and their microbes, including evolution of host-microbe relationships, the impact of microbes on human health, the techniques used to study the microbiota, the biology of the microbiome, and other recent advances in the field. Crosslisted as BIOL 606.

BIOL 307. Conservation Genetics. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Other:3**

As biodiversity has quickly eroded for the past few centuries, some scientists argue that humans are causing the 6th mass extinction event. This course emphasizes the application of population genetics, molecular phylogenetics, and reproductive genetics to answering biological questions in wildlife conservation. Crosslisted as ANBE 307 and ANBE 607 and BIOL 607.

BIOL 309. Wildlife and Emerging Diseases. 1 Credit.**Offered Alternating Fall Semester; Lecture hours:3**

Biology of wildlife diseases, especially zoonoses (infections that jump to humans). Course will integrate popular and scientific sources. Prerequisites: BIOL 206 and permission of the instructor. Crosslisted as BIOL 609.

BIOL 310. Neurobiology of Learning and Memory. 1 Credit.**Offered Spring Semester Only; Lecture hours:3; Repeatable**

Focus will be on the cellular mechanisms underlying synaptic plasticity, modification of synapses, signaling cascades, and consolidation of synaptic changes during learning and memory formation. Primary literature will be used extensively. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor.

BIOL 312. Comparative Vertebrate Anatomy. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation**

Gross morphology with emphasis on functional and evolutionary modifications of animal structure. Gross dissection and techniques used in morphology. Prerequisites: BIOL 122 or BIOL 206 and permission of the instructor. Crosslisted as BIOL 612.

BIOL 313. Mammalogy. 1 Credit.**Offered Alternating Fall Semester; Lecture hours:3,Other:3; May require dissection or live animal experimentation**

Biology of mammals, including evolution, classification, biodiversity, behavior, anatomy, physiology, ecology, and conservation. Lab will include specimen identification, preparation, and field studies. Prerequisite: permission of the instructor. Crosslisted as BIOL 613.

BIOL 314. Amphibian Biology and Conservation. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Other:3**

The biology of amphibians, including classification, physiology, reproduction, ecology, evolution, and conservation. Laboratory section will include identification of amphibians and field work to identify conservation issues surrounding local amphibian populations. Prerequisites: BIOL 206, BIOL 208 or 208E and permission of the instructor. Crosslisted as ANBE 314 and BIOL 614 and ANBE 614.

BIOL 316. Plant Growth and Development. 1 Credit.**Offered Alternating Fall Semester; Lecture hours:3,Other:3**

The physiological and molecular bases of growth and development at the organ, tissue, and cellular levels. Effects of environmental stimuli and hormones on gene expression and the resultant changes at higher levels of organization. Prerequisite: BIOL 205, BIOL 206, and permission of the instructor. Crosslisted as BIOL 616.

BIOL 318. Principles of Physiology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Lab:3**

Emphasizes the breadth of physiology and explores physiological principles of animals from a cellular, organismal, medical, and ecological framework. Laboratory focuses on experimental design and independent research. Prerequisites: BIOL 205, BIOL 206 and permission of the instructor. Crosslisted as BIOL 618.

BIOL 319. Seminar. 1 Credit.**Offered Either Fall or Spring; Lecture hours:Varies,Other:3; Repeatable**

Topics vary. Crosslisted as BIOL 619.

BIOL 320. Seminar. 1 Credit.**Offered Either Fall or Spring; Lecture hours:Varies,Other:3; Repeatable**

Topics vary. Crosslisted as BIOL 620.

BIOL 321. Behavioral Ecology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3**

The consideration of behavioral adaptations to various ecological situations. Topics include habitat choice, foraging behavior, defenses against predation, mate choice, and brood care. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as BIOL 621 and ANBE 321 and ANBE 621.

BIOL 322. Physiological Mechanisms. 1 Credit.**Offered Alternating Spring Semester; Lecture hours:3**

Integration of cell and organ physiology; emphasis on protein, ion transport, nerve and muscle physiology, cardiovascular, renal, and respiratory systems. Prerequisites: BIOL 205 and BIOL 206. Crosslisted as BIOL 622.

BIOL 323. Mammalian Histology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Other:3**

A detailed study of the microscopic architecture and associated physiology of mammalian cells, tissues and organ systems. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor. Crosslisted as BIOL 623.

BIOL 324. Neurophysiology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

A study of neural signaling via stimulus-response, with an emphasis on cellular integration. Sensory-motor as well as more complex brain systems will be explored. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor. Crosslisted as BIOL 624.

BIOL 325. Evolutionary Genomics. 1 Credit.**Lecture hours:3,Other:3**

An exploration of evolutionary questions using large sequencing databases, with an emphasis on developing strategies for computational sequence analysis. Includes review of the primary literature. No coding experience necessary. BIOL 207 required; BIOL 208 recommended, but not required.

BIOL 326. Cytogenetics. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Other:3**

Study of chromosome structure, organization, aberrations, and behavior. Multiple eukaryotic systems will be considered with links to human disease. Prerequisites: BIOL 205 and BIOL 207 and permission of the instructor. Crosslisted as BIOL 626.

BIOL 327. Molecular Biology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Lab:3**

Synthesis of DNA, RNA, and protein, and the regulation of these processes in both prokaryotic and eukaryotic cells; laboratory experience in the manipulation and analysis of genes. Prerequisites: BIOL 205 and BIOL 207 and permission of the instructor. Crosslisted as BIOL 627.

BIOL 328. Endocrinology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Problem Session:2**

Regulation and function of hormones and their receptors from molecular to organismal levels. Role of hormones in development, physiology, and behavior; endocrine disease. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor. Crosslisted as BIOL 628.

BIOL 330. Plant Systematics. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Other:4**

Exploration of the diversity of plant life on Earth through lectures, labs, and field trips; includes biogeography, natural history, evolutionary relationships, ethnobotanical uses, and identification. Prerequisite: BIOL 206 or permission of the instructor. Crosslisted as BIOL 630.

BIOL 331. Genomics. 1 Credit.**Offered Occasionally; Lecture hours:3,Other:2**

A computer research-based course in which students study the structure, content, expression and evolution of genomes. Prerequisites: BIOL 207 and permission of the instructor. Crosslisted as BIOL 631.

BIOL 332. Developmental Neurobiology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Recitation:1**

Primary literature-based senior seminar on topics in developmental neurobiology. Prerequisites: BIOL 205, BIOL 207, and either BIOL 206 or NEUR 100, junior or senior status, and permission of the instructor. Crosslisted as BIOL 632 and NEUR 332.

BIOL 334. Limnology. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Other:3**

The physical, chemical, and biological characteristics of fresh-water communities are studied. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as BIOL 634.

BIOL 336. Anatomy and Microscopy of Plants. 1 Credit.**Offered Occasionally; Lecture hours:3,Lab:3**

Introduction to the internal structure of plants, including subcellular anatomy, plant cell types, tissue types, and the diversity of these types across the plant kingdom. Significant experience with multiple forms of microscopy involved. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor.

BIOL 337. Biology of Aging. 1 Credit.**Offered Fall Semester Only; Lecture hours:3**

This course will explore questions in the biology of aging from a physiological, genetic, and evolutionary framework, with an emphasis on critical reading of primary literature. Prerequisites: BIOL 206 and permission of the instructor. Crosslisted as BIOL 637.

BIOL 339. Developmental Biology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation**

This course provides an introduction to early animal development with emphasis on the molecular, cellular and genetic mechanisms that drive the formation of the embryo. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor. Crosslisted as BIOL 639.

BIOL 340. Biochemical Methods. 1 Credit.**Offered Spring Semester Only; Lecture hours:2,Other:6**

A course in laboratory techniques including cell fractionation and analysis of proteins and nucleic acids. Spectrophotometry, chromatography, centrifugation, electrophoresis, and methods of molecular cloning are emphasized. Prerequisites: BIOL 205 and CHEM 351 and permission of the instructor. Crosslisted as CHEM 358.

BIOL 341. Evolution. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

Survey of evolutionary processes, phenomena, and mechanisms. Topics covered may include natural selection, sexual selection, adaptation, evolutionary constraints, speciation, evolution and development, coevolution, behavioral evolution, and macroevolution. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as ANBE 341 and ANBE 641 and BIOL 641.

BIOL 342. Neuroethology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

A course that integrates neurobiology and behavior in natural contexts. Emphasis on signal detection, recognition, discrimination, localization, orientation, and the control of complex acts. Neuronal and hormonal mechanisms, ontogeny and evolution of behavior will be considered. Prerequisites: BIOL 206 or BIOL 208 and permission of the instructor. Crosslisted as ANBE 342 and ANBE 642 and BIOL 642.

BIOL 347. Virology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Other:2**

The study of virus structure, genome organization, replication and host-interactions. Emphasis will be on animal and bacterial viruses. Prerequisites: BIOL 205, BIOL 207, and permission of the instructor. Crosslisted as BIOL 647.

BIOL 348. Immunology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Other:3; May require dissection or live animal experimentation**

Development and function of the immune system in animals. The immune response in health and disease. Techniques in immunology. Prerequisites: BIOL 205 and BIOL 206 and permission of the instructor. Crosslisted as BIOL 648.

BIOL 350. Independent Study. 1 Credit.**Lecture hours:Varies,Other:3; Repeatable**

Selected topics.

BIOL 351. Field Botany. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Other:1**

Outdoor field experience in plant diversity and ecology. Excursions to natural areas focused on identification, community dynamics, and ecological interactions/adaptations. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as BIOL 651.

BIOL 352. Cell Biology. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Lab:3**

Covers biomembranes, cell growth patterns, cell signaling, the cytoskeleton, cell organelles, and microscopic techniques. Laboratory includes experience with cell culture. Prerequisites: BIOL 205 and permission of the instructor. Crosslisted as BIOL 652.

BIOL 353. Ecosystem Ecology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Recitation:1**

Interactions between organisms and the physical and chemical environment including nutrient cycling and energy flow, biogeochemistry, and temporal and spatial dynamics of ecosystems. Prerequisites: BIOL 208, junior or senior status, and permission of the instructor. Crosslisted as BIOL 653 and ENST 353.

BIOL 354. Tropical Ecology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

Introduction to tropical ecology including life history strategies of vertebrates and invertebrates, biodiversity management and conservation. Emphasis on class and individual projects, data collection, and journal keeping. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as ANBE 354 and ANBE 654 and BIOL 654.

BIOL 355. Social Insects. 1 Credit.**Offered Fall Semester Only; Lecture hours:3,Recitation:2**

Evolution and genetics of social behavior, caste, communication in foraging and colony defense, queen and worker control over reproduction, social homeostasis and population dynamics. Occasionally may be taught as a laboratory science. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as ANBE 355. Juniors and seniors only.

BIOL 356. Plant-Animal Interactions. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Other:3**

The ecological and evolutionary interactions among plants and animals, covering pollination, herbivory, seed dispersal, human applications, and effects of global change. Crosslisted as ANBE 356, and ANBE 656, and BIOL 656.

BIOL 357. Ornithology. 1 Credit.**Offered Occasionally; Lecture hours:3,Other:3**

The biology of birds, including evolution, behavior, anatomy, physiology, ecology, and conservation; lab trips focus on identification of birds in the field. Prerequisites: BIOL 206, BIOL 208 and permission of the instructor. Crosslisted as ANBE 357 and ANBE 657 and BIOL 657.

BIOL 358. Invertebrate Zoology. 1 Credit.**Offered Alternating Fall Semester; Lecture hours:3,Other:3**

A survey of the invertebrate phyla covering phylogenetic relationships, functional morphology, ecology, life histories, symbiosis, ontogeny, and behavior. Includes hands-on study of organisms in lab and field. Prerequisites: BIOL 206, BIOL 208, and permission of the instructor. Crosslisted as BIOL 658.

BIOL 359. General Entomology. 1 Credit.**Offered Alternating Fall Semester; Lecture hours:3,Other:3**

The biology of insects and their kin: anatomy, physiology, ecology, behavior, development, evolution, systematics, and diversity. Prerequisites: BIOL 206, BIOL 208, and permission of the instructor. Crosslisted as BIOL 659.

BIOL 360. Applications of Calculus to Medicine and Biology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3**

Biology has been described as the most mathematical science. Researchers in biology use mathematical models to design strategies for controlling epidemics, administering drugs, and managing ecosystems. In this class you will learn how to develop your own models, approximate solutions to your models, and compare these solutions to real data. Crosslisted as BIOL 662 or MATH 260.

BIOL 361. Systematic Biology. 1 Credit.**Offered Occasionally; Lecture hours:3**

Seminar in systematics, the study of the classification, diversity, and evolutionary relationships of all life. Emphasis placed on molecular data and the importance of systematics to all fields of biology. Prerequisites: BIOL 207, BIOL 208 and permission of the instructor. Crosslisted as BIOL 661.

BIOL 362. Topics in Cell Biology. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Other:1.5**

Selected topics in cell biology will be covered in a format (lecture, discussion, demonstration, seminar) that may vary from year to year. Topics may include membrane structure and dynamics, cell signaling, the cytoskeleton, protein synthesis and targeting, the cell cycle, mitosis, cell-cell interactions and cell-substrate interactions, among others.

BIOL 363. Receptors of Biological Membranes. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3**

A course focused on the receptors and channels that function in biological membranes. The primary research literature will be used to explore the molecular bases of cellular communication, neuronal connectivity, and sensory transduction. Prerequisites: BIOL 205 and either BIOL 206 or NEUR 253. Crosslisted as BIOL 663 and NEUR 363.

BIOL 365. Introduction to Microscopy. 1 Credit.**Offered Spring Semester Only; Lecture hours:3,Other:3**

This course is designed as an overview of light and electron microscopy, with emphasis placed on the use of instrumentation. Prerequisite: Permission of the instructor. Crosslisted as BIOL 665.

BIOL 370. Primate Behavior and Ecology. 1 Credit.**Offered Fall Semester Only; Lecture hours:3; May require dissection or live animal experimentation**

Introduction to research on prosimians, monkeys, and apes with emphasis on the evolutionary origin of diversity, habitat use, social structure, social behavior, and cognitive abilities. Prerequisites: BIOL 122 or BIOL 208 or ANBE 266 or BIOL 266 or PSYC 266 and permission of the instructor. Crosslisted as ANBE 370 and ANBE 670 and BIOL 670 and PSYC 370 and PSYC 670.

BIOL 371. Field Entomology. 1 Credit.**Offered Fall Semester Only; Lecture hours:2,Other:2**

Introduction to insects in their natural habitats, with emphasis on insect collecting, taxonomy, identification, ecology, and natural history. Students will make a professional-quality insect collection and acquire skills appropriate for biodiversity surveys. Prerequisites: BIOL 208 and permission of the instructor. Crosslisted as BIOL 671.

BIOL 373. Mycology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Other:3**

Biology of fungi, including evolution, classification, biodiversity, ecology, and medical implications. Lab will involve identification, microscopy, culturing techniques, and field collection. Prerequisite: BIOL 206. Crosslisted as BIOL 673.

BIOL 375. Cellular and Molecular Neurobiology. 1 Credit.**Offered Either Fall or Spring; Lecture hours:3,Lab:3**

A course focused on the molecular and cellular mechanisms that drive the firing and wiring of neurons. Topics of emphasis include excitable membrane physiology, synaptic transmission, plasticity and learning, and sensory transduction. The required co-requisite laboratory component provides hands-on neurophysiology experience with live animal models. Crosslisted as BIOL 675.

BIOL 399. Undergraduate Research. .5-2 Credits.**Offered Fall, Spring or Summer; Lecture hours:Varies,Other:Varies; Repeatable; May require dissection or live animal experimentation**

Undergraduate research. Prerequisite: permission of the instructor.