The Citadel

SWAIN FAMILY SCHOOL
OF
SCIENCE
AND
MATHEMATICS

Col. Darin Zimmerman, Dean

Department of Biology
Lt. Col. Mary Katherine Zanin, Interim Head

Department of Chemistry
Lt. Col. Robert M. Granger II, Head

Department of Cyber and Computer Sciences
Col. Shankar Banik, Head

Department of Health and Human Performance
Lt. Col. Timothy Bott, Head

Department of Mathematical Sciences
Col. Mei-Qin Chen, Head

Swain Department of Nursing
Col. Kimberly Subasic, Head

Department of Physics
Lt. Col. Henry "Hank" Yochum, Head
Department of Biology

Department Head: Zanin
Professors: Gramling, J., Gustafson, Nolan, Weinstein, Zardus
Associate Professors: Donnell, J., Johnson, Rocha, Zanin
Assistant Professors: Moran, Capers
Senior Instructor: Gramling, A.

The Biology Department is structured to offer courses which give students a better understanding of themselves, their relationship with their environment, and the diversity of life. Enrichment courses with minimum prerequisites are offered in summer and evening programs for interested individuals.

B.S. Biology Major

The B.S. in Biology degree is intended for those students who plan to enter graduate, medical, dental, veterinary, or other professional schools; military service; and technical positions in the broader field of biology. The major is designed to provide students with a broad background in modern biology that will prepare them for employment or further study. All students majoring in biology are required to take the Introduction to Biology I and II sequence (BIOL 130, 131, 140, 141), Cell Biology (BIOL 210, 211), Evolution (BIOL 208), Genetics (BIOL 308), Ecology (BIOL 406), and Senior Seminar (BIOL 411).

All undergraduate courses taken at The Citadel with a subject prefix of BIOL will count towards the major GPA.

Students must take four additional biology electives. One must be chosen from each of the following course groupings:

Cell and Molecular Biology Courses:
- BIOL 290 Microbiology
- NURS 340 Pathophysiology
- NURS 341 Pharmacology
- BIOL 401 Developmental Biology
- BIOL 402 Descriptive Histology
- BIOL 424 Molecular Genetics
- BIOL 427 Immunology

Ecology and Field Biology Courses:
- BIOL 314 Vascular Flora of South Carolina
- BIOL 407 Conservation Ecology
- BIOL 408 Ornithology
- BIOL 409 Marine Biology
- BIOL 425 Tropical Rainforest and Reef Ecology
- BIOL 426 Freshwater Biology
Organismal Biology Courses:
BIOL 203 Introduction to Plant Biology  
BIOL 301 Invertebrate Zoology  
BIOL 302 Comparative Vertebrate Anatomy  
BIOL 309 Animal Behavior  
BIOL 410 Vertebrate Natural History  
BIOL 419 Economic Botany  
BIOL 421 Toxicology

Physiological Biology Courses:
BIOL 403 Mammalian Physiology  
BIOL 414 Environmental Physiology

Bachelor of Science in Biology/Secondary Teaching Specialization
The Bachelor of Science in Biology/Secondary Teaching Specialization major is designed to provide students with a broad background in modern biology that will prepare them for certification to teach Biology and General Science at the secondary school level. All students choosing this major are required to take the Introduction to Biology I and II sequence (BIOL 130, 131, 140, 141), Cell Biology (BIOL 210, 211), Evolution (BIOL 208), Genetics (BIOL 308), Methods and Applications of Science (BIOL 330), Ecology (BIOL 406), and Senior Seminar (BIOL 411). Students must take four additional biology electives chosen from the list below and all other indicated courses. Students in this program must make a formal application for admission to the School of Education for the Internship in Teaching as outlined on page 165.

All undergraduate courses taken at The Citadel with a subject prefix of BIOL, EART, EDUC and STAT will count towards the major GPA.

Biology Electives: One course must be chosen from each of the three areas below.

Animal Physiology Area
  BIOL 403  Mammalian Physiology  
  BIOL 414  Environmental Physiology

Botany Area
  BIOL 203  Introduction to Plant Biology  
  BIOL 314  Vascular Flora of South Carolina

Zoology Area
  BIOL 301  Invertebrate Zoology  
  BIOL 302  Comparative Vertebrate Anatomy  
  BIOL 408  Ornithology  
  BIOL 410  Vertebrate Natural History
Allied Science and Mathematics Courses
- CHEM 151/161 General Chemistry I
- CHEM 152/162 General Chemistry II
- EART 201 Earth Science
- MATH 106/107 Applied Calculus I and II
- PHYS 203/253 College Physics I
- PHYS 204/254 College Physics II
- STAT 160 Statistical Methods

Required Education Courses
- EDUC 101 Education in Modern Society
- EDUC 202 Educational Psychology
- EDUC 206 Adolescent Development
- EDUC 306 Teaching Reading in the Middle and High School
- EDUC 312 Learners with Exceptionalities
- EDUC 401 Methods and Materials of Middle and High School Teaching
- EDUC 402 Special Methods in Teaching
- EDUC 499 Internship in Teaching (Spring Semester Senior Year)

ROTC Courses
- AERO, MLTY, or NAVL sequence (101, 102, 201, 202, 301, 302, 401 and 402)

Premedical-Predental Program
Students who are planning to enter medical school, dental school, veterinary school, or professional school in allied health should consider the B.S. Biology major. The flexibility of the major course of study permits the preprofessional students to tailor their plans of study to each area of specialty. The department coordinates a voluntary program where students may gain practical experience before graduation. The large number of electives available in the biology curriculum makes it possible for the student to develop the broad science-humanities background necessary in the medical or dental profession.

Research Opportunities
The Biology Department strongly urges majors to engage in research under the direction of a Citadel faculty member. The best way to learn science is to become actively involved in doing science and the Biology Department faculty offer majors many opportunities to become involved in their research programs. Majors can earn academic credit for research by enrolling in BIOL 320 (Intern Research) or in the undergraduate research series (BIOL 321-324). These courses can be used once as a biology elective and may be repeated one time as a general elective.
Students seeking a minor in Biology will be required to complete either Foundations of Biology (BIOL 105 and 115) and a Natural Science strand course (NTSS) or the Introduction to Biology I and II sequence (BIOL 130, 131, 140, 141). A minimum of 12 additional credit hours is required for the minor. One course must be selected from each of the three areas listed below and at least two of these courses must involve laboratory work.

### Cell and Molecular Category Courses
- BIOL 210 Cell Biology
- BIOL 211 Cell Biology Laboratory
- BIOL 290 Microbiology
- BIOL 308 Genetics
- NURS 340 Pathophysiology
- NURS 341 Pharmacology
- BIOL 401 Developmental Biology
- BIOL 402 Descriptive Histology
- BIOL 424 Molecular Genetics
- BIOL 427 Immunology

### Field Biology Category Courses
- BIOL 209 Environmental Science
- BIOL 314 Vascular Flora of South Carolina
- BIOL 406 Ecology
- BIOL 407 Conservation Ecology
- BIOL 408 Ornithology
- BIOL 409 Marine Biology
- BIOL 410 Vertebrate Natural History
- BIOL 425 Tropical Rainforest and Reef Ecology
- BIOL 426 Freshwater Biology

### Organismal Category Courses
- BIOL 203 Introduction to Plant Biology
- BIOL 208 Evolution
- BIOL 217 Human Anatomy and Physiology I
- BIOL 218 Human Anatomy and Physiology II
- BIOL 227 Human Anatomy and Physiology I Laboratory
- BIOL 228 Human Anatomy and Physiology II Laboratory
- BIOL 291 History of Biology
- BIOL 301 Invertebrate Zoology
- BIOL 302 Comparative Vertebrate Anatomy
- BIOL 309 Animal Behavior
- BIOL 403 Mammalian Physiology
- BIOL 414 Environmental Physiology
- BIOL 419 Economic Botany
- BIOL 421 Toxicology

*Total Credit Hours Required:* 12 credit hours beyond the general education requirement, 9 of which must be completed at The Citadel
Minor in Molecular Biology and Biochemistry

The Departments of Biology and Chemistry offer a joint minor in Molecular Biology and Biochemistry. This minor will be beneficial to students interested in careers in medicine, dentistry, and other health science fields as well as those who wish to pursue careers in the chemical and biochemical industry. Active learning exercises, use of scientific literature, computer modeling, inquiry-based laboratories, and research are important components of the courses in the sequence. Requirements for the minor vary slightly depending on the student’s major. The following courses are prerequisites for the minor: BIOL 130/131 and 140/141; CHEM 151/161, 152/162, 207/217, and 208/218.

Requirements for Students Majoring in Biology

BIOL 424 Molecular Genetics
BIOL or CHEM 429 Literature Seminar
CHEM 409 Biochemistry I
CHEM 410 Biochemistry II
CHEM 460 Biochemistry Laboratory
BIOL 290 Microbiology

or

CHEM 300 Quantitative Analysis

Requirements for Students Majoring in Chemistry

BIOL 308 Genetics
BIOL 424 Molecular Genetics
BIOL or CHEM 429 Literature Seminar
CHEM 409 Biochemistry I
CHEM 410 Biochemistry II
CHEM 460 Biochemistry Laboratory

Requirements for All Other Majors

BIOL 308 Genetics
BIOL 424 Molecular Genetics
BIOL or CHEM 429 Literature Seminar
CHEM 409 Biochemistry I
CHEM 410 Biochemistry II
CHEM 460 Biochemistry Laboratory

Total Credit Hours Required: 16 credit hours, 9 of which must be completed at The Citadel
Minor in Sustainability and Environmental Studies

Objectives:
The minor in sustainability and environmental studies is an interdisciplinary minor designed to help undergraduate students gain environmental science literacy; develop an understanding of the environment and an appreciation of sustainability from a variety of perspectives such as business and engineering; and create and/or participate in a project related to local environmental and sustainability efforts. Students pursuing the minor will have the opportunity to take a variety of classes addressing sustainability and environmental studies culminating in a capstone course. The capstone course will provide the students a chance to build upon their previous coursework in the minor through a semester long research project, service-learning activity or internship.

Potential Students:
The minor may be appropriate for undergraduate students from all five schools who are interested in the environment and sustainability. Possible areas of interest could include sustainable agriculture, environmental degradation, supply chain sustainability, environmental history or environmental economics.

Requirements:
To complete a minor in sustainability and environmental studies, students must take a minimum of 15 credit hours from the approved list of courses listed below.

REQUIRED COURSES:
Must take both of the following:
- BIOL 209: Environmental Science (1st course)
- Capstone Course: Including EDUC 409: Service Learning in Environmental and Sustainability Studies, BIOL 320: Intern Research, or similarly approved high-impact experiences.

OPTIONAL COURSES:
Must take THREE of the following:

SCMT 302 – Quality Management
SCMT 402 – Purchasing and Materials Management
SCMT 304- Project Management
MGMT 311 – Human Resource Management
CIVL 322 – Introduction to Environmental Engineering
CIVL 408 – Water and Wastewater Systems
MECH 417 – Renewable Energy
ELEC 427 – Energy Systems Engineering
HIST 392 – Special Topics in History*** (Environmental History)
PSCI 433 – Special Topics in International Politics*** (Global Environment)
BIOL 292 – Leadership for Environmental Sustainability
BIOL 314 – The Vascular Flora of South Carolina
BIOL 406 – Ecology
BIOL 407 – Conservation Ecology
BIOL 409 – Marine Biology
BIOL 414 – Environmental Physiology
BIOL 419 – Economic Botany
BIOL 412 – Special Topics in Biology***
BIOL 421 – Toxicology  
BIOL 426 – Freshwater Biology  
PHYS 243 – Meteorology  
PHYS 301 – Biological Physics  
PHYS 343 – Applied Climatology  
EART 201 – Introduction to Earth Science  
EDUC 409 – Special Topics in Education***

*note only one course can be counted for both a major and a minor

**CIVL 322 and CIVL 408 can be appropriate for non-CE STEM majors. These non-CE STEM majors must complete CHEM 151/161 as a pre-requisite for CIVL 322 and CIVL 322 as a prerequisite for CIVL 408. The CE department must be notified prior to attempting registration to open the course to non-CE STEM majors.

***Special Topics Courses will require approval from the Program Director on a case-by-case basis.

Total Credit Hours Required: 15, at least 9 of which must be completed at The Citadel.

Biology Course Descriptions

BIOL 101 General Biology I  Three Credit Hours  
Corequisite: BIOL 111  
An introductory course in biology designed for non-majors that emphasizes the importance of biology and its impact on human society. Topics include the methods of science, cell structure and function, photosynthesis and cellular respiration, molecular biology, and genetics.  
Lecture: three hours.

BIOL 102 General Biology II  Three Credit Hours  
Corequisite: BIOL 112  
A continuation of the introductory course for non-majors that covers topics including evolution, the diversity of life, plant and animal form and function, and principles of ecology. It is recommended that students complete BIOL 101 and 111 before taking BIOL 102 and 112.  
Lecture: three hours.

BIOL 105 Foundations of Biology  Three Credit Hours  
Corequisite: BIOL 115  
An introductory course in biology designed for non-majors that emphasizes the importance of biology and its impact on society. Topics include the method of science and an overview of key principles related to cell structure and function, genetics, evolution, organisms, and ecology.
BIOL 111  General Biology I Laboratory  One Credit Hour
Corequisite: BIOL 101
Laboratory exercises designed to parallel and support the lecture content of BIOL 101.
Laboratory: two hours.

BIOL 112  General Biology II Laboratory  One Credit Hour
Corequisite: BIOL 102
Laboratory exercises designed to parallel and support the lecture content of BIOL 102.
Laboratory: Two hours.

BIOL 115  Foundations of Biology Laboratory  One Credit Hour
Corequisite: BIOL 105
Laboratory exercises designed to parallel and support the lecture content of BIOL 105.

BIOL 130  Introduction to Biology I  Three Credit Hours
Corequisite: BIOL 131
An introductory course required of all biology majors and education majors whose teaching field is biology; recommended for students in other majors who are interested in medicine or other health professions. Topics include the scientific method and data analysis, cell and molecular biology, and genetics.
Lecture: three hours.

BIOL 131  Introduction to Biology I Laboratory  One Credit Hour
Corequisite: BIOL 130
Laboratory exercises designed to parallel the lecture content of BIOL 130.
Laboratory: three hours.

BIOL 140  Introduction to Biology II  Three Credit Hours
Prerequisite: BIOL 130 and 131 or a grade of “B” or better in BIOL 101 and 111
Corequisite: BIOL 141
A continuation of the introductory course for biology majors. Topics include evolution, the diversity of life, plant and animal biology, and ecology.
Lecture: three hours.

BIOL 141  Introduction to Biology II Laboratory  One Credit Hour
Prerequisite: BIOL 130 and BIOL 131
Corequisite: BIOL 140
Laboratory exercises designed to parallel the lecture content of BIOL 140.
Laboratory: three hours.

BIOL 150  General Biology for Engineers  Three Credit Hours
Corequisite: BIOL 151
An introductory course in biology designed for engineering students. Topics include the methods of science, chemistry and cells, evolution, ecology, and microbiology.
Lecture: three hours.

BIOL 151  General Biology for Engineers Laboratory  One Credit Hour
Corequisite: BIOL 150
Laboratory exercises designed to parallel and support the lecture content of BIOL 150.
Laboratory: two hours.

BIOL 203  Introduction to Plant Biology  Four Credit Hours
Prerequisite: BIOL 102/112 or 140/141
A general survey of the vascular and nonvascular plants. Lecture and laboratory experiences will include a study of the characteristics, life cycles, evolutionary trends, ecological importance, and economic value of each plant group.
Lecture: three hours; laboratory: three hours.

BIOL 206  Human Genetics  Three Credit Hours
Prerequisite: BIOL 101
Does not count toward the biology major
This course will introduce students to a variety of genetic issues that they will encounter during their lives including: 1) the genetic basis of disease; 2) genetically modified organisms; 3) genetic screening and prenatal diagnosis; 4) cancer; 5) the human genome; 6) genetically modified organisms; and 7) DNA fingerprinting. In addition to gaining a scientific understanding of these issues, the ethical and societal impacts will be discussed.
Lecture: three hours.

BIOL 207  Bioterrorism  Three Credit Hours
Prerequisite: BIOL 101
Does not count toward the biology major
This course will focus on specific organisms that could be used as bio-weapons, discussing their normal existence, common methods of weaponization of such organisms, their potential effects on a human population, and strategies for protecting populations from bioterrorism attacks (vaccine development). A detailed study of the biological characteristics of these organisms will be the main focus study for this course.
Lecture: three hours.

BIOL 208  Evolution  Three Credit Hours
Prerequisite: BIOL 140/141
Required of all biology majors
A basic course in the concepts of evolution and population dynamics. The history of evolutionary thought, the processes of organic evolution, and systematics are included.
Lecture: three hours.

BIOL 209  Environmental Science  Three Credit Hours
Does not count toward biology major.
Human impact on our environment has never been so intensive or so far-reaching. Fundamental conditions in global nutrient cycling, biological diversity, atmospheric composition, and climate are changing at an unprecedented rate. This course will use real world case studies to investigate the complex interactions among ecology, geology, chemistry, ethics, policy, and economics.
Lecture: three hours.
BIOL 210  Cell Biology  Three Credit Hours
Prerequisites: BIOL 130/131
An introduction to the morphological, biochemical and biophysical properties of cells and their significance in life processes. Lecture: three hours.
Lecture: three hours

BIOL 211  Cell Biology Lab  One Credit Hour
Prerequisites: BIOL 130/131
Laboratory exercises designed to illustrate and support the lecture content of BIOL 210.
Laboratory: three hours

BIOL 217  Human Anatomy and Physiology I  Three Credit Hours
Prerequisite: BIOL 101/111 or BIOL 105/115 or BIOL 130/131 and EXSC major or Permission of Biology Department Head.
Does not count toward biology major.
An introduction to the integrated structure and function of human organ systems covering cells and tissue; integumentary, skeletal, and nervous systems; and sensory organs.
Lecture: three hours; laboratory: BIOL 227 is optional.

BIOL 218  Human Anatomy and Physiology II  Three Credit Hours
Prerequisite: BIOL 217
Does not count toward biology major.
A continuation of the study of integrated structure and function of the human organ systems covering muscular, cardiovascular, lymphatic, respiratory, digestive, urinary, endocrine, and reproductive systems.
Lecture: three hours; laboratory, BIOL 228 is optional.

BIOL 227  Human Anatomy and Physiology I Lab  One Credit Hour
Prerequisite: BIOL 101/111 or BIOL 105/115
Corequisites or prerequisites: BIOL 217
Does not count toward biology major.
Laboratory exercises designed to illustrate and support lecture content of BIOL 217.
Laboratory: two hours.

BIOL 228  Human Anatomy and Physiology II Lab  One Credit Hour
Prerequisite: BIOL 217
Corequisites or prerequisites: BIOL 218
Does not count toward biology major.
Laboratory exercises designed to illustrate and support lecture content of BIOL 218.
Laboratory: two hours.

BIOL 290  Microbiology  Four Credit Hours
Prerequisite: BIOL 205 or approval of instructor.
A general study of microorganisms and their importance to humans with special emphasis on their fundamental life processes. Includes a brief introduction to epidemiology and immunology.
Lecture: three hours; laboratory: three hours.
BIOL 291  *History of Biology*  Three Credit Hours
Prerequisite: BIOL 140/141 or permission of the instructor.
This course covers major aspects of the development of biological sciences and their relationship to other scientific disciplines. Special attention will be paid to the development and content of theories and to changes in the methods of biological research.
Lecture: three hours.

BIOL 292  *Leadership for Environmental Sustainability*  Three Credit Hours
This course is designed to explore the role of sustainability in managing natural resources and in guiding informed decision-making by principled leaders in the fields of business, politics, science, and beyond. Sustainability is the use of guiding principles to manage the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change so that they are consistent with future as well as present needs. This course highlights the roles of stewardship and sustainability in the decisions that principled leaders must make. Students will develop an understanding of how to evaluate short-term and long-term resource needs and how to communicate the environmental decision-making process.
Lecture: three hours.

BIOL 301  *Invertebrate Zoology*  Four Credit Hours
Prerequisite: BIOL 140/141
A general study of the invertebrate animals, including taxonomy, morphology, and ecology.
Lecture: three hours; laboratory: three hours.

BIOL 302  *Comparative Vertebrate Anatomy*  Four Credit Hours
Prerequisite: BIOL 140/141
A study of the functional anatomy of representative vertebrate animals. Emphasis will be placed on the evolution of the vertebrate body and adaptations in form and function in response to environmental pressures.
Lecture: three hours; laboratory: three hours.

BIOL 308  *Genetics*  Four Credit Hours
Prerequisite: BIOL 140/141 or permission of the instructor; STAT 160 strongly recommended.
Required of all biology majors.
A study of inheritance, including Mendelian genetics, molecular genetics, changes in chromosome structure and number, cytogenetics, and population genetics.
Lecture: three hours; laboratory: three hours.

BIOL 309  *Animal Behavior (Ethology)*  Four Credit Hours
Prerequisite: BIOL 140/141 or PSYĆ 201
This course deals with the description, development, and adaptive nature of behavior in free-living animals. The laboratory will emphasize the description and quantification of behavior patterns. It is highly recommended that students take STAT 160 before enrolling in this course.
Lecture: three hours; laboratory: three hours.
BIOL 314  *The Vascular Flora of South Carolina*  Four Credit Hours
Prerequisite: BIOL 102/112 or BIOL 209 or BIOL 140/141
An introductory study of the native vascular flora of South Carolina, emphasizing the identification and collection of native plants. The student will have practice in use of taxonomic keys and in preparation of specimens.
Lecture: two hours; laboratory: four hours.

BIOL 320  *Intern Research*  Three Credit Hours
Prerequisite: Permission of the department head and supervising instructor.
Students will have the opportunity to participate in ongoing research projects with faculty at The Medical University of South Carolina, National Marine Fisheries Services, and The South Carolina Department of Natural Resources, etc. Students must plan their schedule to allow two free afternoons per week, totaling eight hours per week in the laboratory or field, excluding travel. They are expected to maintain a weekly laboratory notebook and write a research paper detailing their work.
Eight hours per week.

BIOL 321  *Undergraduate Research in Biology I*  Three Credit Hours
Prerequisite: Permission of the department head and supervising instructor.
Students will have the opportunity to participate in ongoing research projects with faculty at The Citadel. Students must plan their schedule to allow two free afternoons per week, totaling eight hours per week in the laboratory or field, excluding travel. They are expected to maintain a weekly laboratory notebook and write a research paper detailing their work. This class may be taken for Biology elective credit with permission of the department head.
Eight hours per week.

BIOL 322  *Undergraduate Research in Biology II*  Three Credit Hours
Prerequisite: Permission of the department head and supervising instructor, and completion of BIOL 321.
Students will have the opportunity to participate in ongoing research projects with faculty at The Citadel. Students must plan their schedule to allow two free afternoons per week, totaling eight hours per week in the laboratory or field, excluding travel. They are expected to maintain a weekly laboratory notebook and write a research paper detailing their work. This class may be taken for Biology elective credit with permission of the department head.
Eight hours per week.

BIOL 323  *Undergraduate Research in Biology III*  Three Credit Hours
Prerequisite: Permission of the department head and supervising instructor, and completion of BIOL 322.
Students will have the opportunity to participate in ongoing research projects with faculty at The Citadel. Students must plan their schedule to allow two free afternoons per week, totaling eight hours per week in the laboratory or field, excluding travel. They are expected to maintain a weekly laboratory notebook and write a research paper detailing their work. This class may be taken for Biology elective credit with permission of the department head.
Eight hours per week.
BIOL 324  Undergraduate Research in Biology IV  Three Credit Hours

Prerequisite: Permission of the department head and supervising instructor, and completion of BIOL 323.

Students will have the opportunity to participate in ongoing research projects with faculty at The Citadel. Students must plan their schedule to allow two free afternoons per week, totaling eight hours per week in the laboratory or field, excluding travel. They are expected to maintain a weekly laboratory notebook and write a research paper detailing their work. This class may be taken for Biology elective credit with permission of the department head.

Eight hours per week.

BIOL 401  Developmental Biology  Four Credit Hours

Prerequisites or corequisites: BIOL 205 and BIOL 308

A study of animal embryology and its molecular control, including: the process of fertilization; the processes of cleavage, gastrulation, and neurulation; the formation of tissues and organs from the three primordial germ layers; the role of secondary induction and of hormones in development; the role of the environment in development; and some of the techniques of molecular biology that are used in the study of developmental processes. The laboratory will include use of model systems to investigate the principles discussed in lecture.

Lecture: three hours; laboratory: three hours.

BIOL 402  Descriptive Histology  Four Credit Hours

Prerequisite: BIOL 140/141

A detailed study of the chief types of animal tissues and a description of the histology of organs. Laboratory work includes microscopic study of cells, tissues, and organs of animals.

Lecture: three hours; laboratory: three hours.

BIOL 403  Mammalian Physiology  Four Credit Hours

Prerequisites: BIOL 140/141 and CHEM 208

A systematic study of the general physiology of mammalian organ systems.

Lecture: three hours; laboratory: three hours.

BIOL 406  Ecology  Four Credit Hours

Prerequisite: BIOL 140/141

Required of all biology majors.

An introduction to the study of biological interrelationships and the effects of the environment on the structure and function of animal and plant populations. Laboratory will emphasize methods and materials of ecological investigations. It is highly recommended that students take Statistics before enrolling in this course.

Lecture: three hours; laboratory: four hours.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIOL 407</td>
<td>Conservation Ecology</td>
<td>Three</td>
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<td></td>
<td>Prerequisite: BIOL 102/112 or BIOL 209 or BIOL 140/141</td>
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<td>Conservation ecology is an integrated science based primarily on ecology, with important contributions from genetics, evolution, biogeography, sociology, economics, and political science. The course will address definitions, origins, and patterns of biological diversity, explore why the maintenance of biodiversity in native and human dominated ecosystems is fundamentally important to the continued well-being of humans and other species, and examine the context and causes of extinction and strategies for preventing or ameliorating the loss of biodiversity.</td>
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<td>Lecture: three hours</td>
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<td>BIOL 408</td>
<td>Ornithology</td>
<td>Four</td>
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<td></td>
<td>Prerequisite: BIOL 102/112 or BIOL 209 or BIOL 140/141</td>
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<td></td>
<td>A study of the structure, function, and ecology of birds. Field trips and bird specimens will give students a working knowledge of birds common to South Carolina.</td>
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<td>Lecture: three hours; laboratory: three hours.</td>
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<td>BIOL 409</td>
<td>Marine Biology</td>
<td>Four</td>
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<td>Prerequisite: BIOL 140/141</td>
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<td>The lectures cover major ecological factors and the fundamentals of oceanography. Laboratory work stresses familiarities with species, taxonomic methods, sampling procedures, experimental design, use of equipment, and data handling.</td>
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<td>Lecture: three hours; laboratory: three hours.</td>
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<td>BIOL 410</td>
<td>Vertebrate Natural History</td>
<td>Four</td>
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<td>Prerequisite: BIOL 140/141</td>
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<td></td>
<td>An introduction to the classification, ecology, evolution and distribution of the vertebrates. Laboratory with emphasis on identification and field study techniques, especially with respect to the vertebrates of South Carolina.</td>
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<td>Lecture: three hours; laboratory: three hours.</td>
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<td>BIOL 411</td>
<td>Senior Seminar</td>
<td>One</td>
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<td>Required of all biology majors. Open only to seniors.</td>
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<td></td>
<td>A group study of current topics of biological interest.</td>
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<td>Lecture: one hour</td>
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<td>BIOL 412</td>
<td>Special Topics in Biology</td>
<td>Four</td>
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<td>Prerequisite: permission of the instructor.</td>
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<td></td>
<td>A course designed for the study of specialized topics in modern biology.</td>
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<td>Lecture: variable; laboratory: variable</td>
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<td>BIOL 414</td>
<td>Environmental Physiology</td>
<td>Four</td>
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<td></td>
<td>Prerequisite: BIOL 205</td>
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<td>This course will cover the physiological adaptations of organisms to physical and chemical parameters of the environment. It includes molecular mechanisms which help organisms adapt to environmental factors.</td>
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<td>Lecture: three hours; laboratory: three hours.</td>
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BIOL 419  *Economic Botany*  Three Credit Hours
Prerequisite: BIOL 102/112 or BIOL 209 or BIOL 140/141
An introductory course in economic botany devoted to the consideration of plants which are useful or harmful to humans; their origins and history, botanical relationships, chemical constituents which make them economically important, and their roles in prehistoric and modern cultures and civilizations.
Lecture: three hours.

BIOL 421  *Toxicology*  Four Credit Hours
Prerequisites: BIOL 102 or 140 and CHEM 104 or 152, or BIOL 218
An overview of the basic science of poisons, including the disposition of chemicals in the body, the role of metabolism in enhancing or reducing their toxicity, mechanisms of toxicity, and the effects of toxicants on major organ systems.
Lecture: three hours; laboratory: three hours.

BIOL 424  *Molecular Genetics*  Four Credit Hours
Prerequisites: BIOL 308, CHEM 208; CHEM 409 Strongly Suggested; BIOL 290 suggested.
Coordinated lecture/laboratory class covering classical molecular and cellular biochemistry as well as modern molecular genetics. Study of the manner in which genetic information is carried in DNA and how DNA directs the synthesis of proteins in bacterial and eukaryotic cells and their associated viruses. Specific topics to be covered include mechanisms governing gene expression, metabolic control system, gene therapy, oncogenesis, molecular genetics of genetic diversity, molecular basis of human diseases, and a review of known disease-causing genes such as the cystic fibrosis gene, Huntington's chorea gene, and the Duchenne Muscular Dystrophy gene.
Lecture: three hours; laboratory: three hours.

BIOL 425  *Tropical Rainforest and Reef Ecology*  Four Credit Hours
The objectives of this experiential course are to survey biodiversity and provide understanding of ecological principles in tropical habitats through physical involvement with the environment. Two co-instructors will lead students on a 10-12 day excursion in forest and reef habitats of the Neotropics, providing natural history instruction and interpretation. Participants will have the opportunity to immerse themselves in the subject by walking forest paths, swimming forest streams, spelunking caves, paddling mangrove swamps, combing beaches, and snorkeling coral reefs. A species list of plants and animals will be assembled for each habitat and readings from the scientific literature, appropriate to the region, will be assigned for analysis and discussion.

BIOL 426  *Freshwater Biology*  Four Credit Hours
Prerequisite: BIOL 140/141
The study of freshwater organisms and their environment. Instruction will cover the biological diversity, ecological and physiological adaptations, and the physical setting of freshwater systems. Local systems of interest include large coastal rivers and lakes, upper portions of estuaries and old rice fields.
BIOL 427  Immunology  Three Credit Hours
   Prerequisites or corequisites: BIOL 205 and BIOL 308
   A description of the immune system including the cells and organs involved
   in immunity; antigen-antibody reactions; immunoglobulin structure, function;
   organization and expression of immunoglobulin genes; the major histocompat-
   ibility complex; immune regulation and tolerance. These basic concepts will be
   applied to understanding the role of the immune system in vaccinations; infectious
   disease; organ transplantation; autoimmune disease; immunodeficiency diseases;
   AIDS and cancer.
   Lecture: three hours.

BIOL 429  Literature Seminar  One Credit Hour
   Prerequisite: BIOL 140/141
   A current topics course that involves discussions of relevant journal articles
   and related materials.
**BIOLOGY MAJOR**  
First Semester

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year Experience</td>
<td>LDRS 101</td>
<td>1 (2,0)*</td>
</tr>
<tr>
<td>Freshman Seminar</td>
<td>FSEM 101</td>
<td>3 (3,0)</td>
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<tr>
<td>Freshman Linked Writing Intensive</td>
<td>FSWI 101</td>
<td>3 (3,0)</td>
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<tr>
<td>Physical Fitness, Resiliency, and Wellness</td>
<td>RPED 260</td>
<td>3 (3,0)</td>
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<tr>
<td>Introduction to Biology II</td>
<td>BIOL 140</td>
<td>3 (3,0)</td>
</tr>
<tr>
<td>Introduction to Biology II Laboratory</td>
<td>BIOL 141</td>
<td>1 (0,3)</td>
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<tr>
<td>General Chemistry I</td>
<td>CHEM 151</td>
<td>3 (3,0)</td>
</tr>
<tr>
<td>General Chemistry I Laboratory</td>
<td>CHEM 161</td>
<td>1 (0,2)</td>
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<tr>
<td>1st Year Basic ROTC</td>
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**SOPHOMORE YEAR**

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<thead>
<tr>
<th>Course Description</th>
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<tr>
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<td>(May be taken either semester)</td>
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<tr>
<td>Evolution</td>
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<td>3 (3,0)</td>
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<td>Organic Chemistry I</td>
<td>CHEM 207</td>
<td>3 (3,0)</td>
</tr>
<tr>
<td>Organic Chemistry I Laboratory</td>
<td>CHEM 217</td>
<td>1 (0,3)</td>
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<tr>
<td>Applied Calculus I</td>
<td>MATH 106</td>
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<tr>
<td>General Elective</td>
<td>3 (3,0)</td>
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</tr>
<tr>
<td>Modern Language</td>
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**JUNIOR YEAR**

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<tr>
<th>Course Description</th>
<th>Code</th>
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<tbody>
<tr>
<td>Junior Ethics Enrichment Experience</td>
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<td>Leadership in Organizations</td>
<td>LDRS 371</td>
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<td>Strand Course§</td>
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<td>Strand Course§</td>
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<td>Genetics</td>
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<td>College Physics I Laboratory</td>
<td>PHYS 253</td>
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**SENIOR YEAR**

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Strand Course§</td>
<td>3 (3,0)</td>
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<tr>
<td>Senior Leadership Integration Seminar</td>
<td>LDRS 411</td>
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<td>Biology Senior Seminar</td>
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<td>General Elective</td>
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<td>2nd Year Advanced ROTC</td>
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</table>

*Represents semester credit, lecture, and laboratory hours, in that order. Var = varies according to course.

**Biology electives must include at least one course from each of the following four areas. Cell and Molecular Biology: BIOL 290, 340, 341, 401, 402, 424; 427; Ecology and Field Biology: BIOL 314, 407, 408, 409, 425, 426; Organismal Biology: BIOL 203, 301, 302, 309, 410, 419, 421; Physiological Biology: BIOL 403 and 414.

§Students must complete four strand courses, which may be completed in any order: English (ENGS 30X), History (HIS 30X), Social Science (SCSS 30X), and Science (NTSS 30X).
## Department of Biology

### BIOLOGY MAJOR

#### Second Semester

**FRESHMAN YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Code</th>
<th>Credits ( Credits, Labs)</th>
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<tbody>
<tr>
<td>Introduction to Biology I</td>
<td>BIOL 130</td>
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<td>Introduction to Biology I Laboratory</td>
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<td>General Chemistry II</td>
<td>CHEM 152</td>
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<td>General Chemistry II Laboratory</td>
<td>CHEM 162</td>
<td>1 (0,2)</td>
</tr>
<tr>
<td>Statistical Methods</td>
<td>STAT 160</td>
<td>3 (3,0)</td>
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<td>Modern Language</td>
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<td>General Elective</td>
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**SOPHOMORE YEAR**

<table>
<thead>
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<th>Code</th>
<th>Credits ( Credits, Labs)</th>
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<tbody>
<tr>
<td>Principled Leadership in American Gov.</td>
<td>LDRS 202</td>
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<td>Cell Biology</td>
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<td>Cell Biology Laboratory</td>
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<td>Organic Chemistry II</td>
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<td>Organic Chemistry II Laboratory</td>
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<td>Applied Calculus II</td>
<td>MATH 107</td>
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<td>Technical Writing and Communication</td>
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**JUNIOR YEAR**

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<thead>
<tr>
<th>Course</th>
<th>Code</th>
<th>Credits ( Credits, Labs)</th>
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<tbody>
<tr>
<td>Strand Course§</td>
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<tr>
<td>Ecology</td>
<td>BIOL 406</td>
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<td>BIOL 3(4)</td>
<td>(var)</td>
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<td>College Physics II</td>
<td>PHYS 204</td>
<td>3 (3,0)</td>
</tr>
<tr>
<td>College Physics II Laboratory</td>
<td>PHYS 254</td>
<td>1 (0,3)</td>
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<tr>
<td>General Elective</td>
<td></td>
<td>3 (3,0)</td>
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<tr>
<td>Required Physical Education</td>
<td>RPED 0</td>
<td>0 (0,1)</td>
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<tr>
<td>1st Year Advanced ROTC</td>
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**SENIOR YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Code</th>
<th>Credits ( Credits, Labs)</th>
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</thead>
<tbody>
<tr>
<td>General Education Capstone</td>
<td>GEND 422</td>
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<td>Biology Elective**</td>
<td>BIOL 3(4)</td>
<td>(var)</td>
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<tr>
<td>General Elective</td>
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<tr>
<td>General Elective</td>
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<td>Required Physical Education</td>
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**REQUIRED FOR GRADUATION:** 131 - 133 credit hours plus successful completion of all RPED, ROTC, and LDRS graduation requirements. ROTC hours (credits, lectures, and labs) vary each semester by military department.
## BIOLOGY MAJOR

**Teaching Specialization in Biology & Comprehensive/Broad Field Science**

### First Semester - FRESHMAN YEAR

<table>
<thead>
<tr>
<th>Course</th>
<th>Code</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year Experience</td>
<td>LDRS</td>
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</tr>
<tr>
<td>Freshman Seminar</td>
<td>FSEM</td>
<td>101</td>
</tr>
<tr>
<td>Freshman Linked Writing Intensive</td>
<td>FSWI</td>
<td>101</td>
</tr>
<tr>
<td>Physical Fitness, Resiliency, and Wellness</td>
<td>RPED</td>
<td>260</td>
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<tr>
<td>Introduction to Biology II</td>
<td>BIOL</td>
<td>140</td>
</tr>
<tr>
<td>Introduction to Biology II Laboratory</td>
<td>BIOL</td>
<td>141</td>
</tr>
<tr>
<td>General Chemistry I</td>
<td>CHEM</td>
<td>151</td>
</tr>
<tr>
<td>General Chemistry I Laboratory</td>
<td>CHEM</td>
<td>161</td>
</tr>
<tr>
<td>Education in Modern Society</td>
<td>EDUC</td>
<td>101</td>
</tr>
<tr>
<td>1st Year Basic ROTC</td>
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### SOPHOMORE YEAR

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<tr>
<th>Course</th>
<th>Code</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Sophomore Seminar in Principled Leadership (211 may be taken either semester)</td>
<td>LDRS</td>
<td>211</td>
</tr>
<tr>
<td>Principled Leadership in American Govt</td>
<td>LDRS</td>
<td>202</td>
</tr>
<tr>
<td>Evolution</td>
<td>BIOL</td>
<td>208</td>
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<tr>
<td>Strand Course§</td>
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<td>3</td>
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<tr>
<td>Applied Calculus I</td>
<td>MATH</td>
<td>106</td>
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<td>Adolescent Development</td>
<td>EDUC</td>
<td>206</td>
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### JUNIOR YEAR

<table>
<thead>
<tr>
<th>Course</th>
<th>Code</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Junior Ethics Enrichment Experience</td>
<td>LDRS</td>
<td>311</td>
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<td>Leadership in Organizations</td>
<td>LDRS</td>
<td>371</td>
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<tr>
<td>Genetics</td>
<td>BIOL</td>
<td>308</td>
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<tr>
<td>College Physics I</td>
<td>PHYS</td>
<td>203</td>
</tr>
<tr>
<td>College Physics I Laboratory</td>
<td>PHYS</td>
<td>253</td>
</tr>
<tr>
<td>Learners with Exceptionalities</td>
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<td>312</td>
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<td>Strand Course§</td>
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### SENIOR YEAR

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<th>Course</th>
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<tbody>
<tr>
<td>Senior Leadership Integration Seminar</td>
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<td>Biology Senior Seminar</td>
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<td>Biology Elective**</td>
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<tr>
<td>Biology Elective**</td>
<td>BIOL</td>
<td>3(4)</td>
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<tr>
<td>Strand Course§</td>
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<tr>
<td>Teaching Reading in Middle &amp; High School</td>
<td>EDUC</td>
<td>306</td>
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<tr>
<td>Special Methods in Teaching</td>
<td>EDUC</td>
<td>402</td>
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</table>

*Represents semester credit, lecture, and laboratory hours, in that order. Var = varies according to course.

**Biology electives must include at least one course from each of the following four areas: Animal Physiology Area: BIOL 403, BIOL 414; Botany Area: BIOL 203, BIOL 314; Zoology Area: BIOL 301, BIOL 302, BIOL 408, BIOL 410. Students must complete four strand courses, which may be completed in any order: English (ENGS 30X), History (HISS 30X), Social Science (SCSS 30X), and Science (NTSS 30X).**
### BIOLOGY MAJOR

#### Teaching Specialization in Biology & Comprehensive Broad Field Science

#### Second Semester

**FRESHMAN YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Biology I</td>
<td>BIOL 130</td>
<td>3 (3,0)</td>
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<tr>
<td>Introduction to Biology I Laboratory</td>
<td>BIOL 131</td>
<td>1 (0,3)</td>
</tr>
<tr>
<td>General Chemistry II</td>
<td>CHEM 152</td>
<td>3 (3,0)</td>
</tr>
<tr>
<td>General Chemistry II Laboratory</td>
<td>CHEM 162</td>
<td>1 (0,2)</td>
</tr>
<tr>
<td>Statistical Methods</td>
<td>STAT 160</td>
<td>3 (3,0)</td>
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<tr>
<td>Physical Fittness, Resiliency, and Wellness</td>
<td>RPED 260</td>
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<td>Educational Psychology</td>
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**SOPHOMORE YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Code</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Cell Biology</td>
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<tr>
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<td>Foundations in Reading</td>
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<td>Technical Writing and Communication</td>
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<tr>
<td>Introduction to Earth Science</td>
<td>EART 201</td>
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**JUNIOR YEAR**

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<thead>
<tr>
<th>Course</th>
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<th>Credits</th>
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<tbody>
<tr>
<td>Ecology</td>
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<td>BIOL</td>
<td>3(4) (var)</td>
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<tr>
<td>College Physics II</td>
<td>PHYS 204</td>
<td>3 (3,0)</td>
</tr>
<tr>
<td>College Physics II Laboratory</td>
<td>PHYS 254</td>
<td>1 (0,3)</td>
</tr>
<tr>
<td>Strand Course§</td>
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<tr>
<td>Methods &amp; Materials-Middle &amp; High School</td>
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**SENIOR YEAR**

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<tr>
<th>Course</th>
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**REQUIRED FOR GRADUATION:** 146-149 credit hours plus successful completion of all RPED, ROTC, and LDRS graduation requirements. ROTC hours (credits, lectures, and labs) vary each semester by military department.