

## Biology

PROFESSORS **Heideman** (Chair), **Allison, Bradley, Fashing, Saha, Sanderson,** and **S. Ware.** ASSOCIATE PROFESSORS **Capelli, Case, Chambers, Cristol, Forsyth, Gilchrist, Griffin, Shakes, Swaddle,** and **Zwollo.** ASSISTANT PROFESSORS **Engstrom, Kerscher,** and **Wawersik.** PROFESSOR EMERITUS **Hoegerman.** RESEARCH PROFESSORS **Byrd, Grant,** and **Watts.** RESEARCH ASSOCIATE PROFESSOR **D. Ware.** VISITING ASSISTANT PROFESSOR **Sher.** INSTRUCTORS **Sadler, Saunders.**

The program of the Department of Biology is organized to provide majors with a sound introduction to the principles of biology and to develop an appreciation for the diversity and complexity of living things. The department attempts to provide majors both breadth and depth of training as well as a variety of approaches to the study of life, while allowing maximum flexibility in the development of programs consistent with the interests and needs of individual students. The major requirements below have been designed with these objectives in mind.

Given the increasing intersection of modern biology with other sciences, majors may wish to enhance their training through a minor in other programs. In addition to those programs offering undergraduate majors, minors are also available in Biochemistry and, through the Applied Science program, in Computational and Mathematical Biology. See catalogue for further information.

### Requirements for Major

**Required Credit Hours:** 37 (Chemistry 103, 206, 307 or 209, and 308 or 305, and associated labs Chemistry 151, 252, 353, and 354 or 356 are required for a biology major, but the credit hours for these courses do not apply toward the minimum requirements for a major in biology.)

**Major Computing Requirement:** The Major Computing Proficiency Requirement is satisfied by completion of either Biology 204 or 203.

**Major Writing Requirement:** The Major Writing Requirement in biology can be fulfilled by Biology 300 or Biology 496 (consult the catalog description concerning how to register for the writing requirement).

**Core Requirements:** It is strongly recommended that biology majors, especially those planning on pursuing advanced degrees, complete two semesters in both mathematics and physics. The following four courses (16 credits) are required of all majors. Credits are given in parentheses. Students who received a score of 5 on the Advanced Placement Examination should consult the catalog section on Requirements for Degrees in regard to credit and exemption options.

- 203 Principles of Biology: Molecules, Cells, Development with Laboratory (4)
- 204 Principles of Biology: Organisms, Ecology, Evolution with Laboratory (4)
- 205 Integrative Biology: Plants with Laboratory (4)
- 206 Integrative Biology: Animals with Laboratory (4)

In addition to the above, a major must complete at least six credits from each group of courses listed below and must complete laboratory work in at least one course numbered above 300. A laboratory course from either group will satisfy this minimal requirement. Biology 403 and/or Biology 495-496 cannot substitute for the laboratory requirement. BIOL 100-level courses are not applicable toward the minimum requirements.

## Molecules, Cells, Genes and Development

- 345 Neurobiology (3)
- 406 Molecular Cell Biology (3); 407 Molecular Cell Laboratory (1)
- 414 Biochemistry (3)
- 415 Endocrinology (3)
- 419 Plant Development and Physiology with Laboratory (4)
- 420 Genetic Analysis (3); 421 Genetic Analysis Laboratory (1)
- 430 Mechanisms of Bacterial Symbioses (3)
- 432 Principles of Animal Physiology with Laboratory (4)
- 433 Developmental Biology (3); 434 Developmental Laboratory (1)
- 436 Advanced Cell Biology (3)
- 437 Immunology (3); 438 Immunology Laboratory (1)
- 439 Gene Regulation (3)
- 440 Microbiology (3), 441 Microbiology Laboratory (1)
- 442 Molecular Genetics (3); 443 Molecular Genetics Laboratory (1)
- 446 Nuclear Structure and Gene Activity (3)
- 447 Neurophysiology with Laboratory (4)
- 450 Microbial Pathogenesis (3)

## Organisms, Populations, Ecology and Evolution

- 314 Vertebrate Biology (3)
- 315 Vertebrate Biology with Laboratory (4)
- 316 Invertebrate Biology with Laboratory (4)
- 317 Paleontology with Laboratory (3)
- 401 Evolutionary Genetics (3)
- 410 Animal Behavior (3)
- 412 Vascular Plant Systematics with Laboratory (4)
- 416 Introduction to Ornithology with Laboratory (4)
- 417 Population and Community Ecology with Laboratory (4)
- 418 Functional Ecology (3)
- 426 Aquatic Ecology with Laboratory (4)
- 427 Wetland Ecosystems with Laboratory (4)
- 428 General Entomology with Laboratory (4)
- 431 Physiological Ecology of Plants (3)
- 448 Evolutionary Biology (3)
- 449 Sexual Selection (3)

### Requirements for Minor

**Required Credit Hours:** 21 credits,

**Core Requirements:** Biology 203, 204, 205 and 206 are required. The remaining 5 credits may be taken from either group of courses listed above. Biology 105, 108, 109, 110, 111, 150W, 403, or 495-496 are not applicable toward the minimum requirements.

### Description of Courses

#### 105. Plants, People, and Agriculture

(GER 2B) Fall (Alternate years, offered 2008-2009) (3) Engstrom.

An introduction to the complex relationship between people, plant, and agriculture with an emphasis on agricultural sustainability as it pertains to both historical and current agricultural practices. Not applicable toward the minimum requirements for a major or minor in biology. Three class hours plus two field trips.

#### 106. Disease, Biomedicine, and Biomedical Research.

(GER 2B) Fall (3) Shakes. (Alternate years, not offered 2008-2009)

Introduction to the biology of common devastating diseases. Topics include the biological basis of specific disease and general approaches for accessing biomedical information, interpreting data from clinical trials, and appreciating the methodological approaches used by biomedical researchers to investigate disease. Not applicable toward the minimum requirements for a major or minor in Biology. Three class hours.

**108. Introduction to Ecology and Environmental Science.**

(GER 2B) Spring (3) Capelli.

Designed for non-majors. An introduction to selected principles of ecology and their application to current environmental issues. Topics include food chain structure, nutrient cycling, competitive and predator/prey interactions, and population growth. Applications range from large scale (global warming) to local (Lake Matoaka issues). Not applicable toward the requirements for a major or minor in biology. Three class hours.

**109. Introduction to Ecology and Environmental Science Laboratory.**

(GER 2) (Lab) Spring (1) Staff. Corequisite BIOL 108.

A field-oriented laboratory that provides first-hand experience with selected issues and methods. Focus will be on the College Woods as a protected but threatened terrestrial habitat, and Lake Matoaka as a highly impacted aquatic one. Designed to accompany BIOL 108. Three laboratory hours.

**110. Insects and Society.**

(GER 2B) Spring (3) Fashing

A survey of insects and related arthropods emphasizing their role on earth as well as their interactions with humans. Not applicable toward the requirements for a major or minor in Biology. Three class hours.

**111. Insect Biology Laboratory.**

(Lab) Spring (1) Fashing. Prerequisite or co-requisite: Bio 110 or consent of instructor. (Not offered 2007-2008)

A laboratory designed to provide non-majors with an appreciation of insects and related arthropods. Field trips and laboratory exercises emphasize the biology and recognition of common insects. Three laboratory hours.

**150W. Freshman Seminar.**

Fall and Spring (4,4) Staff.

A course designed to introduce freshmen to various aspects of the study and consequences of the biological sciences. Not applicable toward the minimum requirements for major or minor in biology.

**\*201. Freshman Research.**

Fall and Spring (1,1) Staff. Prerequisite: Consent of department and instructor.

Introduction to research with faculty mentor for freshmen identified by the Biology Department as having an unusually strong Biology background. Can substitute for BIOL 200 biology major requirement. Students cannot register themselves for this course.

**203. Principles of Biology with Laboratory: Molecules, Cells, Development.**

(GER 2B, Lab) Spring (4) Allison. Prerequisite: BIOL 204 or consent of instructor. CHEM 103 strongly recommended.

Lecture and laboratory exercises explore the molecular and cellular characteristics of living organisms including cell structure, biochemistry, metabolism, molecular genetics, and cellular processes in development. Recommended for science majors. Presupposes strong background in high school biology and chemistry. Three class hours, one discussion hour, three laboratory hours.

**204. Principles of Biology with Laboratory: Organisms, Ecology, Evolution.**

(GER 2B, Lab) Fall (4) Cristol

Designed for potential biology majors. Lectures and laboratory exercises explore the diversity of living organisms, their interrelationships, and the evolutionary processes which result in diversity. Topics include major kingdoms, representative phyla, ecology, genetics, and evolution. Presupposes strong background in high school biology. Three class hours, one discussion hour, three laboratory hours.

**205. Integrative Biology: Plants.**

Spring (4) Engstrom. Prerequisites: BIOL 203, BIOL 204.

An examination of major groups of plants, as well as prokaryotes, algae and fungi. The structure, reproduction, physiology and ecological importance are emphasized in an evolutionary context. Three class hours, three laboratory hours.

**206. Integrative Biology: Animals.**

Fall (4) Heideman. Prerequisites: BIOL 203, BIOL 204.

The study of the evolution, classification, ecology, behavior, development and functional systems of the major animal phyla. Certain aspects of human biology will also be covered. Three class hours, three laboratory hours.

**275W. University Seminar.**

Fall and Spring (4) Sher.

A reading-, writing-, and discussion-intensive seminar. Topics vary by semester and by instructor. Restricted to transfer students and co-enrolled students. Students receiving a grade of "C-" or better in the seminar will have satisfied the lower-division writing requirement. This course does not fulfill the Freshman Seminar requirement.

**\*300. Writing in the Biological Sciences.**

Fall and Spring (0,0) Staff. Prerequisite: Consent of instructor.

Students fulfill the Major Writing Requirement in biology by working with an individual faculty member, typically in a lecture course or laboratory or by conducting a research project (Biology 403, Research in Biology or Biology 495-496, Honors). Fulfilling this requirement can also be done without registration in a formal course. Declared majors should discuss the writing requirement with a faculty member during the first two weeks of the semester during which they would like to fulfill the writing requirement. Once accepted by a faculty member, the student will be given permission to enroll in the proper section of Biology 300 by the faculty member. Students must register for this course during the add/drop period.

**314. Vertebrate Biology.**

Fall (3) Staff. Prerequisite: BIOL 206. (Not offered 2008-2009)

A study of the ecology, phylogeny, behavior, physiology and functional morphology of vertebrates, with special emphasis on fishes, amphibians and reptiles. Three class hours. Students cannot receive credit for both 314 and 315.

**315. Vertebrate Biology with Laboratory.**

Fall (4) Sanderson. Prerequisite: BIOL 206. (Not offered 2008-2009)

A study of the ecology, phylogeny, behavior, physiology and functional morphology of vertebrates, with special emphasis on fishes, amphibians and reptiles. Three class hours, three laboratory hours. Students cannot receive credit for both 314 and 315.

**316. Invertebrate Biology.**

Fall (4) Staff Prerequisites: BIOL 203, BIOL 204. BIOL 206 recommended. (Alternate years, not offered 2008-2009)

Biology of the major invertebrate groups with an emphasis on marine and estuarine species. Strongly recommended for students interested in marine biology. Three class hours, three laboratory hours.

**317. Paleontology.**

Spring (3) Lockwood. Prerequisites: GEOL 101 or GEOL 110 or GEOL 150 or both BIOL 203 and BIOL 204, or consent of the instructor.

The taxonomy of fossil organisms and the role of fossils in the study of organic evolution and the time relations of rock sequences. The laboratory stresses invertebrate morphology and quantitative measurement of local marine fossils. Field trips. Two class hours, two laboratory hours. (Cross listed with GEOL 302) Does not fulfill upper-division lab requirement.

**330. Introduction to Oceanography.**

Fall (3) Bauer, Patterson. Prerequisites: BIOL 203, BIOL 204. (Alternate years, offered 2008-2009)

Description of physical, chemical, biological and geological processes operating in the world ocean. The interdisciplinary nature of oceanography is emphasized, providing an integrated view of factors which control ocean history, circulation, chemistry and biological productivity. Three class hours. (Cross listed with GEOL 330)

**345. Neurobiology.**

Spring (3) Griffin. Prerequisites: BIOL 203.

An introduction to the fundamental concepts of neurobiology; this course will cover basic neuroanatomy and electrophysiology, but will emphasize the molecular basis of neuronal development and signaling, including sensory systems, motor systems, learning and memory, behavior and disease of the nervous system. Three class hours.

**401. Evolutionary Genetics.**

Spring (4) Gilchrist. Prerequisite: BIOL 204. (Not offered 2008-2009)

Evolution as an ongoing process, rather than as a history, is emphasized. Topics include theoretical and experimental population genetics, ecological genetics, interactions of evolutionary forces, genetic divergence, speciation, and molecular evolution.

**\*403. Research in Biology.**

Fall and Spring (Credit to be arranged) Staff. Prerequisite: Consent of instructor.

Independent laboratory or field research under the supervision of a faculty member. A written report is required. No more than three hours may be applied toward the minimum 37 required for a biology major. May be repeated for credit up to a maximum of 6 hours. Hours to be arranged.

**404. Topics in Biology.**

Fall and Spring (1-4, 1-4) Staff.

Areas of special current research interest presented by resident and visiting faculty members as opportunities and demand arise. May be repeated for credit. Four credit courses have an associated laboratory. Credits count toward major.

**406. Molecular Cell Biology.**

Fall, Spring (3) Shakes, Wawersik. Prerequisites: BIOL 203, BIOL 204. CHEM 307 recommended. (Not offered Spring 2008)

An introduction to the principles by which eukaryotic cells function with an emphasis on the molecular biology of cells and experimental approaches to their analysis. Three class hours.

**407. Molecular Cell Biology Laboratory.**

Fall (1) Shakes. Prerequisite or corequisite: BIOL 406. (Not offered 2008-2009)

An introduction to the use of cell biology laboratory techniques including light and electron microscopy, mutant analysis and selected biochemical techniques. Three laboratory hours.

**410. Animal Behavior.**

Fall (3) Cristol. Prerequisite: BIOL 204. (Alternate years, offered 2007-2008)

The study of vertebrate and invertebrate behaviors as adapted traits under the influence of both genes and the environment. Animal behavior, including that of humans and endangered species, will be placed in an ecological and evolutionary context. Three class hours.

**412. Vascular Plant Systematics.**

Fall (4) Case. Prerequisite: BIOL 205. (Not offered 2008-2009)

A study of the principles and research methods of vascular plant systematics, emphasizing classification, evolution, and comparative morphology of the major families of vascular plants. Three class hours, four laboratory hours.

**414. Biochemistry.**

Spring (3) Staff. Prerequisite: CHEM 307 or CHEM 209; prerequisite or corequisite: CHEM 305 or CHEM 308.

Chemistry listing: "The molecular basis of living processes; the chemistry of important constituents of living matter, biosynthesis, metabolism, bioenergetics, enzyme kinetics, metabolic control, transport mechanisms. Section 01 primarily for life science majors; 02 for physical science majors." (Cross listed with BIOL 414) Biology listing as above but with cross listing to CHEM 414.

**415. General Endocrinology.**

Fall (3) Bradley. Prerequisites: BIOL 206, CHEM 307.

A survey of the neuroendocrine physiology of major systems including the hormones of the hypothalamus, pituitary, adrenal, pancreas, thyroid, GI tract, and reproductive systems. The molecular-cellular control of general metabolism and reproduction in both health and disease is considered. Three class hours

**416. Ornithology.**

Fall (4) Cristol. Prerequisite: BIOL 204. (Alternate years, not offered 2008-2009)

Lectures, laboratory exercises, field experiments and birding trips will provide a comprehensive introduction to the ecology and evolution of birds. Phylogenetic relationships, behavior, conservation, and identification of Virginia's avian fauna will be stressed. Three class hours, three laboratory hours, several early morning field trips.

**417. Population and Community Ecology.**

Fall (4) Ware. Prerequisites: BIOL 205, BIOL 206; one may be taken concurrently.

Discussion of the structure and dynamics of ecological populations and biotic communities. Emphasis will be on environmental constraints and species interactions that control population growth and determine both diversity and similarities in community structure and function. Three class hours, three laboratory hours.

**418. Functional Ecology.**

Spring (3) Sanderson. Prerequisite: BIOL 206. (Not offered 2008-2009)

Concepts and approaches in physiological ecology, biomechanics and ecological morphology. The course emphasizes critical thinking, discussion, and student presentations on journal articles from the primary literature. Hypothesis formulation and methods of data collection and analysis will be studied. Three class hours.

**419. Plant Development and Physiology.**

Spring (4) Engstrom. Prerequisite: BIOL 205, 206. Recommended: CHEM 307, CHEM 308. (Alternate years, not offered 2008-2009)

An investigation of major topics in plant biology, encompassing plant development, reproduction, energetics and physiology, and the use of genetic, molecular, and biochemical approaches to elucidate major outstanding questions. The accompanying lab will introduce students to model plant systems and a range of genetic, molecular, and histological techniques.

**420. Genetic Analysis.**

Spring (3) Kerscher. Prerequisites: BIOL 203, BIOL 204.

Discussion of classical and modern genetics. Topics will be drawn from the following: Mendelian inheritance, recombination and linkage, cytogenetics, model genetic systems, mutation analysis, mitochondrial, and chloroplast genetics. Three class hours.

**421. Genetic Analysis Laboratory.**

Spring (1) Staff. Prerequisite or corequisite: BIOL 420.

Designed to illustrate genetic principles through experimental work with living organisms, including *Drosophila*, flowering plants, fungi and bacteria. Three laboratory hours.

**425. Introduction to Biostatistics.**

Fall (4) Gilchrist. Prerequisites: BIOL 205, BIOL 206 and consent of instructor. (Not offered 2008-2009)

An introduction to statistics and research design, including statistical inference, hypothesis testing, descriptive statistics and commonly used statistical tests. Emphasis is placed on the application of quantitative techniques in the biological sciences and solution methods via use of the computer. Three class hours, three laboratory hours.

**426. Aquatic Ecology.**

Fall (4) Capelli. Prerequisite: BIOL 204 or permission of instructor

Introduction to the ecology of aquatic systems; discussion of the important physical and chemical characteristics of aquatic environments and the adaptations of organisms living in water; community structure and the important processes affecting it, including major aspects of water pollution. Three class hours, three laboratory hours.

**427. Wetland Ecosystems.**

Fall (4) Chambers. Prerequisite: BIOL 203 and BIOL 204.

An investigation of structure and function of wetland ecosystems, considering their formation and distribution at local, regional and continental scales. Interactions amongst biologic, geologic and hydrologic components in wetland development will be presented in lecture, lab and field exercises. Three class hours, three laboratory hours.

**428. General Entomology.**

Fall (4) Fashing. Prerequisites: BIOL 203 and BIOL 204.

An introduction to the biology of insects designed to give the student an overview of entomology. Included are such topics as classification, morphology, physiology, behavior, ecology and economic importance. Three class hours, four laboratory hours.

**430. Mechanisms of Bacterial Symbiosis.**

Fall (3) Forsyth. Prerequisite: BIOL 440 or consent of instructor. (Alternate years, not offered 2008-2009)

Symbiotic relationships encompass a spectrum from parasitism to mutualism. This class will explore the molecular basis of bacterial diseases and the basis of bacterial host mutualistic relationships. Three class hours.

**431. Physiological Ecology of Plants.**

Spring (3) Ware. Prerequisite: BIOL 205.

Consideration of the effects of environment on the growth, physiology and distribution of plants. The factors which determine the adaptability of plants to various habitats will be discussed. Three class hours.

**432. Principles of Animal Physiology.**

Spring (4) Staff. Prerequisites: BIOL 206, CHEM 307. (Offered as a 3 credit BIOL 404 course in Spring, 2009)

The function of the animal as a whole as indicated by the physiology and interrelationships of different organs and organ systems. The emphasis is on vertebrates, with comparative examples from selected invertebrates. Three class hours, four laboratory hours.

**433. Developmental Biology.**

Fall (3) Saha. Prerequisite: BIOL 203, 204

An introduction to embryonic and post-embryonic development processes in animals emphasizing both molecular and organismal mechanisms governing cellular differentiation, and the generation of form, shape, and function. Applications of developmental biology to human disease will also be covered including birth defects, stem cell biology, and regenerative medicine. Three class hours.

**434. Developmental Biology Laboratory.**

Fall (1) Staff. Prerequisite or corequisite: BIOL 433. (Not offered 2008-2009)

An intensive examination of molecular techniques as applied to developmental processes; this semester-long laboratory will involve cloning and analyzing a developmentally significant gene. Three laboratory hours.

**436. Advanced Cell Biology.**

Spring (3) Shakes. Prerequisite: BIOL 406. (Not offered 2008-2009)

An in-depth study of a specific topic in cell biology based on readings from the current primary literature. Topics will vary but may include the cytoskeleton or cell signaling. Course may be repeated for credit when topics vary. Three class hours.

**437. Immunology.**

Spring (3) Zwollo. Prerequisites: BIOL 203, BIOL 204.

This course gives an overview of the cells and molecules that compose the immune system and the mechanisms by which they protect the body against foreign invaders, with emphasis on current experimental approaches and systems. Three class hours.

**438. Immunology Laboratory.**

Spring (1) Zwollo. Prerequisite or corequisite: BIOL 437.

An introduction to current techniques available to study immune responses in mice. Includes tissue culture of lymphocytes, measuring antibody levels using ELISA techniques, and detection of proteins expressed during lymphocyte development using Western blot analyses. Three laboratory hours.

**439. Gene Regulation.**

Fall (3) Zwollo. Prerequisite: BIOL 203. Corequisite: BIOL 442, or BIOL 437, or consent of instructor.

Students will gain experience in reading and critically analyzing articles from the primary literature. Topics will involve current research approaches in the field of gene regulation during immune system development. Course may be repeated for credit when topics vary.

**440. Microbiology.**

Spring (3) Forsyth. Prerequisites: BIOL 203, BIOL 204.

Introduction to the biology of prokaryotes and viruses. Classical topics such as growth, metabolism and genetics as well as molecular biology are covered. The roles of microorganisms in ecological, biogeochemical, and environmental processes and human health and history are stressed. Three class hours.

**441. Microbiology Laboratory.**

Spring (1) Forsyth. Corequisite: BIOL 440.

An introduction to the techniques used routinely in various disciplines of microbiology. Experiments will cover basic microbiological technique, microbial ecology, and a solid foundation in molecular genetic methodology used in molecular biology research in various fields. Three laboratory hours.

**442. Molecular Genetics.**

Fall (3) Allison. Prerequisites: BIOL 203, BIOL 204.

This course gives a comprehensive introduction to molecular genetics emphasizing genome organization, DNA replication and repair, synthesis of RNA and proteins, regulation of prokaryotic and eukaryotic gene expression, epigenetics, RNA processing, molecular genetics of cancer, DNA biotechnology and human gene therapy. Three class hours.

**443. Molecular Genetics Laboratory.**

Fall (1) Allison. Prerequisite or corequisite: BIOL 442.

Experiments illustrating current techniques in molecular genetics, including basic cloning, transformation of bacteria with recombinant DNA, plasmid and genomic DNA purification, gel electrophoresis, restriction digests, DNA labeling, Southern transfer, PCR and green fluorescent protein expression in transfected mammalian cells. Three laboratory hours.

**\*444. Biology Laboratory Teaching.**

Fall, Spring, Summer (1,1,1) Staff. Prerequisites: Student must have achieved an A- or above in an upper level biology laboratory class in which they will assist. Consent of instructor.

An introduction to biology laboratory teaching through selected readings and short discussion sessions. Teaching skills will be developed by assisting in an advanced biology laboratory. Three laboratory hours.

**446. Nuclear Structure and Gene Activity.**

Spring (3) Allison. Prerequisite: BIOL 442 or consent of instructor. (Alternate years, not offered 2008-2009)

An in-depth, advanced exploration of the structure of the nucleus and molecular mechanisms of eukaryotic gene regulation, based on readings from the current primary literature. Topics will include mechanisms regulating nuclear import and export of transcription factors and RNA, the role nuclear architecture plays in gene activity and RNA processing, and how failure to appropriately coordinate these processes leads to abnormal or diseased states. Three class hours.

**447. Neurophysiology.**

Fall (4) Griffin. Prerequisites: BIOL 203, CHEM 307, or consent of instructor.

An exploration into the basic concepts related to the activity of the nervous system. This course will focus on electrical and chemical signaling within the nervous system and the ability to control and regulate other physiologic systems. Three class hours, three laboratory hours.

**448. Evolutionary Biology.**

Spring (3) Swaddle. Prerequisites: BIOL 204 or BIOL 206.

An introduction to the mechanisms and outcomes of evolution. Examples are drawn from many disciplines (e.g. genetics, behavior, and paleontology) to discuss how researchers study the evolution of organisms and develop evolutionary theory. Emphasis will be given to organismal processes. Three class hours

**449. Sexual Selection.**

Fall (3) Swaddle. Prerequisites: BIOL 204 or BIOL 206. (Offered as a 1 cr BIOL 404 course in Fall 2008)

An advanced seminar course using the study of sexual selection as a framework to critically examine the primary literature in organismal evolutionary biology and behavioral ecology. Emphasis is placed on student participation in evaluative discussions of published articles and the development of novel ideas for hypothesis testing. Three class hours.

**450. Microbial Pathogenesis.**

Fall (3) Forsyth. Prerequisite: BIOL 440. (Alternate years, offered 2008-2009)

Class covers genetic, immunologic and evolutionary aspects of microbial virulence based on readings from the primary literature. Major bacterial and viral disease mechanisms will be examined. Three class hours.

**451. Cellular Biophysics and Modeling.**

Fall (3) Smith. Prerequisite: MATH 112 or 113, BIOL 203, or consent of instructor.

An introduction to simulation and modeling of dynamic phenomena in cell biology and neuroscience. Topics covered will include the biophysics of excitable membranes, the gating of voltage- and ligand-gated ion channels, intracellular calcium signaling, and electrical bursting in neurons. (Cross-listed with APSC 451)

**452. Self-Organization in Life and Chemical Sciences**

Spring (3) Del Negro and Bagdassarian.

Here we investigate self-organization and complex collective behaviors that emerge from simple dynamical principles in a variety of living and chemical systems. We consider, for example, oscillatory chemical reactions, single-celled organisms and their communal behaviors, as well as the spread of HIV in

human populations using agent-based computer simulation to model and analyze these systems. The course culminates in a final research project wherein students, in consultation with the instructors, develop and analyze their own original model. (Cross listed with APSC 452)

**454. Bioinformatics and Molecular Evolution.**

Spring (3) Smith. Prerequisite: MATH 112 or 113, BIOL 203, or consent of instructor.

An introduction to computational molecular biology and molecular evolution including nucleotide and amino acid sequence comparison, DNA fragment assembly, phylogenetic tree construction and inference, RNA and protein secondary structure prediction and substitution models of sequence evolution. (Cross listed with APSC 454)

**480. Directed Readings in Biology.**

Fall and Spring (1-3,1-3) Staff. Prerequisite: BIOL 203 and BIOL 204.

A directed readings course to investigate the biological basis of an advanced special topic in biology, with intensive reading of review of articles, texts, and primary literature on the topic.

**†495-496. Honors.**

Fall, Spring (3,3) Staff. Prerequisites: Senior standing, an overall major grade point average of 3.0 and consent of departmental committee on honors and undergraduate research.

Independent laboratory or field research for biology majors under the supervision of a faculty member. Students are required to write an Honors thesis based on a review of the literature and their research. Six hours may be applied toward the minimum 37 required for the biology major. For College provisions governing the Admission to Honors, see catalog section titled Honors and Special Programs.

**Graduate Program**

The department offers the degrees of Master of Science and Master of Arts. For degree requirements and a description of graduate courses, write to the Chair of the Graduate Committee for a graduate catalog.