

Biology

PROFESSORS Allison (Chair), Bradley, Chambers, Cristol, Fashing, Griffin, Heideman, Saha, Sanderson, and Swaddle. ASSOCIATE PROFESSORS Capelli, Case, Forsyth, Shakes, Wawersik, and Zwollo. ASSISTANT PROFESSORS Allen, Engstrom, Hinton, Kerscher, LaMar, Leu, and Williamson. PROFESSOR EMERITUS Hoegerman. VISITING ASSISTANT PROFESSORS, Glaser, Murphy, Sher. INSTRUCTORS 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, Environmental Science and Policy, Marine Science, and, through the Applied Science program, in Computational and Mathematical Biology. See catalogue for further information.

Requirements for Major

Required Credit Hours: 37

A minimum of 37 hours of biology as outlined below. In addition Biology majors are required to take Chemistry 103 and 206 with their associated labs, Math 131 (or Math 111), and either Math 132 (or Math 112) or Intro to Biostatistics (Bio 425). Credits from required courses in mathematics and chemistry are not applicable toward the minimum requirements for a major in biology. Biology majors, especially those planning on pursuing advanced degrees, are strongly recommended to take two semesters of physics and two additional semesters of chemistry. Students who received a score of 5 on the Advanced Placement Examination should consult the catalog section on Requirements for Degrees in regards to credit and exemption options.

Major Computing Requirement: The Major Computing Proficiency Requirement is satisfied by completion of either Biology 221 or 226.

Major Writing Requirement: The Major Writing Requirement in biology is fulfilled in the required upper-level seminar, Biology 460 or a course that is specifically designated as fulfilling the seminar requirement.

Core Requirements:

1. Principles of Biology: BIOL 220, 221 (or 298), 225, and 226 (or 299).
2. Biological Diversity/Integrative Biology requirement. Two of the following three courses: BIOL 302, 304, or 306.
3. Molecular Cell Biology requirement: BIOL 310
4. Evolutionary Biology requirement: One of the following courses: BIOL 312, BIOL 317, or BIOL 412.
5. Genetics requirement: One of the following courses: BIOL 401, 420, or 442
6. Advanced laboratory experience: Laboratory work in at least one 400 level course. BIOL 403 and/or BIOL 495-496 cannot substitute for the laboratory requirement.
7. Advanced seminar requirement: BIOL 460 or course specifically designated as a seminar course.
8. The remainder of the 37 credits can be completed by any additional 300 and 400 level BIOL courses.

Note: 100 level biology courses are not applicable towards the minimum requirements.

Requirements for Minor

Required Credit Hours: 21 credits,

Core Requirements:

BIOL 220, 221, 225, and 226. The remaining credits may be completed by taking any additional 200-400 level biology courses except BIOL 403. 100 level biology courses are not applicable toward the minimum requirements.

Description of Courses

105. Plants, People, and Agriculture.

(GER 2B) Fall (3) Engstrom. (Alternate years, not offered 2011-2012)

An introduction to the complex relationship between people, plants, 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, offered 2011-2012)

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. (not offered in 2011-2012)

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) Chambers. Prerequisite or Corequisite BIOL 108. (not offered in 2011-2012)

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.

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.

112. Medicine and the Mind.

(GER 2B) Fall (3) Griffin (Not offered in 2011-2012).

The first half of this course will take a historical look at medical science and those who looked into the brain for answers about its function, including Thomas Willis and Christopher Wren. The second half will focus on our brains and which has more influence, nature or nurture. Not applicable toward the requirements for a major or minor in biology. Three class hours.

115. The Brain, Memory, and Learning.

Fall or Spring (1) Heideman.

A review of research on the structure and function of brain areas involved in learning and memory in relation to research on the development of expertise. Includes a review of methods to improve learning efficiency and quality.

150W. Freshman Seminar.

Fall and Spring (4,4) Sher, 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. Students cannot register themselves for this course.

220. Introduction to Organisms, Ecology, Evolution.

(GER 2B) Fall (3) Cristol. Corequisite: BIOL 221 or BIOL 298

Course is designed for potential biology majors. Lectures explore the diversity of organisms, their interactions with each other and the environment, and the evolutionary processes that produce diversity. Topics include Mendelian genetics, major taxonomic groups, ecology, and evolution. Presupposes strong background in high school biology. Three class hours. (formerly BIOL204 lecture)

221. Introduction to Organisms, Ecology, Evolution Laboratory. (Lab)

Fall (1) Staff Corequisite: BIOL 220

Laboratory investigations in ecology, Mendelian genetics, and animal behavior. One discussion hour, three laboratory hours. (formerly BIOL204 Lab)

225. Introduction to Molecules, Cells, Development.

(GER 2B) Spring (3) Saha. Prerequisite: BIOL 220 and BIOL 221 or consent of instructor. Corequisite: BIOL 226 or BIOL 299. CHEM 103 strongly recommended.

Lecture 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. (formerly BIOL203 lecture)

226. Introduction to Molecules, Cells, Development Laboratory.

(Lab) Spring (1) Staff. Prerequisite: BIOL 220 and BIOL 221, Corequisite: BIOL 225

Laboratory investigations in cell, molecular, and developmental biology. One discussion hour, three laboratory hours. (formerly BIOL203 Lab)

230. Introduction to Marine Science.

Fall (3) Staff. Prerequisites: BIOL 220 (formerly BIOL 204)

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 and MSCI 330)

298. Freshman Honors Biology Laboratory I

(Lab) Fall (1) Forsyth and Saha. Corequisite: BIOL220 optional

The lab will focus on a genomics approach to bacterial pathogenicity and cell fate specification in the vertebrate nervous system. Students will master basic lab skills related to the projects, construct cDNA and genomics libraries, and conduct high throughput sequencing.

299. Freshman Honors Biology Laboratory II

(Lab) Spring (1) Forsyth and Saha. Corequisite: BIOL 225 optional

The lab will focus on a genomics approach to bacterial pathogenicity and cell fate specification in the vertebrate nervous system. Students will conduct in depth bioinformatics analysis of the sequenced cDNA and genomic libraries.

302 . Integrative Biology: Animals.

Fall (4) Heideman. Prerequisites: BIOL 220, BIOL 225.

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. (formerly BIOL 206)

304. Integrative Biology: Plants.

Spring (4) Engstrom. Prerequisites: BIOL 220, BIOL 225.

An examination of major groups of photosynthetic organisms, with emphasis on terrestrial plants and their interactions with other organisms. Their structure, reproduction, physiology and ecological importance are emphasized in an evolutionary context. Three class hours, three laboratory hours. (formerly BIOL 205)

306. Microbiology.

Spring (4) Forsyth. Prerequisites: BIOL 220, BIOL 225.

Introduction to the biology of prokaryotes and viruses. Classical topics such as growth, metabolism and genetics, ecology, and molecular biology are covered in the lecture section. The laboratory introduces techniques routinely in microbiology such as sterile techniques, staining and microscopy, biochemical assays, microbial ecology, and genetics. Three class hours, three laboratory hours. (formerly BIOL440)

310. Molecular Cell Biology.

Fall, Spring (3) Staff, Shakes. Prerequisites: BIOL 220, BIOL 225. Prerequisite or corequisite: CHEM 206.

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. (formerly BIOL 406)

312. Evolution of Organisms.

Fall, Spring (3) Murphy, Swaddle. Prerequisites: BIOL 220 or BIOL 225. BIOL 302 (formerly BIOL 206) recommended.

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 and test evolutionary theory using integrative approaches. Three class hours. (formerly BIOL 448)

317. Paleontology.

Spring (3) Lockwood. Prerequisites: GEOL 101 or GEOL 110 or GEOL 150 or both BIOL 220 and BIOL 225, 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.

318. Conservation Biology.

Spring (3) Leu. Prerequisites: BIOL 220 and BIOL 221 or consent of the instructor.

An introduction to the fundamentals of conservation biology and an examination of current conservation issues. Topics include threats to biodiversity, endangered species management, and the interplay

of politics, economics, or societal values in conservation decision-making. Three class hours.

345. Neurobiology.

Spring (3) Griffin. Prerequisites: BIOL 225.

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.

351. Cellular Biophysics and Modeling.

Fall (3) Smith. Prerequisite: MATH 112 or 113, BIOL 225, 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 351)

401. Evolutionary Genetics.

Spring (4) Staff. Prerequisite: BIOL 220. (Not offered in 2010-2011)

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. Special Topics in Biology.

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

If there is no duplication of topic, courses with this number may be repeated for credit. Four credit courses have an associated laboratory. Credits count toward major.

407. Molecular Cell Biology Laboratory.

Spring (1) Shakes. Prerequisite: BIOL 310.

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

409. Virology.

Fall (3) Williamson. Prerequisites: BIOL 220, 221, 225, 226, and 310

This course gives an overview of fundamental concepts in virology. Topics include the discovery of viruses, principles of viral structure, viral morphogenesis, viral detection methods, viral vaccines, and ecological significance of viruses. A strong emphasis is placed on molecular mechanisms of viral replication. Three class hours.

410. Animal Behavior.

Spring (3) Cristol. Prerequisite: BIOL 220.

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 304 (formerly BIOL 205).

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.

Spring (3) Bradley. Prerequisites: BIOL 302 (formerly BIOL 206) and BIOL 310.

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) Staff. Prerequisite: BIOL 220. (Alternate years; not offered in 2011-2012)

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.

Spring (4) Staff. Prerequisites: BIOL 302 (formerly BIOL 206), BIOL 304 (formerly BIOL 205); 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 302 (formerly BIOL 206). (Not offered 2011-2012)

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. This course fulfills the seminar requirement in biology.

419. Plant Development and Physiology.

Spring (4) Engstrom. Prerequisite: BIOL 304 (formerly 205) and BIOL 310. (Alternate years)

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 220, BIOL 225.

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) Kerscher. 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.

Spring (3-4) Murphy. Prerequisites: BIOL 205, BIOL 206 and consent of instructor.

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. Includes a separate lab (BIOL 425L) when offered as a 4 credit course.

426. Aquatic Ecology.

Fall (4) Capelli. Prerequisite: BIOL 220 or consent 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 220 and BIOL 225.

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 220 and BIOL 225.

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 306 (formerly BIOL 440) or consent of instructor. (Alternate years)

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. This course fulfills the seminar requirement in biology.

432. Principles of Animal Physiology.

Spring (4) Heideman. Prerequisites: BIOL 302 (formerly BIOL 206), CHEM 307.

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 220, BIOL 225, and BIOL 310.

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.

437. Immunology.

Spring (3) Zwollo. Prerequisites: BIOL 220, BIOL 225, and BIOL 310 or BIOL 306 (formerly BIOL 440).

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 225. 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. This course fulfills the seminar requirement in biology.

441. Microbiology Laboratory.

Spring (1) Forsyth. Prerequisite: 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 220, BIOL 225, and BIOL 310.

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.

445. GIS for Biologists.

Fall (3) Leu. Prerequisites: BIOL 220, BIOL 225, and consent of instructor.

This hands-on course will integrate Geographical Information Systems into biological research. Emphasis will be on developing spatial metrics, comparing cell or land cover patterns across spatial or temporal scales, classifying satellite or medical imagery, and modeling species distributions. Three class hours.

447. Neurophysiology.

Fall (4) Griffin. Prerequisites: BIOL 225, 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. In the fall of 2011, this course will have a prerequisite of BIOL 345 and CHEM 307.

449. Sexual Selection.

Fall (3) Swaddle. Prerequisites: BIOL 220 or BIOL 302 (formerly BIOL 206).

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 306 (formerly BIOL 440). (Alternate years; offered in 2010-2011)

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. This course fulfills the seminar requirement in biology.

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 225, 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)

455. How Students Learn.

Fall (1) Heideman. Prerequisites: Two years of college science and/or mathematics and consent of Instructor.

A practical review of research on the structure and function of brain areas involved in learning (2/3 of the class) followed by practical methods to use this knowledge in teaching at the high school level (1/3 of the class). Not applicable to major or minor, with the exception that students pursuing a career in education may petition to count this toward a Biology major or minor.

456. Vertebrate Biology.

Fall (3) Staff. Prerequisite: BIOL 302 (formerly BIOL 206). (Not offered 2011-2012)

A study of the ecology, phylogeny, behavior, physiology and functional morphology of vertebrates, with special emphasis on fishes, amphibians and reptiles. Three class hours.

457. Invertebrate Biology.

Fall (4) Allen. Prerequisite: BIOL 302 (formerly BIOL 206)

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. (formerly BIOL 316)

458. Conservation Biology Laboratory.

Spring (1) Leu. Corequisite or prerequisite: Bio 318.

This course has two goals. First, students will learn current field techniques to sample local flora and fauna and how to analyze survey and long-term monitoring data sets. Second, students will learn current quantitative approaches in conservation to model connectivity, population viability, and reserve design. Three laboratory hours.

460. Advanced Seminar in Biology

Fall and Spring (3) Staff. Prerequisites and corequisites vary by topic.

Special topics of interest will be discussed within the context of small, advanced seminar courses. Advanced seminars emphasize critical reading of the primary literature and discussions of experimental design. Students will be expected to give one or more oral presentations and complete one or more major writing assignments. Fulfills the major writing requirement in biology. Appropriate for juniors and seniors. With instructor permission, courses with this number may be repeated for credits when the topic varies, however only one counts towards the minimum 37 credits required for the major. Three class hours.

See Current Listing and Description of seminar topics on the Biology website at www.wm.edu/biology

480. Directed Readings in Biology.

Fall and Spring (1-3,1-3) Staff. Prerequisite: BIOL 220 and BIOL 225.

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.