

BIOLOGY

Chair: Velinda Worix

Faculty: Andrew N. Ash, Mary Ash³, Ben A. Bahr⁶, W. Bruce Ezell, Jr., Rita Hagevik⁵, Debby Hanmer¹, Jonathan Hopper, Leon S. Jernigan, Jr.², Lisa Kelly, Harold D. Maxwell, Dennis McCracken, John McDonald, David W. Morse, Brandi Norman, Maria Pereira⁴, Robert E. Poage, John Roe, Maria S. (Marisol) Santisteban, Marilu Santos, Jeremy Sellers, Patricia Sellers, Erika Young, David D. Zeigler, Mary (Meg) Zets

¹Director of Undergraduate Studies

²Environmental Science Coordinator

³Science Education Undergraduate Coordinator

⁴Biotechnology Program Director

⁵Science Education Graduate Director

⁶William C. Friday Distinguished Professor of Molecular Biology and Biochemistry

The objectives of the Biology Department are to afford students an opportunity to gain an understanding of themselves and their environment and thus prepare themselves for taking a fuller, more satisfying role in society; to train students in their ability to reason inductively and deductively; to encourage original thought; to prepare teachers in the biological sciences for the elementary and secondary school; and to provide a background in subject matter and laboratory skills for curricula in which the fundamentals of the various sciences are used.

The department offers programs leading to the Bachelor of Science degree in Biology with indicated track, the Bachelor of Science degree in Environmental Science, the Bachelor of Science degree in Science Education, and the Bachelor of Science degree in Biotechnology (in conjunction with the Department of Chemistry and Physics). Students should consult the department head for details of each program. Course offerings in the interdisciplinary Bachelor of Science Degree program in Science Education are offered through the Biology Department.

Biology (with tracks in **Botany**, **Zoology**, **Molecular Biology**, or **Environmental Biology** possible)

Biology — Biomedical Emphasis

Biology — Pre-Physical Therapy/Pre-Occupational Therapy

Biotechnology

Environmental Science (with track in **Sustainable Agriculture** available)

Science Education (with concentrations in Biology 9-12, Chemistry 9-12, Earth Science 9-12 Physics 9-12, or Middle Grades Science 6-9)

BACHELOR OF SCIENCE IN BIOLOGY

Requirements for a Bachelor of Science Degree in Biology

Core of Required Courses (below), including General Education

Electives

Sem. Hrs.

86-87

33-34

Total: 120

CORE OF REQUIRED COURSES (for all degree programs in Biology)

Freshman Seminar

General Education Requirements*

Required Biology Courses: BIOL 1000, BIO 1000, 1010, 1020, 3040, 3180, 3710

Biology Track (see below): choose one

Botany Track; Zoology Track; Molecular Biology Track; Environmental Biology Track; or No Track (any 2000- or above-level courses with the BIO, ENV, or BTEC prefix)

Chemistry Requirements: 1300, 1310, 1100, 1110

Mathematics Requirements: 1070 or 1090, 2100, and 2150 or 2210

*12 semester hours of Natural Sciences and Mathematics count toward Gen. Ed. and toward major requirements. Additional requirements apply to specific programs.

Sem. Hrs.

1

44

24

11-12

8

10

Core Total*:

86-87

Biology Tracks (choose one to meet Concentration Requirement in the Core)

Botany Track (11-12 sem hr): Three of the following:

BIO 2310, 2320, 3050, 3400, 3540, BIO/ENV 2200

Environmental Biology Track (11-12 sem hr): Three or four of the following:

BIO 2310, 2500, 3010, 3050, 3400, 3420, 4100, 4320, ENV 2200, 2300, 2400, 3100

Molecular Biology Track (11-12 sem hr): Three of the following:

BIO 3150, 3540, 4130, 4610; BTEC 3220, 3230

Zoology Track (11-12 sem hr): Three of the following:

BIO 2040, 2050, 2500, 3010, 3100, 3190, 4610; BIO/ENV 2300

BIOLOGY: BIOMEDICAL EMPHASIS

Requirements for a Bachelor of Science Degree in Biology with Biomedical Emphasis	Sem. Hrs.
Freshman Seminar and General Education*	45(33)
BIOL 1000, BIO 1000, 1020, 2110, 2120, 3040, 3150, 3180, 3710, 4610	36
Choose one from BIO 3190, 3200, 3750, 3810	3-4
CHM 1300, 1100, 1310, 1110, 2500, 2510, 3110, 3120	20
PHY 1500, 1510, 1560, 1570	8
MAT 1070, 2100, 2150	10
Electives	9-10
	Total: 120

*12 semester hours of Natural Sciences and Mathematics count toward General Education and toward major requirements.

BIOLOGY: PRE-PHYSICAL THERAPY/PRE-OCCUPATIONAL THERAPY

Requirements for a Bachelor of Science Degree in Biology: Pre-Physical Therapy/Pre-Occupational Therapy	Sem. Hrs.
Freshman Seminar and General Education*	45(33)
BIOL 1000, BIO 1000, 1020, 2110, 2120, 3040, 3150, 3180, 3710, 4610	36
Choose any 2 additional BIO courses except those for non-majors	6-8
CHM 1300, 1100, 1310, 1110	8
PHY 1500, 1510, 1560, 1570	8
MAT 1070 or 1090, 2100, 2150 or 2210	10
PSY 1010** and two of the following: PSY 2050, 2250, 3600, or 4010	9(6)
PED 4110 and 4120	6
SOC 1020** or 1050**	3(0)
Electives	3
	Total: 120

*12 semester hours of Natural Sciences and Mathematics count toward General Education and toward major requirements. **If taken as part of the General Education Program, hours will not increase concentration total hours

BACHELOR OF SCIENCE IN SCIENCE EDUCATION (9-12, 6-9)

Coordinator: Mary Ash

Upon successful completion of the program of study in Science Education and related requirements, graduates are eligible for a Standard Professional I license to teach in the State of North Carolina. For a more detailed description, including the program standards and goals and objectives, turn to Undergraduate Licensure Programs in the School of Education section of this catalog.

Requirements for a Bachelor of Science Degree in Science Education		Sem. Hrs.
Freshman Seminar and General Education		45(33)*
Content Courses —Select one area of concentration (*12 semester hours of Natural Sciences and Mathematics may count toward General Ed)		
Biology (9-12) Concentration:		62
BIOL 1000 & BIO 1000, 1010, 1020, 3040, 3180, 3710, 4220		
Select one (min. of 3 hours): BIO 3510, 4310, 4990, or BIOS 3xxx		
Guided Electives – 1 hour		
MAT 1070 or 1090, 2150		
CHM 1300 & 1100, 1310 & 1110		
GLY 1150 & GLYL 1150, GLY 1250 & GLYL 1250		
PHY 1500 & 1560, 1510 & 1570		
Chemistry (9-12) Concentration:		62
CHM 1300 & 1100, 1310 & 1110, 2260, 2270, 2500, 2510, 3110		
Select one (minimum of 3 hours): CHM 3990 or CHMS 4xxx		
MAT 2210, 2220		
BIOL 1000 & BIO 1000; BIO 1010 or 1020		
GLY 1150 & GLYL 1150, GLY 1250 & GLYL 1250		
PHY 1500 & 1560, 1510 & 1570		
Earth Science (9-12) Concentration:		62
GLY 1000 & GLYL 1000 or GLY 1150 & GLYL 1150; GLY 1250 & GLYL 1250, GLY 2260, 2460, 2620, 3100 and 3110, 3250		
select one: GLY 3660, 4250; GLYS 4xxx		
PHS 1560		
MAT 1090		
CHM 1300 & 1100, 1310 & 1110, 2500		
BIOL 1000 & BIO 1000; BIO 1010 or 1020		
PHY 1500 & 1560, 1510 & 1570		
Physics (9-12) Concentration:		62
PHY 2000, 2010, 2060, 2070, 2180, 2560, 3000, 3200, 3260, 4200		
MAT 2210, 2220, 3320		
BIOL 1000 & BIO 1000; BIO 1010 or 1020		
GLY 1150 & GLYL 1150		
CHM 1300 & 1100, 1310 & 1110		
PHS 1560, 1570		
Middle Grades Science (6-9) Concentration:		59
BIOL 1000 & BIO 1000, 1030, 3040		
GLY 1150 & GLYL 1150, GLY 1250 & GLYL 1250		
CHM 1300 & 1100		
PHY 1500 & 1560		
PHS 1560, 1570		
MAT 1070, 2100		
Completion of a second Academic or Professional Concentration		
Select one Concentration from the following: American Indian Studies, Art, Biology, English, Exercise and Sport Science, Geography,		
Middle Grades Science (6-9) Concentration (cont.)		
Geology, History, Mathematics, Music, Physics, Psychology, Reading, Sociology, Spanish, or Special Education		
Guided Electives – 0-10 hours**		
Professional Studies Core		12
EDN 2100, 3130, 3140, SED 3310		

Content Pedagogy**21-24**

SCE 3000, 3010, 3500 (required for the 6-9 concentration) or 4000
 (required for the 9-12 concentration), 4490, 4750
 CSC 4050
 EDN 3400 (required only for the 6-9 concentration)

(9-12) Total: 128

**The number of elective hours required in the Middle Grades Science Concentration will be determined based on the student's second academic concentration. 128 hours are required for the degree.

NOTE: Students who desire teacher licensure in Science Education should declare the major as soon as possible in their college career. Consultation with the Program Coordinator or program advisor prior to registering for General Education courses is strongly recommended.

BACHELOR OF SCIENCE IN BIOTECHNOLOGY

Requirements for a Bachelor of Science Degree in Biotechnology	Sem. Hrs.
Freshman Seminar	1
General Education Requirements*	44(32)
Biology Core Course Requirements	26
BIOL 1000, BIO 1000, 3150, 3180, 3510, 3710; BTEC 3220, 4900	
Chemistry and Physics Core Course Requirements	27
CHM 1100, 1110, 1300, 1310, 2270, 2500, 3110, 3120; BTEC 3510; PHY 1500, 1560	
Elective Courses (Choose 3 of the following)	11-12
BIO 3200, 3540, or 3810; BTEC 3230, 3610, BTES 4xxx; CHM 3210, 3240; PHY 1510 and 1570	
Mathematics Course Requirements	8
MAT 2210, 2220	
Free Electives	14-15
	Total: 120

*Students who plan to major in Biotechnology should consult the program director or coordinator before registering for General Education courses. Twelve hours of General Education courses are listed separately above as specific core requirements.

BACHELOR OF SCIENCE IN ENVIRONMENTAL SCIENCE

Requirements for a Bachelor of Science Degree in Environmental Science	Sem. Hrs.
Freshman Seminar	1
General Education*	44(32)
Required Courses:	
BIO 1000*, 3040, 3420, 4310 (WE), 4310 (WE)	18
ENV 2200, 2300, 3100, 3200, 4900	19
CHM 1100, 1110, 1300*, 1310	8
GGY 4040 and two of the following: GGY 2500, GGY 2700, GLY 2260, GLY 2460, GLY 2620	9-10
MAT 1070* or 1090*, 2100	6
Environmental Science degree electives**—choose 3 of the following:	9-12
ENV 2400, 4100; BIO 2500, 3010, 3400, 4100, 4220	
Sustainable Agriculture Track—required: ENV 2450, 3250, 4200	11
Electives (ENTR 2000, 2100, and 4000 are recommended, but not required, electives for the Sustainable Agriculture Track.)	11-15
	Total: 120

*Courses marked with an asterisk are General Education courses, and their hours are counted as General Education hours.

**Sustainable Agriculture Track (11 sem. hrs.): ENV 2450, 3250, 4200 (These courses are required instead of the Environmental Science degree electives.)

ACADEMIC CONCENTRATION IN BIOLOGY

For students seeking a baccalaureate degree in Elementary Education, Middle Grades Education, Special Education, or Physical Education, the Biology Department offers an Academic Concentration of 26 hours. This Academic Concentration is available to other students, regardless of major.

Required Courses for an Academic Concentration in Biology:	Sem. Hrs.
BIOL 1000, BIO 1000, 1010, 1020, 1030, and one additional approved upper-level biology course with a laboratory	
ENV 1100	
CHM 1300, 1100	
	Total: 26

MINOR IN BIOLOGY

Requirements for a Minor in Biology:	Sem. Hrs.
BIOL 1000, BIO 1000, 1010, 1020, and any BIO or ENV courses above the 1000 level to bring the total to 18-20 total hours	
	Total: 18-20

MINOR IN SUSTAINABLE AGRICULTURE

Requirements for a Minor in Sustainable Agriculture:	Sem. Hrs.
Core Courses: BIO 1000, ENV 2450, ENV 3250, ENV 4200	14
Elective Courses (select two): BIO 1010 (not BIO majors), BIO 3010, BIO 3040 or ENV 1100 (not BIO majors), BIO 3050, BIO 3420, ENV 4100, GLY 2620 (prereq GLY 1000 or 1150)	6-8
	Total: 20-22

COURSES

BIOLOGY (BIO, BIOL)

BIO 1000. Principles of Biology (3 credits)

An introduction to modern and classical biology concepts. Lecture.

BIOL 1000. Laboratory Investigations and Experiences in General Biology (1 credit)

Introductory laboratory experiments in which basic principles of biology will be investigated. Laboratory. PREREQ: Enrollment in or credit for Biology 1000.

BIO 1010. General Botany (4 credits)

Introductory plant science with emphasis on morphology and physiology of the seed plants and a survey of representative types from the plant kingdom. A prerequisite to all other courses in botany. Lecture and Laboratory. PREREQ: BIO 1000.

BIO 1020. General Zoology (4 credits)

Introductory coverage of the animal kingdom with emphasis on vertebrate systems, classification & survey of the animal phyla, and coverage of cellular respiration. Laboratory time will be spent on histology, anatomy, and a survey of phyla. A prerequisite to all other zoology courses. Lecture and Laboratory. PREREQ: BIO 1000.

BIO 1030. Basic Human Biology (3 credits)

An elementary study of the human body in health and disease. This course relates fundamental knowledge about human anatomy and physiology to current issues. Questions such as how do birth control pills work? and what causes cancer? will be explored. Does not fulfill a BIO elective. Lecture.

BIO 1060. Exploring Life's Diversity (3 credits)

A survey of the Kingdoms of living organisms to include an introduction to the theory of evolution and evidence for evolution, and an introduction to the fundamental principles of ecology. This course will not satisfy the prerequisite requirement for other biology courses. Lecture.

BIO 2040. Vertebrate Zoology (3 credits)

The biology of several classes of vertebrate animals, both living and extinct, with emphasis on their diversity, evolution, morphology, physiology, and behavior. Lecture. PREREQ: BIO 1000, 1020.

BIO 2050. Animal Behavior (4 credits)

A survey of the functional and complexity categories of behavior with emphasis in the animal kingdom. Examples will range from one-celled organisms to humans. Other selected topics will include the evolution of behavior, sociobiology, animal cultures, behavioral ecology, behavioral genetics, neurobiology, consciousness and others. Lecture and Laboratory. PREREQ: BIO 1000, 1020.

BIO 2110. Human Anatomy and Physiology I (4 credits)

A course covering the structure and function of certain organ systems of the human body. This is the first of a two-semester sequence in human anatomy and physiology. Topics to be covered include: an introduction to anatomy and physiology, the language of anatomy, homeostasis, histology and the integumentary, skeletal, muscular and nervous systems. Lecture and Laboratory. PREREQ: BIO 1000.

BIO 2120. Human Anatomy and Physiology II (4 credits)

A course covering the structure and function of certain organ systems of the human body. The second in a two-semester sequence of courses in human anatomy and physiology. Systems covered include the circulatory, immune, lymphatic, respiratory, digestive, excretory, and reproductive systems. Lecture and Laboratory. PREREQ: BIO 1000. BIO 2110 is recommended but not required.

BIO 2200. Field Botany (ENV 2200) (4 credits)

An introduction to the theory and practice of field botany, with emphasis placed on higher plants. Topics covered will include basic taxonomy, collection of field data, monitoring of the physical environment, census/sampling techniques, physiological and population ecology, and a general treatment of the plant communities of North Carolina. Lecture and Laboratory.

BIO 2300. Field Zoology (ENV 2300) (4 credits)

An introduction to the theory and practice of field zoology, with emphasis on vertebrates. Topics covered will include basic identification and taxonomy, collection of field data, monitoring of the physical environment, census/sampling techniques, physiological and population ecology, and mathematical modeling. Lecture and Laboratory.

BIO 2310. Morphology of the Non-Vascular Plants (4 credits)

A comprehensive survey of the algae, fungi, and bryophytes dealing with structure, form, and reproduction. Lecture and Laboratory. PREREQ: BIO 1000, 1010.

BIO 2320. Morphology of the Vascular Plants (4 credits)

A continuation of Biology 231, a survey of the plant kingdom with emphasis on selected types of vascular plants. Lecture and Laboratory. PREREQ: BIO 1000, 1010.

BIO 2400. Field Microbiology (ENV 2400) (4 credits)

This course is an introduction to the microbial diversity of ecosystems. It includes field collection, identification, and digital imaging of live samples. Emphasis will be placed on organisms that are important in ecosystem function and include those that serve as indicators of water quality or environmental health. Protists will be emphasized. Lecture and Field Laboratory.

BIO 2500. Ornithology (4 credits)

This course is designed to familiarize students with the major groupings of birds, basics of flight, adaptations, behavior, and birding “hot spots” in North Carolina. Emphasis will be placed on field identification techniques and habitat associations. Lecture and Laboratory.

BIO 3010. Entomology (4 credits)

An introduction to the study of insects which emphasizes the classification, morphology, physiology, ecology, behavior, and importance of insects. Approximately one week will be devoted to spiders. A small collection with identification is required. Lecture and Laboratory. PREREQ: BIO 1000, 1020.

BIO 3025. Natural History of Costa Rica (3 credits)

An introduction to different ecosystems within Costa Rica. Students participate in field trips and excursions to study first-hand the biological complexities of the tropics. Students will experience cultural aspects of Costa Rica, discuss Costa Rica's conservation ethic and the impact of humans on the environment. Offered in the summer of odd numbered years; students spend two full weeks in Costa Rica.

BIO 3040. Principles of Ecology (4 credits)

An analysis of the interactions of organisms with each other and the physical environment. Ecological process is examined at individual, community, and ecosystem levels. The basic kinds of ecosystems are surveyed. Lecture and Laboratory. PREREQ: BIO 1000.

BIO 3050. Introductory Mycology (3 credits)

An introduction to the fungi, with emphasis upon taxonomy and physiology, including some reference to their economic importance. Special emphasis will be given to those that are animal or plant pathogens. Lecture and Laboratory. PREREQ: BIO 1000, 1010.

BIO 3100. Invertebrate Zoology (4 credits)

A survey of the major invertebrate phyla emphasizing classification, morphology, natural history, evolution, and behavior. At least one Saturday coastal field trip is required. Lecture and Laboratory. PREREQ: BIO 1000, 1020.

BIO 3150. Microbiology (4 credits)

The biology of bacteria, fungi, algae, protozoa, and viruses, with special reference to bacteria. Microbial diseases, immunity and the role of microorganisms in human affairs are also emphasized. Lecture and Laboratory. PREREQ: BIO 1000.

BIO 3180. Principles of Genetics (4 credits)

An introduction to the basic principles of heredity and molecular genetics. General aspects of human genetics are included. Lecture and Laboratory. PREREQ: BIO 1000, MAT 1070.

BIO 3190. Animal Parasitology (4 credits)

An introduction to the biology of parasites emphasizing classification, morphology, life history, pathology, treatment, ecology and evolution. Lecture and Laboratory. PREREQ: BIO 1000, 1020.

BIO 3200. Developmental Biology (4 credits)

A course on the classical, genetic, and molecular analysis of embryonic development with lab. Its purpose is to offer a blend of classical and modern topics, which are organized in three parts: 1. the natural sequence of developmental stages from gametogenesis and fertilization to histogenesis; 2. the differential gene expression; and 3. a series of core topics including pattern formation, sex determination, hormonal control, and growth. Examples are picked as they serve best to illustrate the general points to be made. Mammals or other vertebrates will be preferred whenever possible because we have a natural interest in their development. Lecture and Laboratory.

BIO 3400. Plant Systematics (4 credits)

An introduction to systematic botany and plant community ecology. The course emphasizes identification of the local flora as well as the recognition and characteristics of plant communities found in North Carolina. Lecture and Laboratory. PREREQ: BIO 1000, 1010.

BIO 3420. Pollution Ecology (3 credits)

An introduction to the sources, nature, transformations, and distribution of pollutants within biological and ecological systems, with emphasis on how those systems are affected. Emphasis will be placed on those aspects of chemistry, physiology, and ecology most useful for practitioners in the field of environmental science. Content will draw on general and specific pollution sources and events. Lecture. PREREQ: CHM 1300 recommended.

BIO 3510. Research Strategies (3 credits)

Introduction to scientific investigation including experimental design, data analysis, laboratory note-taking, and communication of the scientific results. Provides design and implementation of a focused project utilizing current techniques and methods in biotechnology. Recent research reports will also be analyzed to obtain an understanding of the principles underlying these approaches. Lecture. PREREQ: BIO 1000, 3180.

BIO 3540. Plant Physiology (4 credits)

A study of the physiological activities in plants such as water relations, metabolism, plant growth hormones, as well as growth, development, and environmental adaptations. Lecture and Laboratory. PREREQ: BIO 1000, 1010.

BIO 3700. Science Communication and Research Methods (1 credit)

A review of the current literature in a variety of biomedical journals. The format for presentation of material and the research methods employed will be examined. Designed so that students can obtain an understanding of how research is done and how it is reported. Lecture. PREREQ: BIO 1000, Consent of Instructor.

BIO 3710. Cell Biology (4 credits)

A study of cellular ultrastructure, molecular organization, and physiology. Lecture and Laboratory. PREREQ: BIO 1000, CHM 1300, 1310. Recommended: CHM 2500, 2510.

BIO 3750. Neurobiology (4 credits)

This course covers the fundamentals of neurobiology, the cellular basis of nervous system function, the characteristics and functions of neurons, and the various ways signals are relayed within the nervous system. We examine how neurons receive, integrate and transmit information and how groups of neurons produce both simple and complex behaviors. The cellular and molecular basis of sensory and motor systems, plasticity, development and learning will be analyzed, with emphasis on the relationship of cellular and physiological processes to human behavior. The laboratory/discussion section will include dissection of preserved brains, basic laboratory techniques in neuroscience, and analysis and discussion of relevant portions of the recent scientific literature. Lecture and Laboratory. PREREQ: BIO 1000, 1020.

BIO 3810. Immunology (3 credits)

The biology and molecular events underlying the immune response and its relationship to the activities and strategies of foreign invaders (both infectious and non-infectious). Applied immunology including biotechnology and diagnostic tools is also presented. Lecture. PREREQ: BIO 1000, 3180, CHM 1310.

BIO 4100. Marine Biology (3 credits)

A survey of the common organisms associated with tropical marine habitats. Emphasis will be on fish, invertebrates, algae, and birds. Coverage will include discussions of the coral reef, mangrove, and other marine communities, ocean currents, and physical and geological factors. The course includes two weeks of on-campus study followed by one week of field work at the Bermuda Institute of Oceanic Sciences (BIOS). There are additional costs involved in the Bermuda trip. Lecture and Laboratory. PREREQ: BIO 1000.

BIO 4130. Molecular Biology (4 credits)

A laboratory-oriented course intended to introduce students to both basic and advanced concepts of molecular biology. Students will be introduced to the theory and practical uses of instrumentation and procedures currently used to analyze nucleic acids and proteins including, but not limited to, gene cloning, macromolecule isolation, PCR, electrophoresis, and hybridization/blotting techniques. Other advanced topics introduced in lecture and/or lab may include microarrays, DNA sequencing, RNAi, cell culture, and bioinformatics. PREREQ: BIO 3180.

BIO 4140. Biogeography (3 credits)

The principles of biogeography will be discussed in light of current understanding of geology, geography and evolutionary biology. Biogeographic processes are examined at individual, community and ecosystem levels. The effects of a changing earth on species distribution and extinction will be assessed. Causes of modern and historical distributions of taxa will be examined. Lecture. PREREQ: BIO 1000.

BIO 4220. Evolution (3 credits)

An introduction to and analysis of the concepts of organic evolution, mutation, adaptation, selection, competition, and origin of species are considered. Lecture. PREREQ: BIO 1000.

BIO 4310. Biometrics (4 credits)

This course covers the nature of the scientific method, hypothesis formulation, experimental protocols, and hypothesis testing. An emphasis is placed on the concepts of experimental design in biological systems, and on current methods of standard data analysis. During the semester, students will design a research project, collect data, analyze this data in an appropriate way, and write a research

paper that conforms to standards of current biological journals. The course is recommended for students planning a research career in biology. Student understanding of basic statistics and familiarity with microcomputer data bases and word processing programs are assumed. Lecture. PREREQ: BIO 1000.

BIO 4320. Conservation Biology (4 credits)

The science of conserving the Earth's biodiversity. This course will examine mankind's impact on species, populations, and habitats. The role of government and the private sector in conservation will be discussed. Emphasis will be placed on defining the problems and identifying scientific solutions, based on ecological principles and case studies. Lecture and Laboratory. PREREQ: BIO 1000, 1010, 1020.

BIO 4610. Animal Physiology (4 credits)

Physiological principles study as they occur throughout the animal kingdom with special emphasis on mammals. A detailed study of the mechanisms involved in the maintenance of the homeostatic condition. Lecture and Laboratory. PREREQ: BIO 1000, 1020 required; CHM 2500, 2510, and BIO 3710 recommended.

BIO 4700. Reading and Writing in the Natural Sciences (3 credits)

This course will utilize science books, essays, and journal articles intended for various audiences to provide practice in reading and thinking critically about the connections among various disciplines of science. The skill of writing will be addressed as a process with a chance for multiple drafts and peer review. This course is intended for senior majors in the Natural Sciences.

BIO 4950. Biology Seminar (1 credit per semester, repeatable up to 4 credits)

A seminar series in which current biology research projects are presented and discussed. Most seminars will be presented by visiting scientists recruited from research laboratories in industry and universities. Lecture. PREREQ: BIO 1000, Consent of Instructor.

BIO 4990. Research in Biology (1-3 credits per semester, repeatable up to 12 credits)

Designed to provide the student with experience in the analysis and solution of problems in an area of biological interest. Students should approach appropriate departmental faculty and discuss the possibility of collaboration on BIO 4990 hours prior to registration. Faculty approval is required for registration. PREREQ: Consent of mentoring faculty member.

BIO 3xxx. Special Topics in Biology (1-4 credits)

A course designed to meet the unusual needs of individuals in special programs such as the Science Institute for school teachers and those working toward licensure. The specific contents and credit for the course will be determined by the needs of the students and is subject to departmental approval. Lecture. PREREQ: BIO 1000.

BIOTECHNOLOGY (BTEC)

BTEC 3220. Biotechnology I (4 credits)

A laboratory-oriented course with lecture and laboratory components. Its purpose is to familiarize students with DNA science techniques in biotechnology and with scientific write-up of laboratory reports and to encourage their interest in graduate research and careers in this area. The course is open to Biology and Chemistry majors and is especially recommended to students that want to gain laboratory experience and dexterity before taking other higher level required courses. Lecture and Laboratory. PREREQ: BIO 1000, 3180.

BTEC 3230. Biotechnology II (4 credits)

A laboratory-oriented course to familiarize students with more advanced techniques in biotechnology, molecular genetics, and cell biology. The lecture portion of the course will cover concepts on which the techniques are based along with current and future applications. Students will gain experience with tissue and cell cultures, will learn techniques not covered in other required biology courses, and will become familiar with scientific write-up of laboratory reports. Lecture and Laboratory. PREREQ: BTEC 3220.

BTEC 3510. Bioprocessing (3 credits)

See listing in Dept, of Chemistry and Physics. PREREQ: BIO 3150 or BIO 3710 and CHM 3110.

BTEC 3610. Bioseparations Technology (3 credits)

See listing in Department of Chemistry and Physics. PREREQ: CHM 2510

BTEC 4300. Principles of Medical Biotechnology (3 credits)

A broad overview of methods, strategies, and applications used in medical biotechnology with emphasis on therapeutic concepts including discovery of target molecules, disease models, and testing of pharmaceutical agents. Will also cover analytical methods as applied to experimental design, drug safety, and the analysis of data. FDA drug regulation, product development, and patient procedures will also be covered. Lecture. PREREQ: BIO 1000 and CHM 1310.

BTEC 4900. Internship/Co-op (3 credits)

A course designed to give students first-hand experience working with a biotechnology host organization. Internships are arranged on an individual basis and must involve supervision by both the host organization's staff and the Biotechnology Program Director or Coordinator. Three hours of academic credit will be awarded for a minimum of 320 contact hours (8 weeks at 40 hours per week) of work with the host organization. Pass/Fail grading. PREREQ: Consent of the Biotechnology Program Director or Coordinator.

BTES 4xxx. Special Topics in Biotechnology (3 credits)

A course designed to offer special and advanced topics in Biotechnology. Title and topic will vary from year to year. PREREQ: Consent of the instructor.

ENVIRONMENTAL SCIENCE (ENV)**ENV 1100. Environmental Science (3 credits)**

A study of environmental science emphasizing the impact that an increasing human population has on the biosphere. The course deals specifically with the demands placed by humans on natural resources and the resulting acceleration of environmental deterioration, human attitudes toward the environment, and techniques and policies by which resources could be intelligently managed. Does not fulfill a BIO elective. Lecture.

ENV 2200. Field Botany (BIO 2200) (4 credits)

An introduction to the theory and practice of field botany, with emphasis placed on higher plants. Topics covered will include basic taxonomy, collection of field data, monitoring of the physical environment, census/sampling techniques, physiological and population ecology, and a general treatment of the plant communities of North Carolina. Lecture and Laboratory.

ENV 2300. Field Zoology (BIO 2300) (4 credits)

An introduction to the theory and practice of field zoology, with emphasis on vertebrates. Topics covered will include basic identification and taxonomy, collection of field data, monitoring of the physical environment, census/sampling techniques, physiological and population ecology, and mathematical modeling. Lecture and Laboratory.

ENV 2400. Field Microbiology (BIO 2400) (4 credits)

This course is an introduction to the microbial diversity of ecosystems. It includes field collection, identification, and digital imaging of live samples. Emphasis will be placed on organisms that are important in ecosystem function and include those that serve as indicators of water quality or environmental health. Protists will be emphasized. Lecture and Field Laboratory.

ENV 2450. Principles of Sustainable Agriculture (4 credits)

This course will explore the characteristics of a sustainable food system. It will discuss the challenges of balancing food production with preservation of ecological resources and promoting integrated livable communities. Case studies will be used to analyze integrated farming systems that illustrate multiple concepts of sustainable agriculture. The associated lab will include visits to local farms, food distribution centers, and films. Does not fulfill a BIO elective. Lecture and Laboratory.

ENV 3100. Freshwater Ecosystems and Watershed Management (4 credits)

An introduction to the ecology of ponds, lakes, streams, and rivers. Topics covered include plant and animal communities, abiotic factors affecting these communities, water chemistry, sampling/monitoring techniques, and management strategies for aquatic ecosystems and adjacent watersheds. Lecture and Laboratory.

ENV 3200. Soils and Hydrology (4 credits)

An overview of soil physical properties, chemical properties, and hydrology. Topics covered include the formation, structure, and description of soils, soil water and the hydrologic cycle, and the modeling of soil systems. Lecture and Laboratory.

ENV 3250. Plant Cropping and Weed Management (3 credits)

This course will explore the differences between crops and cropping, cropping seasons, plant growth and development, and principles of sustainable weed management for croplands. It will define and discuss the different agronomic/field crops and the concepts of multiple cropping and intercropping as a sustainable method to maintain nutrient levels in the soil while increasing crop yield. Concurrently, it will emphasize sustainable cropping systems that prevent weed problems, rather than using quick-fix approaches. Alternatives to conventional tillage systems, including allelopathy, intercropping, crop rotations, and a weed-free cropping design. Does not fulfill a BIO elective. Lecture.

ENV 4100. Environmental Laws and Regulations (3 credits)

An overview of major federal and state environmental legislation. Topics covered will include agriculture, air and water pollution, hazardous waste, wetlands, endangered species, multiple use management, the governmental agencies responsible for administering/enforcing these laws, and private environmental organizations that affect policy decisions. Lecture.

ENV 4200. Pest Management (4 credits)

A practical course in the biology, recognition, and management of common insect, fungal, and other pests of crops and livestock. Emphasis will be on how to reduce disease pressure through knowledge of pest life cycles and preventative measures. Management strategies will focus on sustainable practices, integrated pest management, and biocontrol. Lecture.

ENV 4900. Internship (3 credits)

A course designed to give students an opportunity to obtain first-hand experience working with an environmental agency. PREREQ: Departmental approval.

SCIENCE EDUCATION (SCE)**SCE 3000. Early Experiences for Prospective Science Teachers (1 credit)**

An introduction to the teaching of science for prospective secondary science teachers. A minimum of 16 clock hours of directed classroom observations and planned participation in actual classroom settings and 8 clock hours of seminar class instruction in the teaching area.

SCE 3010. Early Laboratory Experiences for Prospective Science Teachers (2 credits)

An introduction to the role of the laboratory in science teaching including research on laboratory use in K-12 schools, safety and liability issues, inquiry-based activities, and the planning and evaluation of laboratory lessons. A minimum of 16 clock hours of directed field experiences in actual classroom settings and 16 clock hours of seminar class instruction. PREREQ: SCE 3000 and at least 16 semester hours of science credits.

SCE 3500. The Teaching of Science in the Middle Grades (6-9) (3 credits)

Purposes, methods, materials, and evaluation procedures in the life and physical sciences; preparation of teaching plans and materials appropriate for teaching science in the middle grades. PREREQ: SCE 3000.

SCE 4000. Teaching Science in the Secondary School (3 credits)

Purpose, methods, materials, and evaluation procedures in the life and physical sciences; preparation of teaching plans and materials. PREREQ: SCE 3000, 3010.

SCE 4490. Internship in Science in Middle/Secondary Schools (9 credits)

Provides continuous full-time teaching experiences in an off-campus public school setting. Pass/Fail grading. PREREQ: SCE 4000.

SCE 4750. Professional Seminar in Middle/Secondary Science (3 credits)

A seminar designed to parallel the full semester student teaching experience (SCE 4490). Emphasis will be placed on the appropriate application of methods of teaching and assessment in a clinical setting. Topics will include the proper use of instructional materials, classroom management, participation in the reflective teaching process, professionalism, and required Teacher Education assessments. PREREQ: Admission to Professional Semester.