

# BIOLOGY

*Faculty: Ruppel, Chair; Ramage, Associate Chair; Burton, Coster, Cox, Foster, Gowan, Gubbels Bupp, Laws, Lim-Fong, Schmidt, Shepherd, Stevens, and Taylor-Cornejo.*

Biology invites students to participate in the scientific study of living organisms in all their fascinating complexity from molecular and cellular processes to the functioning of entire ecosystems. Students majoring in biology may satisfy their curiosity about the workings of the natural world, define their strengths and interests, and become lifelong learners in one of hundreds of biology-related careers. All students undertaking a study of biology should receive a thorough grounding in biological principles, should understand the interdisciplinary connections between biology and other sciences, and should realize that our knowledge of biology is built on scientific discovery. Our curriculum seeks to develop in students the values, habits, and practices of a scientist by allowing them to actually do biology beginning in their freshman year, continuing in subsequent upper division courses, and culminating in a senior-level capstone experience. An innovative course (BIOL 121), taken during the freshman year, engages students in discovery-based laboratory exercises. Biology majors will subsequently deepen their understanding of molecular biology (BIOL 123), genetics (BIOL 200), and evolution (BIOL 205), coupled with balanced and concentrated learning experiences through upper-level courses from each of the three major sub-disciplines of contemporary biology:

1. cell and molecular biology
2. organismal biology
3. ecology

Each student works closely with a departmental adviser to select upper-level courses for an individualized curriculum to prepare for careers or graduate studies in fields including medicine, allied health science, ecology, and environmental science. Finally, each student will take a capstone course (BIOL 499), which reinforces the skills and abilities developed in the major by having students read the primary literature and discuss the work with scientists who conducted the studies. Biology students are also encouraged to participate in research early in their college career by taking research courses and/or by participating in the College's Shapiro Undergraduate Research Fellowship program (SURF).

Many graduate and professional programs require the completion of additional courses in biology, chemistry, physics, and the humanities. Prospective biology majors should meet with a departmental adviser in their career area(s) of interest at or before the beginning of the sophomore year, or immediately upon transfer.

- Biology Major - BA (<https://catalog.rmc.edu/programs/biology/biology-major/>)
- Biology Major - BS (<https://catalog.rmc.edu/programs/biology/biology-major-bs/>)
- Biology Minor (<https://catalog.rmc.edu/programs/biology/biology-minor/>)

## BIOL 121 - Foundations of Experimental Biology (4 Hours)

This introductory course is designed to encourage students to develop the values, habits, and practices of a scientist. Students will learn the scientific method and how it is employed including: how to make scientific observations and form hypotheses, how to plan and conduct experiments, and how to display and interpret data and communicate scientific results. The course is made up of a series of multi-week research modules taught in a studio format. There will be two three-hour sessions per week during which talking about biology and doing biology are seamlessly integrated. Modules will focus on major topics in Biology, such as organismal biology, evolution, and ecology. This course is designed for students intending to major in biology and/or apply to health-focused graduate programs. A minimum grade of C- in both BIOL 121 and BIOL 123 is a prerequisite to many biology courses numbered 200 and above; however, the courses can be taken in either order. Open to freshmen and sophomores only, or with permission of instructor. A special fee (\$75) is charged for this course. C21:NS,SP,WA.  
**Curriculum:** NS,SP,WA

## BIOL 123 - Principles in Molecular Biology (3 Hours)

What are genes and how do they and their products work? In this course, students will become conversant in the essential principles of biochemistry and molecular biology to answer this question and more. Concepts will be introduced and then repeated throughout the semester as we discuss specific examples of how genetic variations influence human traits and may contribute to genetic health conditions. The course is designed for students intending to major in biology and/or apply to health-focused graduate programs. A minimum grade of C- in both BIOL 121 and BIOL 123 is a prerequisite to many biology courses numbered 200 and above; however the courses may be taken in either order.

**Prerequisite(s):** freshmen or sophomore status or permission from the instructor

## BIOL 126 - Insects and Humans (4 Hours)

Since antiquity, insects have infected us with disease, pestered our animals, attacked our crops, infested our food stores, and damaged or destroyed our possessions. But they have also inspired artisans, architects, cartoonists, engineers, gourmards, religious thinkers, engineers, and scientists. Insects and Humans examines the long and complex relationship between insects and humans. Lectures begin with basic overviews of insect morphology, classification, and biology, followed by targeted surveys that explore the influence of insects on our art, history, literature, science, technology, and popular culture. The lab focuses on the morphology and classification of insects and other arthropods. C21:NS,SP.

**Curriculum:** NS,SP

## BIOL 127 - Cell Biology for the Citizen (4 Hours)

This course will deal with theories and concepts concerning the origin and evolution of life, the structure and functioning of cells as the fundamental units of life, and the knowledge and methods of classical and modern genetics by which disease may be cured and modified life forms created. Students will be introduced to basic concepts in chemistry and bioenergetics which will serve as a basis for understanding theories of organic and cellular evolution; structure, functioning, and metabolism of cells; and the molecular genetics of prokaryote and eukaryote cells. Also covered will be the methods of recombinant DNA technology, as well as the social and ethical problems resulting from current and future applications of this knowledge. Laboratory topics will clarify and support lecture concepts. Offered alternate years. Open to all students. C21:NS,SP,WA.

**Curriculum:** NS,SP,WA

**BIOL 129 - The Human Machine (4 Hours)**

A study of the human body and how it works through detailed analyses of its organ systems. Special emphasis will be placed on structure-function relationships and issues relevant to health and disease. Laboratories will stress anatomical and physiological investigation of body functions. C21:NS,SP.

**Curriculum:** NS,SP

**BIOL 133 - Health and Immunity (4 Hours)**

Allergy, asthma, cancer, and autoimmune diseases affect a growing number of individuals each year. In light of this, "Health and Immunity" will examine how the immune system works and how dysfunction of the immune response can lead to these common health issues. Attempts to deliberately manipulate the immune response, via vaccinations, health supplements, and immunotherapies for the purpose of influencing disease outcomes may also be discussed. Not open to students who have passed HONR 138. C21:NS,OC,SP.

**Curriculum:** NS,SA,SP

**BIOL 151 - Biological Diversity (4 Hours)**

An introduction to the major concepts in conservation biology. The course will examine the diversity found in species, communities, and ecosystems; judge the economic and ethical value of biological diversity to humans; investigate regions of the Earth where most biodiversity is found; and evaluate current policies used to protect biodiversity. Material from a range of disciplines will be covered, including biology, ecology, mathematics, social science, and public policy. C21:NS,SP.

**Curriculum:** NS,SP

**BIOL 160 - Evidence-Based Nutrition (3 Hours)**

This course will review all the pertinent facts about nutrition and its impact on health and disease from a cellular and macroscopic level. Throughout the course, emphasis will be placed on the evidence that supports (or doesn't support) nutritional claims. The impact of culture and socioeconomic status on nutrition will be addressed as well as the impact of nutrition on the current health care crisis nationally and globally, and the potential impact of nutrition on public policy. A history of nutrition will be introduced and its effects on the evolution of Homo sapiens.

**BIOL 175 - Experimental Field and Laboratory Ecology (4 Hours)**

The goals of the course are to present the major concepts and principles of ecology and to investigate many of these experimentally in field and laboratory study. The major topics to be discussed include the abiotic environment, the nature of ecosystems and their functioning, ecology of populations, behavioral ecology, and community structure and organization. Field and laboratory study will involve the formulation and carrying out of experiments relating to some of these ecological principles and concepts. Data from these studies will be analyzed and presented. Open to all students. C21:NS,SP.

**Curriculum:** NS,SP

**BIOL 200 - Genetics (4 Hours)**

A study of the major laws of inheritance and the cellular and molecular bases for these laws. Topics will include cell division, Mendelian inheritance, linkage, recombination, quantitative inheritance, probability theory and statistical applications in genetics, problem-solving strategies, and molecular genetics. A special fee (\$75) is charged for this course.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 201 - Cell Biology (4 Hours)**

A study of the structure and functions of eukaryotic cells. Topics explored include the evolution of cells, basic biochemistry of biological macromolecules, recombinant DNA technology, gene expression, cell membranes, protein sorting in the secretory and endocytic pathways, cell metabolism, cell signaling, the cytoskeleton, the cell cycle, the extracellular matrix, cancer cell biology, and stem cells. Labs develop general lab skills, emphasize hands-on learning of methods and research concepts in cell biology (e.g. microscopy, SDS-PAGE, cell culture, etc.), and use the primary literature. A special fee (\$75) is charged for this course. Counts on the biology major in the cell and molecular group.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 202 - Plant Taxonomy (4 Hours)**

A field course emphasizing the methods of identification and recognition of local vascular plant species and families. Supporting topics include vegetative and reproductive morphology, natural history and ecology of Virginia plant species, nomenclature, classification, ethnobotany, and economic botany. Field trips will be taken to local habitats of interest. Counts on the biology major in the organismal group.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 204 - Plant Physiology (4 Hours)**

This course will introduce students to a broad range of concepts in plant physiology and development with an emphasis on vascular plants. We will also discuss topics of plant cell biology, genetics, and anatomy. The themes covered in this course will highlight applications of plant biology in today's society, including agriculture and bioenergy. The major topics in the course cover the entire plant life cycle with an emphasis on seed development and germination, hormone regulation, photosynthesis, solute and mineral nutrition, and reproduction. Students will also learn how plants must incorporate a multitude of environmental signals such as light, temperature, and gravity to shape plant form. Counts on the biology major in the organismal group.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 205 - Evolution (3 Hours)**

The concept of evolution unifies all fields of biology. Whether you are interested in medicine, biomechanics, microbiology, ecology, or genetics, you must understand evolutionary theory. This course will introduce the history of evolutionary thought and the mechanisms of evolutionary change. We will explore topics such as natural selection, adaptation, speciation, and evolutionary issues in modern society.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 230 - Ichthyology (4 Hours)**

An introduction to the study of fish, the most diverse group of vertebrates on Earth with over 25,000 species. This course will explore the evolutionary history, anatomy, taxonomy, physiology, ecology, behavior, and zoogeography of these interesting creatures. In lab we will collect and identify many of the 210 freshwater species in Virginia and learn about their habitats, life-histories, and the problems we face in conserving this valuable resource. Offered alternate years. Counts on the biology major in the organismal group.

**Prerequisite(s):** BIOL 121

**BIOL 235 - Marine Biology (4 Hours)**

An introduction to the interrelationships between marine and estuarine organisms and their environment. Lecture and lab sessions will focus on a general ecological survey of the marine and estuarine environment stressing ecological relationships at the individual, population, community, and ecosystem levels. A major part of the course will be a 7-day field trip to the Florida Keys. The role of adaptation will provide a central theme as various habitats are explored through field studies emphasizing quantitative data collection and analysis. Counts on the biology major in the ecology group. Offered alternate years. C21:EL.

**Prerequisite(s):** BIOL 121 and BIOL 123

**Curriculum:** EL

**BIOL 248 - Entomology (4 Hours)**

Insects are the most diverse group of animals on earth. This course introduces their study with an emphasis on insect biology, diversity, classification, and identification. Lectures consider insect diversity, evolution and zoogeography, morphology, physiology, development, behavior, ecology, and pest management. Laboratory activities focus on insect morphology, classification, and field techniques for the study and collection of insects. A fully prepared insect collection identified to order and family is required. Counts on the biology major in the organismal group. Offered alternate years.

**Prerequisite(s):** BIOL 121

**BIOL 249 - Medical & Veterinary Entomology (4 Hours)**

A comprehensive survey of insects and other arthropods that adversely affect the health of humans, domestic animals, and wildlife. Overviews of medical-veterinary entomology and epidemiology emphasize the ecological relationships between arthropod vectors, pathogens or parasites, and vertebrate hosts. Lectures include in-depth taxonomic surveys that include information on vector identification and biology, disease transmission and prevention, and vector control. The laboratory focuses on morphology and identification of insect and other arthropod vectors. Counts on the biology major in the ecology group. Offered alternate years.

**Prerequisite(s):** BIOL 121

**BIOL 251 - Human Anatomy and Physiology I (4 Hours)**

A study of the structure (gross and microscopic) and function of the integumentary, skeletal, muscular, and nervous systems of the human body. Laboratory work involves the use of anatomical models, histology, digital resources, specimen dissections, and physiological experiments. Counts on the biology major in the organismal group.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 252 - Human Anatomy and Physiology II (4 Hours)**

A study of the structure (gross and microscopic) and function of the circulatory, respiratory, digestive, urinary, endocrine, and reproductive systems of the human body. Laboratory work involves the use of anatomical models, histology, digital resources, specimen dissections, and physiological experiments. Counts on the biology major in the organismal group.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 260 - Vertebrate Field Biology (4 Hours)**

This course is designed to provide students with an appreciation for vertebrate diversity (especially local species) and the field techniques that are used to study these important communities. Lectures will focus on vertebrate origins, diversity, classification, and conservation, and lab activities will include surveying the vertebrates in the region, identifying specimens, and becoming familiar with the taxonomy, ecology, and behavior of local species. Counts on the biology major in the organismal group. C21:CC.

**Prerequisite(s):** BIOL 121 and ENGL 185

**Curriculum:** CC

**BIOL 271 - Guided Research (1 Hour)**

These guided research courses are intended to provide interested students an opportunity to do research prior to the 3-credit courses. Students will work with a biology faculty member to be trained in techniques appropriate to their field. Permission of a biology faculty member is required and students will be required to spend at least three hours per week doing research tasks.

**Prerequisite(s):** BIOL 121

**BIOL 272 - Guided Research (1 Hour)**

These guided research courses are intended to provide interested students an opportunity to do research prior to the 3-credit courses. Students will work with a biology faculty member to be trained in techniques appropriate to their field. Permission of a biology faculty member is required and students will be required to spend at least three hours per week doing research tasks.

**Prerequisite(s):** BIOL 121

**BIOL 310 - Freshwater Ecology (4 Hours)**

This course has three goals: to understand the physical, chemical and biological properties of natural streams, rivers and lakes; to examine how these properties relate to form a functioning watershed; and to explore how humans influence these functions. In the laboratory component of the course, students collect data on macroinvertebrate populations, monitor water quality and make measurements of parameters defining physical habitat in a variety of freshwater habitats. Three hours of lecture and three hours of laboratory per week. Offered alternate years. Counts on the Biology major in the ecology group.

**Prerequisite(s):** BIOL 121

**BIOL 311 - Microbiology (4 Hours)**

A study of the structure, function, and practical significance of disease-producing and beneficial microorganisms. Lecture topics will include the structure, physiology, genetics, and classification of bacteria, viruses, and disease-producing eukaryotes. Disease production by microorganisms, disease pathology, and microbial control will also be discussed. The laboratory will instruct students in the methods and procedures used in growth, identification, and control of micro-organisms. Counts on the biology major in the cell and molecular group.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 315 - Infectious Disease & Public Health (4 Hours)**

This course focuses on the pathophysiology of select infectious diseases and their associated public health issues. Students will be introduced to the types of pathogens that cause infectious diseases, the modes through which they are transmitted, and how they are combated by the immune system as well as basic epidemiological concepts and public health measures. Legal and ethical issues that arise out of public health policies directed towards combating infectious diseases will be addressed. C21:OC.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 320 - Reproductive & Stem Cell Biology (3 Hours)**

This course is an investigation of the current science of stem cell biology and the basic reproductive cell biology that provides the foundation for advances in the field of regenerative medicine. Stem cells have become a household word as well as a political football. But what are stem cells, really, and how do we know one when we see one? We will investigate the cutting edge of our knowledge about stem cell capabilities and limitations by surveying the current literature and hosting invited speakers. The course will cover topics such as the cell biology of gametes (sperm and egg cells), fertilization, early embryonic development, cellular differentiation, different types of stem cells (embryonic, adult, and induced pluripotent stem cells), and therapeutic approaches based on stem cells. We will also consider the ethical, legal, social, and political implications of stem cells. BIOL 200 or BIOL 201 is recommended. Counts on the biology major in the cell and molecular group. C21:CC.

**Prerequisite(s):** BIOL 123 and ENGL 185

**Curriculum:** CC

**BIOL 325 - Ecology (4 Hours)**

A study of the descriptive and theoretical aspects of ecology and evolutionary biology. Lecture topics include the following: the process of evolution, ecosystem concepts, ecology of populations, physiological ecology, community ecology, and energy flow in ecosystems. Current ideas of evolutionary ecology will be integrated with the above topics to represent the unifying nature of these two major areas of biology. Laboratory periods will involve primarily field work in local communities. Emphasis will be on sampling of biological communities and analysis of ecological data. Counts on the biology major in the ecology group.

**Prerequisite(s):** BIOL 121

**BIOL 327 - Tropical Biodiversity (4 Hours)**

This course will travel to a tropical region renowned for its biological diversity. Students will travel to several nature reserves for a comparative exploration of complex ecological interactions and learn about a range of taxa including indigenous animals, plants, and marine flora and fauna. With a strong emphasis on fieldwork, the aim of this course is to provide an in-depth understanding of tropical ecology by investigating the origin of tropical diversity, conducting biodiversity assessments, exploring evolutionary adaptations, and reflecting on human impacts and responsibilities in tropical ecosystems. C21:EL.

**Prerequisite(s):** BIOL 121

**Curriculum:** EL

**BIOL 330 - Human Ecology and Evolution (4 Hours)**

This course examines interactions between humans and their environment and provides an overview of the evolutionary history of our species. The ecology of technologically advanced human societies will be compared to non-industrialized societies as well as a wide variety of other species ranging from the ape-like ancestors of modern humans to beavers to ants. By applying classical ecological frameworks and methodologies to humans, the course aims to: (1) introduce/reinforce the fundamentals of ecology from a unique perspective, (2) place humans within the context of the broader ecosystem, (3) explore the extent to which general ecological principles apply to the human species, (4) stimulate discussion about whether humans remain part of "nature", and (5) consider the implications of all of the above for conservation and environmental management. Counts on the biology major in the ecology group.

**Prerequisite(s):** BIOL 121

**BIOL 335 - Conservation Genetics (4 Hours)**

Students will explore the science behind wildlife management as they take on the role of zookeepers, conservation officers, and state and federal biologists and contemplate the challenges of how to save a threatened species. The course reviews fundamental concepts in population genetics and evolution and then explores topics including, genetic diversity, inbreeding, hybridization, invasive species, captive population management and animal movement. The course is relevant to students interested in ecology, evolution, or environmental studies and those interested in studying genetic variability from a population level. Counts on the biology major in the ecology group.

**Prerequisite(s):** two of the following courses: BIOL 121 and BIOL 123

**BIOL 340 - Ecological Simulation (3 Hours)**

Ecological systems are incredibly complex and much about them remains mysterious. Many questions are difficult or impossible to answer with experiments or observations, but a relatively new method of inquiry, computer simulation, can often provide insight. Now a critical tool for modern biologists, simulations are used for a wide variety of applications, and they are particularly useful for exploring interactions between variables in complex systems. This course will explore ecological simulations through: a) an examination of the peer-reviewed literature, and b) hands-on computer coding and simulation. Students will answer an original question via a research project conducted independently or in small groups. Approximately half of class time will be devoted to independent computer work. Counts on the biology major in the ecology group.

**Prerequisite(s):** BIOL 121

**BIOL 350 - Biostatistics (4 Hours)**

An introduction to the design and statistical analysis of experiments in the life sciences. An integrated lecture/lab format directs students on how to pose questions in the form of scientific hypotheses, design valid experiments to investigate the questions, and use appropriate statistical techniques to analyze the data. Students will use computer statistical packages for most analyses.

**Prerequisite(s):** BIOL 121



**BIOL 351 - Biological Microscopy (4 Hours)**

This is a laboratory-intensive course that develops understanding of and proficiency with several common cell biological tools and approaches used in biomedical research with an emphasis on microscopy and protein biochemistry. Student projects will address current biomedical research questions that employ light microscopy, immunofluorescence microscopy, confocal microscopy, transmission and scanning electron microscopy, and related immunological applications used to localize proteins in cells. Protein biochemical studies will include instruction in proteomics, SDS-PAGE and Western analysis, and protein assays. Students will make extensive use of the primary literature and technical publications. Experimental design, use of appropriate controls, and data interpretation will be emphasized, and students will write and present formal reports on their work. Counts on the biology major in the cell and molecular group.

**Prerequisite(s):** BIOL 200, BIOL 201, BIOL 204, BIOL 251, BIOL 252, or BIOL 311

**BIOL 353 - Molecular Genetics (3 Hours)**

An in-depth study of eukaryotic gene expression and its regulation at the molecular level. In this course, students will delve into topics such as transcriptional regulation of genes, the role of mRNA processing in gene expression, and epigenetic mechanisms in gene regulation. Concepts in gene regulation will be discussed in the context of development and human health conditions and their treatments. Students will gain an understanding of molecular tools used to study genes and gene expression through the analyses of current research papers. Counts on the biology major in the cell and molecular group.

**Prerequisite(s):** BIOL 200 or BIOL 201 and CHEM 215

**BIOL 354 - Human Genetics (3 Hours)**

A course exploring the molecular bases of specific human health conditions. For each genetic health condition, molecular approaches used to identify and characterize associated genes, the cellular pathways affected, and molecularly-based therapeutics will be examined. Through the analyses of current research papers, students will gain an understanding of experimental approaches and learn to think critically about experimental design and the interpretation of results. Students will orally present and write about molecular techniques and their uses in recently published studies on a regular basis in this course. Counts on the biology major in the cell and molecular group. C21:CC.

**Prerequisite(s):** BIOL 200 and ENGL 185

**Curriculum:** CC

**BIOL 355 - Neurogenetics and Behavior (3 Hours)**

This course will investigate the role of genetics in the development and function of the nervous system, with a focus on the relationship between genes and behavior. Emphasis will be placed on the process of scientific discovery through the lens of various model organisms (nematodes, drosophila, zebrafish, and mice). Students will learn about the classic and contemporary genetic tools utilized by researchers to study behaviors such as courtship, addiction, social behavior, memory, sleep, and aggressive behavior. Students will analyze and present data from primary scientific articles and learn to effectively communicate complex scientific concepts. Counts on the Biology major in the Cell and Molecular group, and on the Behavioral Neuroscience major as a Category B course. C21:CC

**Prerequisite(s):** C- or better in BIOL 200 OR BIOL 201

**BIOL 360 - Microbial Symbiosis (3 Hours)**

Symbiosis, that is, living together, is a common theme in the natural world. In this writing and speaking-intensive seminar, through the reading of research papers, we will explore how bacteria are intimately associated with larger organisms. We will learn about how various mutualistic symbioses become established, how host and symbiont adapt to their new life together, and how symbioses can benefit both partners. We will consider mutualisms from molecular and ecological perspectives to understand symbiosis in an evolutionary framework. Counts on the Biology major in the ecology group. C21:CC.

**Prerequisite(s):** one of the following course combinations: (BIOL 121, BIOL 123 and ENGL 185) or (BIOL 121, BIOL 200 and ENGL 185)

**Curriculum:** CC

**BIOL 371 - Guided Research (1 Hour)**

These guided research courses are intended to provide interested students an opportunity to do research prior to the senior research courses. Students will work with a biology faculty member to develop and execute a research project. Permission of a biology faculty member is required. Students will be required to spend at least three hours per week in the laboratory.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 372 - Guided Research (1 Hour)**

These guided research courses are intended to provide interested students an opportunity to do research prior to the senior research courses. Students will work with a biology faculty member to develop and execute a research project. Permission of a biology faculty member is required. Students will be required to spend at least three hours per week in the laboratory.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 381 - Special Topics in Biology (3 Hours)**

These courses focus on areas of biology not specifically covered in the general curriculum and are designed to meet the needs of advanced students. Counts on the biology major in the cell and molecular group.

**BIOL 382 - Special Topics in Biology (4 Hours)**

These courses focus on areas of biology not specifically covered in the general curriculum and are designed to meet the needs of advanced students. Counts on the biology major in the organismal group.

**BIOL 383 - Special Topics in Biology (4 Hours)**

These courses focus on areas of biology not specifically covered in the general curriculum and are designed to meet the needs of advanced students. Counts on the biology major in the ecology group.

**BIOL 442 - Immunology (4 Hours)**

This course presents a comprehensive view of the basic principles of immunology. We examine the tissues and cells that make up the immune system and discover the elegant mechanisms through which the immune system defends against pathogens. Health issues associated with immune dysfunction such as autoimmunity, allergy, cancer, transplants, and AIDS are also discussed. Lectures are frequently supplemented with medical case studies and articles from leading immunological journals. The laboratory component involves multi-week projects examining innate immunity, adaptive immunity, and the cooperation between the two. Counts on the biology major in the cell and molecular group.

**Prerequisite(s):** two of the following courses: BIOL 121 or BIOL 123 and ONE of the following: BIOL 200 or BIOL 201

**BIOL 450 - Internship in Biology (3 Hours)**

This course provides students with practical working experience in the biological sciences and requires a minimum of 130 hours of work in a laboratory or field site. The nature of the project and the site is determined in consultation with a faculty supervisor and is approved by the department. A paper and seminar on the internship work must be presented to the biology department by the last day of class for the semester in which the internship is completed. Application required; see Bassett Internship Program. C21:EL. A special fee (\$200) is charged for this course.

**Prerequisite(s):** 54 semester hours of class work, a minimum cumulative GPA of 2.25, and completion of at least five biology courses

**Curriculum:** EL

**BIOL 451 - Internship in Biology (3 Hours)**

This course provides students with practical working experience in the biological sciences and requires a minimum of 130 hours of work in a laboratory or field site. The nature of the project and the site is determined in consultation with a faculty supervisor and is approved by the department. A paper and seminar on the internship work must be presented to the biology department by the last day of class for the semester in which the internship is completed. Application required; see Bassett Internship Program. C21:EL. A special fee (\$200) is charged for this course.

**Prerequisite(s):** 54 semester hours of class work, a minimum cumulative GPA of 2.25, and completion of at least five biology courses

**Curriculum:** EL

**BIOL 455 - Directed Field Study (3 Hours)**

A Field Study is an experiential learning course combining elements of workplace experience, observation, and research. Students are expected to work closely with a faculty field study supervisor to develop learning objectives and a plan of study appropriate to the discipline. Assignments may include a reflective journal, activity reports, and one or more directed research papers appropriate to the discipline. Workplace experience requirements should be similar to those of internships. Students should not receive compensation from workplace experience if they are receiving three-hour course credit.

**BIOL 457 - Internship in Biology (Paid) (3 Hours)**

With prior approval, students may earn Experiential Cross Area Requirement (CAR) credit and transcript notation for one credit hour for a paid internship. This course provides students with practical working experience in the biological sciences and requires a minimum of 130 hours of work in a laboratory or field site (160 hours recommended). The nature of the project and the site is determined in consultation with a faculty supervisor and is approved by the department. A paper and seminar on the internship work must be presented to the biology department by the last day of class for the semester in which the internship is completed. The course fulfills one of the required six upper-level electives on the Biology major. Note that BIOL 450 or BIOL 457 may count in the major, but not both. Application required; see Bassett Internship Program. C21:EL.

**Prerequisite(s):** 54 semester hours of class work, a minimum cumulative GPA of 2.00, and completion of at least five biology courses

**Curriculum:** EL

**BIOL 463 - Cellular & Molecular Neurobiology (4 Hours)**

This course focuses on the molecular and cellular underpinnings of nervous system function. Topics include the regulation of the neuronal cell cytoskeleton, axon guidance, intracellular transport, the generation and propagation of the action potential, synaptic mechanisms, growth factor influences on development and regeneration, neuronal stem cells, and sensory signal transduction. A team-based-learning approach that involves hands-on experimentation is used in a studio format. Two 3-hour meetings per week. Counts on the biology major in the cell and molecular group.

**Prerequisite(s):** BIOL 121 and BIOL 123

**BIOL 491 - Independent Study (3 Hours)****BIOL 492 - Independent Study (3 Hours)****BIOL 493 - Research in Biology (3 Hours)**

Students select a research topic in a specialized area of biology. Projects are student-designed in consultation with a faculty member. A proposal (including a literature review and a research plan) must be submitted to the faculty member. The project will culminate in a formal written report and/or research seminar at the end of the term. C21:EL.

**Prerequisite(s):** BIOL 121

**Curriculum:** EL

**BIOL 494 - Research in Biology (3 Hours)**

Students select a research topic in a specialized area of biology. Projects are student-designed in consultation with a faculty member. A proposal (including a literature review and a research plan) must be submitted to the faculty member. The project will culminate in a formal written report and/or research seminar at the end of the term. C21:EL.

**Prerequisite(s):** BIOL 121 and BIOL 493

**Curriculum:** EL

**BIOL 496 - Senior Project (3 Hours)**

A special research problem selected by the student in consultation with the biology faculty. A detailed proposal (including a literature review and a plan of research) must be submitted to the faculty member. A research seminar and a written thesis must be presented to the biology department at the end of the second term of the senior project. The student must pass an oral examination in defense of the thesis. Student earns a total of six hours for the full senior project experience (496, 497, and 498). C21:EL.

**Prerequisite(s):** senior status

**Curriculum:** EL

**BIOL 497 - Senior Project (3 Hours)**

A special research problem selected by the student in consultation with the biology faculty. A detailed proposal (including a literature review and a plan of research) must be submitted to the faculty member. A research seminar and a written thesis must be presented to the biology department at the end of the second term of the senior project. The student must pass an oral examination in defense of the thesis. Student earns a total of six hours for the full senior project experience (496, 497, and 498). C21:EL.

**Prerequisite(s):** senior status

**Curriculum:** EL

**BIOL 498 - Senior Project (3 Hours)**

A special research problem selected by the student in consultation with the biology faculty. A detailed proposal (including a literature review and a plan of research) must be submitted to the faculty member. A research seminar and a written thesis must be presented to the biology department at the end of the second term of the senior project. The student must pass an oral examination in defense of the thesis. Student earns a total of six hours for the full senior project experience (496, 497, and 498). C21:EL.

**Prerequisite(s):** senior status

**Curriculum:** EL

**BIOL 499 - Biology Capstone (3 Hours)**

Students will learn about cutting-edge research from practicing scientists in academia by reading relevant scientific literature by these scientists and listening to invited talks during weekly seminars. Students are expected to synthesize biological principles across the different sub-disciplines (cell and molecular, organismal, and ecology), and to apply skills that they have learned as Biology majors, such as speaking and evaluating experimental design. C21:CS.

**Prerequisite(s):** BIOL 121 and BIOL 123 and senior status

**Curriculum:** CS