Department of Organismal and Environmental Biology

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Faculty

Professor: Atkinson, Whiting
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Assistant Professor: Collar, Harwell
Lecturer: Burke, Lattanzio
Emeriti: Bankes, Cheney, Cones, Mollick, Reed

Mission Statement

The Department of Organismal and Environmental Biology (OENB) will develop a meaningful level of scientific literacy in all students through exploration of fundamental concepts and processes of the natural world. Majors build upon this foundation and gain the necessary background, understanding, and experience to be successful in the fields of biology and environmental science; this is achieved through coursework complemented by research and independent study opportunities. The OENB faculty members are actively engaged in quality teaching, research, mentoring and service. These traditions provide the model for our goal to instill motivation, intellectual drive, dedication, integrity, and professionalism in all graduates.

The aims of the curriculum and faculty in the Department of Organismal and Environmental Biology are to acquaint students with the body of knowledge in these disciplines and to teach them to apply this knowledge usefully and responsibly. Coursework includes discussion of historical and philosophical developments of biology and environmental science. The biology program is organized to enable majors to survey the entire field of biology and also to focus in one of a number of areas, including botany, marine science, environmental science, zoology, and preparation for one of the many health professional programs.

The Department offers two degrees, the Bachelor of Arts and the Bachelor of Science in biology. Within the Bachelor of Science in biology there are four possible majors. Additional information about the department, the degrees offered, and other opportunities can be obtained from the department office or the department website at oenb.cnu.edu.

Note that the Department of Molecular Biology and Chemistry offers additional biology courses and more details on the major in cellular, molecular and physiological biology.

Health-Related Professions

The CNU Pre-med & Pre-health Program can help students from any academic major prepare for application to medical and other health profession programs. Many students find that a biology major provides excellent preparation for these career choices. The Program offers a variety of resources, such as academic and career advising, mentoring, clinical internship opportunities, workshops and seminars to help any highly motivated student gain admission to the professional school of her or his choice. Additional information can be obtained at prehealth.cnu.edu or by contacting the Director of Pre-health Programs, Dr. Gwynne D. Brown, at gwynne.brown@cnu.edu.

The Bachelor of Arts Degree in Biology

The Bachelor of Arts degree in biology requires a minimum of 35 credits in biology. Students may present no more than two biology courses with grades lower than *C*- for the degree.

In addition to the successful completion of the liberal learning curriculum, the Bachelor of Arts degree in biology requires the successful completion of:

1. Biology Core*: BIOL 211/211L-212/212L- 213/213L, 391W, 491W;
2. CHEM 103/103L-104/104L*;
3. MATH 125, and 130 or higher;
4. 21 credits of biology courses with a minimum of four credits chosen from each of the required course lists: cellular, molecular and physiological biology major, environmental biology major, organismal biology major. At least three of the courses taken must have a laboratory component. Only three of those credits can be at the 200-level.

* The biology degree requires that students have a *C* or better in BIOL 211/211L-212/212L-213/213L and a *C*- or better in BIOL 391W and 491W and CHEM 103/103L-104/104L.

The Bachelor of Science Degree in Biology

The Bachelor of Science degree in biology requires a minimum of 35 credits in biology. In the B.S. in biology, students must choose an area of focus called a major. Three of the majors build upon the introductory biology and chemistry courses by way of specific sets of courses in the area of focus: cellular, molecular and physiological biology; environmental biology; and organismal biology. The fourth major, integrative biology, allows students to continue to build upon the breadth of the foundation courses at the upper-level.

Students may present no more than two biology courses with grades lower than *C*- for the degree. **Earning a double major within the Bachelor of Science degree in biology is not possible.**

In addition to the successful completion of the liberal learning curriculum, the Bachelor of Science degree in biology requires successful completion of the following courses:

The Major in Cellular, Molecular and Physiological Biology

See catalog description for Department of Molecular Biology and Chemistry.

The Major in Environmental Biology

1. Biology Core*: BIOL 211/211L-212/212L- 213/213L, 391W, 491W;
2. CHEM 121/121L-122/122L*, 321/321L-322/322L;
3. MATH 125 and 130 or higher;
4. PHYS 151/151L-152/152L;
5. 21 credits of biology courses, only three of those credits can be at the 200-level. Of these 21 credits at least 15 must come from the following courses, and three of these courses must have a laboratory component: BIOL 306/306L, 308/308L, 403/403L, 407/407L, 435/435L, 450/450L, 454; CHEM 465, 440.

* The biology degree requires that students have a *C* or higher in BIOL 211/211L-212/212L-213/213L and a *C*- or higher in BIOL 391W and 491W and CHEM 121/121L-122/122L.

The Major in Integrative Biology

1. Biology Core*: BIOL 211/211L-212/212L- 213/213L, 391W, 491W;
2. CHEM 121/121L-122/122L*, 321/321L-322/322L;
3. MATH 125 and 130 or higher;
4. PHYS 151/151L-152/152L;
5. 21 credits of biology courses, only three of those credits can be at the 200-level. At least four credits will come from the required courses list of each of the other three majors. At least three of the courses taken must have a laboratory component.

*The biology degree requires that students have a *C* or higher in BIOL 211/211L-212/212L-213/213L and a *C*- or higher in BIOL 391W and 491W and CHEM 121/121L-122/122L.

The Major in Organismal Biology

1. Biology Core*: BIOL 211/211L-212/212L- 213/213L, 391W, 491W;
2. CHEM 121/121L-122/122L*, 321/321L-322/322L;
3. MATH 125 and 130 or higher;
4. PHYS 151/151L-152/152L;
5. 21 credits of biology courses, only three of those credits can be at the 200-level. Of these 21 credits at least 15 must come from the following courses, and three of these courses must have a laboratory component: BIOL 310/310L, BIOL 312/312L, 403/403L, 409/409L, 425/425L, 440/440L, 445/445L, 457/457L, 465/465L.

* The biology degree requires that students have a *C* or higher in BIOL 211/211L-212/212L-213/213L and a *C*- or higher in BIOL 391W and 491W and CHEM 121/121L-122/122L.

The Minor in Biology (27 Credits)

BIOL 211/211L-212/212L-213/213L all with a grade of *C* or higher, (requires the completion of CHEM 103/103L-104/104L or CHEM 121/121L-122/122L) and a minimum of seven BIOL credits at the 300- or 400-level, including one course with a laboratory component.

Five-Year Program: Master of Science in Environmental Science

The Master of Science in environmental science is designed for current and prospective students in the new, rapidly growing field of environmental monitoring and conservation. This five-year program leads to both a Bachelor of Science in biology and a Master of Science in environmental science and provides a solid background in ecological and environmental conservation theory.

This degree program is flexible enough to fit the interest and needs of a wide variety of students and is designed for students planning to pursue a Ph.D., teachers desiring a Master of Science in a biological science, and students interested in careers involving environmental assessment, monitoring, or conservation.

How and When to Apply

After completion of 65 credit hours of undergraduate study, the application to the Five-Year B.S./M.S. Program is submitted no later than February 1 of the junior year. Applications for admission to the Five-Year Program are available at gradstudies.cnu.edu. Formal acceptance by the Office of Graduate Studies will constitute admission to the Master of Science in environmental science program as long as the student has the required 3.00 GPA upon undergraduate graduation.

Requirements for Admission

Criteria for student admission into the five-year program:

1. Undergraduate cumulative GPA of 3.00 or higher.
2. GPA in the student's major of at least 3.00.
3. Submission of one of the following:
   a. A minimum SAT Score of 1100 with a minimum of 530 in the verbal and quantitative sections (must be less than five years old);
   b. A Graduate Record Examination (GRE) General Test score of at least 295 for the verbal and quantitative sections combined. It is highly desirable to have a reasonably balanced score between the verbal and quantitative sections.
4. Two letters of recommendation. One must be from a faculty member in the major who has taught/or mentored the student in a major course or research project.

Teacher Preparation in Biology

Those students who wish to become teachers may apply to the Five-Year Master of Arts in Teaching (M.A. T.) Program as an undergraduate or after completion of a Bachelor of Science degree in biology. Application to the Five-Year Program must be made in spring of the junior year. See the *Graduate Catalog* for application instructions and requirements. Students will earn a Bachelor of Science degree in biology during the first four years and complete an additional year of study leading to the M.A.T. degree. Students majoring in biology can prepare to teach all core subjects of elementary school, pre-kindergarten through grade six**,** or in the content area of biology in secondary school grades six through 12. Students accepted into this program must complete one of the following tracks for graduation with the bachelor's degree:

Elementary level (PK-6) Track

Major courses required:

See major requirements for the B.A. or B.S. in Biology.

Support courses required:

- ENGL 123, 223; 310 or 430, and 316;
- COMM 201 or THEA 230;
- CPSC 110;
- MATH 109, 125;
- HIST 111, 121, 122;
- POLS 101;
- GEOG 210;
- PSYC 208, 312;
- SOCL 314/314L;
- BIOL 107 or 108; CHEM 103; PHYS 141; PHYS 105L or BIOL 109L;
- NSCI 310;
- and other support courses for the B.A. or B.S. degree in biology.

* Support courses may change based on regulations from the Virginia Department of Education.

Graduate courses* required (senior year):

Select six credits from a), b), or c):

a) MATH 570;
b) PSYC/TCHG 544;
c) MLAN 511, ENGL 530.

Secondary level (6-12) Track

Major courses required:

1. BIOL 211/211L, 212/212L, 213/213L, 391W, 491W;
2. BIOL 313;
3. BIOL 407/407L;
4. Fifteen additional credits at the 200-400 level are required. Twelve of these credits must be at the 300-400-level and must have laboratory components. (BIOL 215 and 314/314L, or BIOL 420/420L are recommended for all secondary biology teachers.)

Support courses required:

CHEM 121/121L, 122/122L; 321/321L, 322/322L;
CPSC 110; COMM 201 or THEA 230;
PHYS 151/151L, 152/152L; MATH 125 and 130 or higher;
PSYC 207 or 208, 312; SOCL 314/314L.

Graduate courses* required (senior year);

Select six credits: ENVS 510/510L, 518, 522, 530, 532/532L, 536/536L, 540/540L, 550, 590 or 595.

* See the graduate catalog for course descriptions.

THE CURRICULUM IN BIOLOGY

BIOL 107. General Biology I (3-3-0) AINW

Fall, Summer.

Does not count toward any biology major degree program.

BIOL 107 is managed and taught by the OENB Department. First semester of introductory biology sequence for non-majors; major topics covered are ecology, genetics, evolution, and diversity.

BIOL 108. General Biology II (3-3-0) AINW

Spring, Summer.

Does not count toward any biology major degree program.

BIOL 108 is managed and taught by the OENB Department. Second semester of introductory biology sequence for nonmajors; major topics covered are energy metabolism, cell biology, biotechnology, plant biology, and animal biology.

BIOL 109L. General Biology Laboratory (1-0-2) AINW

Fall, Spring and Summer.

Pre or Corequisite: BIOL 107 or 108 or 111 or 112 or 113 or 115.

Does not count toward any biology major degree program.

BIOL 109L is managed and taught by the OENB Department. Laboratory exercises to accompany any BIOL 107, 108, 111, 112, 113 and 115 AINW Area of Inquiry courses. Lab fees apply each term.

BIOL 111. Topics in Botany (3-3-0) AINW
Does not count toward any biology major degree program.
Through a botanical topic, this Area of Inquiry course will examine the process of science, history of science, and how science affects contemporary thought and society. The particular topics covered will vary each semester.

BIOL 115. Topics in Ecology and the Environment (3-3-0) AINW
Does not count toward any biology major degree programs.
Through an ecological topic, this course examines the process of science, history of science, and how science affects contemporary thought and society. The particular topics covered vary each semester.

BIOL 195. Special Topics (credits vary 1-3)
Topics vary, determined by the special interests and needs of students and the expertise of faculty. May require prerequisites as set by instructor.

BIOL 211 Principles of Biology I (3-3-0)
Pre or Corequisite: CHEM 103/103L or 121/121L.
Restricted to students in biology degree programs.
BIOL 211 is managed and taught by the MBCH Department.
Principles of Biology I is the first course in the three course sequence for students seeking degrees in biology. This course introduces fundamental chemical concepts to allow discussion of the composition and functioning of cells. Topics include respiration, photosynthesis, Mendelian genetics, DNA replication, and gene functioning.

BIOL 211L Principles of Biology I Laboratory (1-0-4)
Pre or Corequisite: BIOL 211.
Restricted to students in biology degree programs.
BIOL 211L is managed and taught by the MBCH Department.
Principles of Biology I Lab is the laboratory component of the first course in the three course sequence for students seeking degrees in biology. This course introduces students to basic laboratory techniques and fundamental cellular and molecular topics. Lab fees apply each term.

BIOL 212 Principles of Biology II (3-3-0)
Prerequisite: BIOL 211/211L with a C or better and CHEM 103/103L or 121/121L with a C- or higher; or EVST 220 with a grade of C or higher.
Restricted to students in biology degree programs.
BIOL 212 is managed and taught by the OENB Department.
Principles of Biology II is the second course in the three course sequence for students seeking degrees in biology. This course introduces evolutionary and ecological topics as well as provides an overview to the diversity of life.

BIOL 212L Principles of Biology II Laboratory (1-0-4)
Pre or Corequisite: BIOL 212.
Restricted to students in biology degree programs.
BIOL 212L is managed and taught by the OENB Department.
Principles of Biology II Lab is the laboratory component of the second course in the three course sequence for students seeking degrees in biology. This course covers evolutionary, diversity, and ecological topics by way of in-class and in-the-field exercises. As per instructions given in class, students should expect to be in the field for some lab activities. Lab fees apply each term.

BIOL 213 Principles of Biology III (3-3-0)
Prerequisite: BIOL 212/212L with a C or better and CHEM 104/104L or 122/122L with a C- or higher.
Restricted to students in biology degree programs.
BIOL 213 is managed and taught by the OENB Department.
Principles of Biology III is the third course in the three course sequence for students seeking degrees in biology. This course covers form and function of botanical and zoological organisms in some detail.

BIOL 213L Principles of Biology III Laboratory (1-0-4)
Pre or Corequisite: BIOL 213.
Restricted to students in biology degree programs.
BIOL 213L is managed and taught by the OENB Department.
Principles of Biology III Lab is the laboratory component of the third course in the three course sequence for students seeking degrees in biology. This course covers aspects of the form and function of botanical and zoological organisms by way of in-class and in-the-field exercises. Lab fees apply each term.

BIOL 295. Special Topics (credits vary 1-6)
Fall and Spring.
Topics vary, determined by the special interests and needs of students and the expertise of faculty. Biology majors may apply no more than nine credits in elementary, intermediate, or advanced topics toward graduation. May require prerequisites as set by instructor.

BIOL 306. Environmental Conservation (3-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Fall.
Study of soil, forest, land, water, air, wildlife, and recreational resources; their interrelationships and modifications by humans; steps necessary to use them wisely for present and future generations.

BIOL 306L. Environmental Conservation Laboratory (1-0-4)
Pre or Corequisite: BIOL 306.
Fall.
The lab seeks to expose students to the most current issues facing organizations that seek to conserve ecosystems. Beyond mere exposure to these efforts, 306L seeks to actually pair student teams with collaborating organizations in the conduct of science in support of conservation decisions. Participation in these activities may require off-campus travel, meeting teams at times beyond those scheduled for lab, and your signature on a risk awareness form. Lab fees apply each term.

BIOL 308. Plant Biology (4-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 308L.
Spring.
This course explores the clever and sophisticated ways plants have evolved to survive, grow, and reproduce. An emphasis will be placed on the interactions between plants and other organisms, including fungi, herbivores, and pollinators. In addition, we will discuss the interactions between plants and people by examining the cultural and medicinal uses of plants around the world. Examples from the primary literature will be used to deepen our understanding of these topics.

BIOL 308L. Plant Biology Laboratory (0-0-4)
Corequisite: BIOL 308.
Spring.
In the lab portion of this course, we will study the botanical life on our campus and within our community. Lab fees apply each term.

BIOL 310. Plant Systematics (4-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 310L.
Fall.
A study of land plant morphology, diversity, and classification within an evolutionary context. Students learn to construct and interpret phylogenies and identify major evolutionary patterns in land plant lineages.

BIOL 310L. Plant Systematics Laboratory (0-0-4)
Corequisite: BIOL 310.
Fall.
The laboratory portion of the course emphasizes the plant communities found in local ecosystems and plant identification in the lab and field. The morphology and life cycles of the major groups of land plants are also covered. Lab fees apply each term.

BIOL 312. Invertebrate Zoology (4-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 312L.
Spring.
A study of invertebrate biology emphasizing morphology and evolutionary relationships, and including taxonomy, physiology, and behavior.

BIOL 312L. Invertebrate Zoology Laboratory (0-0-4)
Corequisite: BIOL 312.
Spring.
Hands-on experience with living and preserved invertebrates. Dissections, slide work, on-campus and off-campus field work are included. Lab fees apply each term.

BIOL 328. Island Biology and Experimental Design (3-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Spring.
This course combines in-class lectures and discussions with field research to expand upon the undergraduate biology experience. In the lecture component, students will synthesize the primary literature on topics in biodiversity and island biology in order to identify unanswered research questions and propose experiments. During the field trip to a private island in the Bahamas, students explore the lush biodiversity, execute their experiments, and collect data to answer research questions. Students analyze, graph, and present their data when they return to campus.

BIOL 365. Evolutionary Biology (3-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Spring.
This course studies examples illustrating principles of evolutionary biology while demonstrating the techniques used by modern evolutionary biologists to study in the field and in the lab. Students will leave this course with a deep understanding of the most integrative field of biology.

BIOL 391. WI: Junior Seminar (1-1-0)
Prerequisites: ENGL 223 with a C- or higher; BIOL 213/213L with a C or higher.
Fall and Spring.
A seminar format course with each section having a different topic. Students present reports orally and write short papers focusing on both the process of writing and the subject matter. Partially satisfies the writing intensive requirement.

BIOL 395. Special Topics (credits vary 1-3)
Prerequisite: as announced.
Fall and Spring.
Topics vary, determined by the special interests and needs of students and the expertise of faculty. Biology majors may apply no more than nine credits in elementary, intermediate, or advanced topics toward graduation. May require additional prerequisites as set by instructor.

BIOL 403. Marine Biology (3-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 403L.
Fall.
Taxonomic and ecological investigations of the major marine groups; pollution ecology; applied marine science.

BIOL 403L. Marine Biology Laboratory (1-0-4)
Pre or Corequisite: BIOL 403.
Fall.
Lab includes hands-on classroom exercises and on- and off-campus field exercises. Lab fees apply each term.

BIOL 407. General Ecology (4-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 407L.
Fall.
This course studies the properties and processes of ecosystems, communities, and populations, with consideration given to the influence of humans on each level.

BIOL 407L. General Ecology Laboratory (0-0-4)
Corequisite: BIOL 407.
Fall.
Lab includes hands-on classroom exercises and on- and off-campus field exercises. Lab fees apply each term.

BIOL 409. Comparative Anatomy of Vertebrates (4-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 409L.
Spring.
General chordate anatomy, emphasizing the vertebrates, considered on a comparative, evolutionary, and functional basis.

BIOL 409L. Comparative Anatomy of Vertebrates Laboratory (0-0-4)
Corequisite: BIOL 409.
Spring.
Laboratory work includes dissection and study of lamprey, shark, mudpuppy, cat, and other supplemental chordates. Lab fees apply each term.

BIOL 418. Animal Behavior (3-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Spring, odd years.
The comparative study of animal behavior, including both vertebrates and invertebrates. Ethological concepts, physiological mechanisms, and adaptive significance will be emphasized. Lab fees apply each term.

BIOL 422. Field Trip Experience (2-1-8)
Prerequisite: BIOL 213/213L with a C or higher.
Extended field trip courses, each of which is preceded by classroom instruction. Includes hands-on classroom exercises and on- and off-campus field exercises. May involve additional fees. (Repeatable twice for a maximum of 4 credits.)

BIOL 425. Ornithology (3-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 425L.
Spring.
An introduction to the biology of birds. Topics include anatomy, physiology, behavior, ecology, evolution, identification, and conservation.

BIOL 425L. Ornithology Lab (1-0-4)
Corequisite: BIOL 425.
Spring.
Lab is field-oriented and includes afternoon field trips throughout the Peninsula region of Virginia. Lab focuses on the identification of birds using both ocular and acoustic characters. Lab fees apply each term.

BIOL 430. Biogeography (3-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Spring.
The study of the patterns of distribution of organisms, both past and present, and the abiotic and biotic factors that produced those distributions.

BIOL 435. Environmental Application of GIS (4-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: Biol 435L.
Spring.
This course applies Geographic Information Systems (GIS) to environmental and ecological issues within the urban and rural landscapes. Computer information mapping, output design, spatial analyzes, GPS (Geographical Positioning System) applications, and remote sensing techniques are discussed, explored (hands-on), and applied to local and regional problems.

BIOL 435L. Environmental Application of GIS Laboratory (0-0-4)
Corequisite: BIOL 435.
Spring.
The application of ARCVIEW (ESRI Co.) software along with Trimble GPS units to geospatially address environmental questions and problems. Includes on- and off- campus field exercises. Lab fees apply each term.

BIOL 440. Herpetology (4-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 440L.
Spring.
The study of the reptiles and amphibians. Evolutionary history, taxonomy, and ecology will be emphasized.

BIOL 440L. Herpetology Laboratory (0-0-4)
Corequisite: BIOL 440.
Spring.
Lab includes hands-on classroom exercises and on- and off-campus field exercises. Lab fees apply each term.

BIOL 445. Mammalogy (4-3-0)
Prerequisites: BIOL 213/213L with a C or higher.
Corequisite: BIOL 445L.
Fall.
Mammalogy is designed to introduce students to basic principles of mammalian biology. Students learn to recognize Virginia's mammals and gain an understanding of global mammalian diversity and systematics. Additionally, this course provides a broad understanding of the natural history of mammalian groups and species. We investigate the role of mammals in natural and urban systems and discuss the conservation of this important taxonomic group.

BIOL 445L. Mammalogy Lab (0-0-4)
Corequisite: BIOL 445.
Fall.
Lab involves hands-on exercises in the lab and in the field that enhance and are complementary of material covered in lecture. Processing, dissection, and necropsy are an expected part of the lab. Lab includes on- and off-campus field exercises. Lab fees apply each term.

BIOL 454. Global Change (3-3-0)
Prerequisite: BIOL 213/213L with a C or higher.
Spring, odd years.
This course examines the evidence, causes, and impacts of global change. It is taught in a modified seminar format with discussion topics covering the basics of global cycles to current climate change issues. Topics include: ecological consequences of global warming, ozone depletion, terrestrial greening, ocean current changes, changing patterns of climate on ecosystem functioning, community interactions, and suitability of human systems.

BIOL 457. Entomology (4-3-0)
Prerequisite: BIOL 213/213L with a C or higher. Corequisite: BIOL 457L.
Fall.
An introduction to the biology of insects. Topics covered include anatomy, physiology, behavior, ecology, evolution, identification, and conservation.

BIOL 457L. Entomology Lab (0-0-4)
Corequisite: BIOL 457.
Fall.
This course provides an accelerated, introductory exposure to the external anatomy and classification of insects. The identification (by sight and dichotomous keys) of orders and select families is a major component of this lab. Effective methods and equipment for collecting, identifying, preserving and storage of insects through personal experience is a second major component of the course. Lab includes hands-on classroom exercises and on- and off-campus field exercises. Lab fees apply each term.

BIOL 465. Fish Biology (3-3-0)
Prerequisite: BIOL 213/213L with a C or higher.
Corequisite: BIOL 465L.
Fall.
An introduction to the biology of fishes, including evolution and phylogeny, anatomy and physiology, processes affecting growth throughout the life cycle, behavior, ecology, and the role of fishes in their environment. The course concludes with a discussion of case studies in the conservation and management of fish species.

BIOL 465L. Fish Biology Laboratory (1-0-4)
Corequisite: BIOL 465.
Fall.
A field-oriented lab involving field trips to sites throughout southeastern Virginia. Students learn field sampling and identification techniques for fishes, as well as data analysis applicable to fish population and community ecology. Lab fees apply each term.

BIOL 491. WI: Senior Seminar (1-1-0)
Prerequisites: ENGL 223 and BIOL 391W each with a C- or higher.
Fall and Spring.
A seminar format course dealing with different topics in each section each semester. Students give in-class presentations. A synthesis paper written by the student on some aspect of the topic is also required. Presentation of this paper occurs on a Saturday late in the semester. Partially satisfies the writing intensive requirement.

BIOL 492. Undergraduate Research Experience (credits vary 1-4)
Prerequisites: BIOL 213/213L with a C or higher; minimum 2.5 GPA and Junior standing.
Fall, Spring and Summer.
This course provides the qualified student an opportunity for scientific research under the supervision of a departmental faculty member. The topic, time-line, and criteria for evaluation are agreed upon in writing by the student and supervising instructor before the student can register for the course. *Course may be repeated for a total of 4 credits. (A six credit maximum from any combination of BIOL 492, BIOL 496, and BIOL 499 can be counted toward the biology degree.)*

BIOL 495. Special Topics (credits vary 1-4)
Prerequisite: as announced.
Fall, Spring and Summer.
Topics vary, determined by the special interests and needs of students and the expertise of faculty. Biology majors may apply no more than nine credits of elementary, intermediate, or advanced topics toward graduation. May require additional prerequisites as set by instructor.

BIOL 496. Practicum (credits vary 1-3)
Prerequisites: BIOL 213/213L with a C or higher; minimum 2.5 GPA and Junior standing.
Fall, Spring and Summer.
This course consists of an internship with an organization, usually external to the University, in which the student gains applied experience in some area of the biological sciences. Specific details of course requirements can be found in the agreement file maintained by the OENB Office. A maximum of three credits can be counted toward the degree. *(A six credit maximum from any combination of BIOL 492, BIOL 496, and BIOL 499 can be counted toward the biology degree.)*

BIOL 499. Problems in Biology (credits vary 1-3)
Prerequisites: BIOL 213/213L with a C or higher; minimum 2.5 GPA; Junior standing; consent of department chair.
Fall, Spring and Summer.
An opportunity for independent study or literature review with guidance of a faculty adviser. No more than three credits may be applied to the degree. *(A six credit maximum from any combination of BIOL 492, BIOL 496, and BIOL 499 can be counted toward the biology degree.)*