

# BIOLOGY

The biology degree allows students to explore biological topics that span the breadth of biology. Diverse course offerings enable students to obtain broad expertise or to specialize within the discipline. The biology major prepares students for a wide range of career choices.

## Other Information

All coursework taken for the Biology major or minor must be completed with a grade of "C-" or better.

## Double Majors

For a double major in **Biology and Molecular and Biomedical Biology**, beyond BIOL 1450, BIOL 1750, BIOL 2140 and BIOL 3020, no other biology courses may count for both majors.

For a double major in **Biology and Bioinformatics**, beyond BIOL 1450, BIOL 1750, BIOL 2140, and BIOL 3020, no other biology courses may count for both majors.

For a double major in **Biology and Environmental Sciences with a Concentration in Life Science**, beyond BIOL 1450, BIOL 1750, BIOL 2140, and BIOL 3340, no other biology courses may count for both majors.

For a double major in **Biology and Psychology or Biology and Neuroscience**, beyond the required fundamentals courses, students cannot use a 3000/4000 level course to count toward both majors.

For a double major in **Biology and Chemistry**, 3000/4000 level courses may count toward both majors. In cases where students are earning **two distinct degrees** (a BA and BS) with one degree in Biology and the other in Chemistry, 3000/4000 level courses will **not** count toward both programs.

## Majors and Minors

For a major in **Biology and a minor in Psychology**, with the exception of PSYC 3130, students cannot use a 3000/4000 level course to count toward both programs.

For a major in **Neuroscience and a minor in Biology**, students cannot use a 3000/4000 level elective course to count toward both programs.

For a major in **Bioinformatics and a minor in Biology**, students cannot use a 3000/4000 level elective course to count towards both programs.

For a major in **Biology and a minor in Bioinformatics**, students cannot use a 3000/4000 level elective course to count towards both programs.

For a major in **Environmental Science with a Concentration in Life Science and a minor in Biology**, students cannot use a 3000/4000 level elective course to count toward both programs.

For a major in **Biology and a minor in Environmental Science**, students cannot use a 3000/4000 level elective course to count toward both programs.

For a major in **Biology and a minor in Chemistry**, 3000/4000 level courses may count toward both programs.

Students may not earn a **Molecular and Biomedical Biology major and a Biology minor, or a Biology major and a Molecular and Biomedical Biology minor**.

## Residency Requirement for Biology Majors

To fulfill degree requirements, 3000/4000 level laboratory courses must be taken at UNO.

## Contact

114 Allwine Hall  
402.554.2641

**Website (<http://www.unomaha.edu/college-of-arts-and-sciences/biology/>)**

## Degrees Offered

Students may choose to pursue a Bachelor of Arts in Biology or a Bachelor of Science in Biology. Each degree option requires at least 36 credits of biology courses of which 18 credits must be 3000-4000 level courses.

- Biology, Bachelor of Arts (<http://catalog.unomaha.edu/undergraduate/college-arts-sciences/biology/biology-ba/>)
- Biology, Bachelor of Science (<http://catalog.unomaha.edu/undergraduate/college-arts-sciences/biology/biology-bs/>)
- Biology, Bachelor of Science with a Concentration in Education (<http://catalog.unomaha.edu/undergraduate/college-arts-sciences/biology/concentration-education/>)

## Writing in the Discipline

All students are required to take a writing in the discipline course within their major. For the biology major, the writing in the discipline requirement can be fulfilled by completing a sequence of approved biology courses at UNO that incorporate discipline-specific writing as part of their requirements. To satisfy the requirement for the writing in the discipline course students must complete BIOL 1450 and BIOL 1750, two courses from BIOL 2140, BIOL 3020 and BIOL 3340 and two additional 3000-4000 level courses that are approved as meeting the writing requirement by the Department of Biology. Only courses taken at UNO and after January 1, 2010 can be applied to this requirement. Students not meeting the writing requirement through this sequence of courses will fulfill the writing requirement by completing BIOL 3150, ENGL 2400, ENGL 3980, or another college-approved advanced writing course.

## Minors Offered

- Biology Minor (<http://catalog.unomaha.edu/undergraduate/college-arts-sciences/biology/biology-minor/>)

Biology is the science of life, both present and past, encompassing many areas of specialization. The curriculum provides a foundation across the discipline with opportunities for in-depth training in such specializations as molecular and cell biology, animal and plant biology, genetics, and ecology. The curriculum emphasizes hands-on laboratory and research experiences.

- Laboratory research technician
- Genetic counselor
- Health communications
- Wildlife biologist
- Research scientist
- Technical writer
- Environmental consultant
- Health professions
- Educator

**BIOL 1020 PRINCIPLES OF BIOLOGY (4 credits)**

Principles of Biology introduces fundamental concepts at all levels of organization in biology. The laboratory emphasizes inquiry-based and problem-oriented approaches to these concepts. Must enroll in one laboratory. Usually offered Fall, Spring, Summer.

**Prerequisite(s):** ENGL1150 placement by the English Placement and Proficiency Exam (EPPE), grade of C- or better in English 1050 or 1100, ACT English subscore of 20 or higher, or permission of the department.

**Distribution:** Natural/Physical Sci General Education lecture&lab

**BIOL 1060 INTRODUCTION TO MEDICAL CAREERS & ETHICS (2 credits)**

A general overview of modern healthcare professions, plus foundational career concepts which include vocational discernment, undergraduate preparation, healthcare ethics, HIPAA certification, challenges and opportunities in healthcare, and evidence-based medicine. An exploration of various careers in healthcare is included. Intended as a preparatory healthcare professional course. Usually offered during the Fall, Spring, and Summer semesters.

**BIOL 1160 TERMINOLOGY OF HUMAN HEALTH & DISEASE (2 credits)**

This completely online course is designed to help students learn clinical terminology in relation to human health and disease. The course will cover root words, terms, and phrases relating to human anatomy, disease conditions, and clinical procedures. The course will also serve as a survey of human diseases across all major organ systems, and common procedural diagnostics and treatments.

**BIOL 1330 ENVIRONMENTAL BIOLOGY (3 credits)**

This course is a study of human ecology with emphasis on the effects of human populations on the earth's resources and on the environment. Usually offered Fall, Spring, Summer.

**Distribution:** Natural/Physical Science General Education course

**BIOL 1450 BIOLOGY I (5 credits)**

First semester of a two semester series on the general principles of biology. Concepts including the chemical and physical basis of living systems, cell structure and function, energy and metabolism, genetics and molecular genetics, and evolution of biological diversity will be presented. Laboratory will provide inquiries into these same topics. Intended as the first course for Biology majors. Must enroll in one lab section. Usually offered Fall, Spring and Summer.

**Prerequisite(s):** High school biology and chemistry. College level chemistry recommended.

**Distribution:** Natural/Physical Sci General Education lecture&lab

**BIOL 1750 BIOLOGY II (5 credits)**

Second semester of a two semester series on the general principles of biology. Introduction to the study of life, concentrating on whole organisms and their interactions with the environment. This course will focus on evolution and natural selection, biodiversity, physiologic responses to the environment, organ systems, population dynamics, community ecology, and energy and material flow through ecosystems. Laboratory will provide inquiries into these same topics. Intended as the second course for Biology majors. Must enroll in one lab section. Usually offered Fall, Spring and Summer.

**Prerequisite(s):** Prerequisite is BIOL 1450. College level chemistry is recommended.

**BIOL 2020 STATISTICS FOR LIFE AND ENVIRONMENTAL SCIENCE (3 credits)**

The course will train life and environmental science students in 1) searching and accessing public data repositories to address questions in the area of life and environmental science, 2) carrying out quality control of data files and preparing data files for statistical analysis, 3) summarizing data with tables and graphs for reports using the principles of descriptive statistics, and 4) applying basic principles of inferential statistics to test simple life and environmental science models. The students will also practice 1) using spreadsheet software (e.g., Excel) for basic data organization, clean-up, and manipulation and 2) carrying out basic descriptive and inferential statistics with R (the standard statistical software used in life and environmental science). In addition to using the frequentist approach (null hypothesis testing) for inferential statistics, the course will also emphasize effect sizes, because statistically significant, yet small effects, are generally of minor importance in biological and environmental systems. (Cross-listed with ENVN 2020).

**Prerequisite(s):** MATH 1120 or MATH 1130 or MATH 1220 or MATH 1300 or MATH 1320 or Permission of Instructor.

**BIOL 2030 INTRODUCTORY TOPICS IN BIOLOGY (3 credits)**

This is course is a lecture and/or laboratory course for Biology and non-Biology majors pertaining to a specific biological topic not available in the regular curriculum. Topics will be developed by individual faculty members reflecting their special interests and expertise. The course may be repeated for credit if the topic differs.

**Prerequisite(s):** Instructor permission.

**BIOL 2060 ART AND SCIENCE OF MEDICAL DECISION-MAKING (3 credits)**

The course explores multiple facets of medical decision-making, including the perspective of the patient, the family, and the healthcare provider. Topics include basic anatomy and medical terminology, which will be used to understand decision-making in the context of the provider. Students use literature and other records to generate and critically evaluate clinical decisions. The course does not satisfy requirements for degree programs in the Department of Biology minor, BA, BS in Biology; BS in Biotechnology. (Cross-listed with MEDH 2060).

**Prerequisite(s):** BIOL 1060 or concurrent.

**BIOL 2140 GENETICS (4 credits)**

This course provides students with a foundational understanding of genetics. First, students will learn to analyze patterns of Mendelian inheritance. Then, they will develop molecular explanations for these patterns and understandings of how gene genes are defined and identified. They will also learn how variations in inheritance patterns arise, using analytical and statistical tools to distinguish between variations on inheritance patterns and to analyze quantitative traits. Then, students will focus in on the nucleus to examine the structure, organization, packaging, and inheritance of chromosomes. They will consider the consequences of genetic recombination on inheritance patterns and for genetic mapping.

**Prerequisite(s):** Prerequisites are BIOL 1450 and 1750, CHEM 1140 or 1180 or the equivalent or permission of the instructor. Must enroll in discussion.

**BIOL 2440 THE BIOLOGY OF MICROORGANISMS (4 credits)**

An introduction to the structure and properties of different types of microorganisms, the importance of microorganisms to our society and our environment, the methods used to control microorganisms, the diseases caused by microorganisms and the defenses of the human body against microorganisms including immune cells. Must enroll in one lab section. Usually offered in Fall, Spring, Summer.

**Prerequisite(s):** High school biology and chemistry.

**BIOL 2740 HUMAN ANATOMY AND PHYSIOLOGY I (4 credits)**

This course is designed for students interested in human healthcare professions and anyone interested in learning about the structures and functioning of the human body. Material covered will include introductory terminology as well as the anatomy and physiology of the integumentary, skeletal, muscular, and nervous systems and the special senses. Usually offered Fall, Summer.

**Prerequisite(s):** High school or college biology or zoology and high school or college chemistry. Must enroll in one lab section.

**BIOL 2840 HUMAN ANATOMY AND PHYSIOLOGY II (4 credits)**

This course is designed for students interested in human healthcare professions and anyone interested in learning about the structures and functioning of the human body. Material covered will include the anatomy and physiology of the endocrine, circulatory, lymphatic, respiratory, digestive, urinary, and reproductive systems. Usually offered Spring, Summer.

**Prerequisite(s):** BIOL 2740 or permission of instructor. Must enroll in one lab section.

**BIOL 3020 MOLECULAR BIOLOGY OF THE CELL (3 credits)**

A study of molecular and cellular biology. Topics to be covered include gene expression and regulation, structure and function of biological macromolecules, metabolism, membrane function and transport, and cell differentiation. Usually offered Fall, Spring, Summer.

**Prerequisite(s):** BIOL 2140 and at least one semester of general chemistry.

**BIOL 3030 MICROBIAL ECOLOGY (4 credits)**

This course will introduce students to the diversity and ecology of microbes in various environments (soils, water, plants, insects, etc.) through an integrated lecture and laboratory course. Emphasis will be placed on molecular approaches to analyzing microbial diversity and evolution, and teacher-directed but student-led investigations. Students will participate in a continuum of course-based research experiences in molecular microbial ecology, from field work to laboratory techniques, and evolutionary analysis of DNA sequence data. The course explores ecological principles as they apply to microorganisms, while emphasizing the molecular, biochemical and evolutionary diversity in the microbial world. (Cross-listed with ENVN 3030).

**Prerequisite(s):** Students interested in class must have passing grades in BIOL 1450 and BIOL 1750. OR with instructor's permission.

**BIOL 3100 PALEONTOLOGY (3 credits)**

An introduction to the history of life through the study of the fossil assemblages, communities, diversity, evolution, extinction, and how fossils are created. We then explore the history of invertebrates, vertebrates, microfossils, and mass extinctions. (Cross-listed with GEOL 3100.)

**Prerequisite(s):** GEOL 1180 or with instructor permission

**BIOL 3150 WRITING AND COMMUNICATION IN THE BIOLOGICAL SCIENCES (3 credits)**

This is a course in writing for students majoring in the biological sciences. It is designed primarily to prepare students to report results of original research in a scientific, scholarly format. Topics will include scientific literature, the organization and presentation of data in biological reports, as well as the preparation of posters and oral presentations for scientific meetings. Usually offered Fall, Spring.

**Prerequisite(s):** Biology major, junior or senior standing, ENGL 1150 and ENGL 1160 or equivalent.

**Distribution:** Writing in the Discipline Single Course

**BIOL 3240 INTRODUCTION TO IMMUNOLOGY (3 credits)**

An introduction to the fundamentals of immunology including the immune system, the immune response, humoral and cellular immunity, and antibodies. In addition, immunoassay, immunopathology, cancer immunology, and histocompatibility will be considered. Usually offered Fall and Spring.

**Prerequisite(s):** Prerequisites are BIOL 1450, 1750 and 2140 and junior-senior standing. Recommended: BIOL 3020. Not open to non-degree graduate students.

**BIOL 3340 ECOLOGY (4 credits)**

Study of interrelationships between organisms and their biotic and abiotic environment; includes the physical environment, population biology, community dynamics, biotic interactions and evolution. Usually offered Fall, Spring, Summer. (Cross-listed with BIOL 8345).

**Prerequisite(s):** Prerequisites are BIOL 1450 and BIOL 1750, junior-senior. Must enroll in one lab section. Not open to non-degree graduate students.

**BIOL 3500 BIOLOGICAL PRINCIPLES OF AGING (3 credits)**

The Biological Bases of Aging Course provides a survey of the primary topics in the biology of aging field for undergraduate students. This a required course for the Gerontology major. By the end of the course, students will understand major theories, biological methods, and seminal research studies in the biology of aging field. Furthermore, students will learn how to critically analyze and interpret primary research about biological aging. This course provides preparation for students considering graduate school in gerontology or biology, geriatric nursing and social work, geriatric medicine, neuroscience, psychology, and exercise science. (Cross-listed with GERO 3500, NEUR 3500)

**Prerequisite(s):** Sophomore/Junior/Senior Standing. Not open to non-degree graduate students.

**BIOL 3530 FLORA OF THE GREAT PLAINS (4 credits)**

A study of common vascular plants found in the Great Plains region, including identification, description, and classification techniques and an introduction to the plant communities of Nebraska. Usually offered every Fall and Summer. (Cross-listed with BIOL 8535.)

**Prerequisite(s):** BIOL 1450, 1750 and junior-senior. Must enroll in lab.

**Distribution:** OBIOVRT3 - Tier III Biology Writing Course

**BIOL 3680 BIOLOGY OF AFRICA (3 credits)**

Biology of Africa (3) Introduction to the plants, animals, and habitats of Africa. Although other groups are included, this course will focus on the large mammals of east Africa and will pay particular attention to elephant reproduction and biology. Other topics include Serengeti migrations, hippos, lions and other large cats, reptiles, and human evolution. Usually offered alternate Spring semesters. (Cross-listed with BIOL 8685).

**Prerequisite(s):** BIOL 1750 or permission of the instructor

**BIOL 3690 BIOLOGY OF AFRICA LAB (1 credit)**

BIOL 3690/8695 Biology of Africa (1) A Hands-on introduction to the major plants and animals of east Africa using a field trip to South Africa. Students will observe, first hand, examples of the flora and fauna of the African savannah, partake in research on elephant reproductive biology, and observe historic African tribal culture.. Students will be required to take a trip to South Africa including Johannesburg, Hoedspruit, Kruger National Park, and Skukuza. Students will be required to register their travel plans through Education Abroad. Usually offered alternate Summer semesters. Students enrolled in this course must have taken BIOL 3680/8685 during the spring semester immediately prior to this class, or have taken it some semester prior. (Cross-listed with BIOL 8695).

**Prerequisite(s):** Previous or concurrent enrollment in BIOL 3680/BIOL 8685 lecture.

**BIOL 3730 FAUNA OF THE GREAT PLAINS (3 credits)**

A survey of the common animal groups in the Great Plains Region and field techniques used to study these groups, with an emphasis on ecosystems and representative animals of Nebraska. Must enroll in lab. Usually offered in fall semesters.

**Prerequisite(s):** BIOL 1450 and BIOL 1750 and junior/senior

**BIOL 3800 ANATOMY ACADEMIC ASSISTANTSHIP PRACTICUM (1 credit)**

Assistantships for students participating in the Anatomy Academic Assistantship (AAA) program provide advanced Human Physiology and Anatomy students with the opportunity to apply their knowledge while gaining leadership and communication skills via the mentorship of current Human Physiology and Anatomy I and II students. Additionally, STEM service learning activities will be offered. This course is not intended to replace other biology courses required for degrees offered by the Department of Biology.

**Prerequisite(s):** Students must have a cumulative GPA of 3.0 or above, a grade of B in BIOL 2740, and be accepted to the Anatomy Academic Assistantship (AAA) Practicum. Students must receive permission of instructor. Not open to non-degree graduate students.

**BIOL 3830 BIOLOGY OF PATHOGENIC MICROORGANISMS (3 credits)**

This course will cover diseases commonly caused by microorganisms and the features of the microorganisms that cause those diseases. The course will also cover terms used to describe infections, their transmission and their occurrence, and the defenses of humans against infections. The goal of the course is to provide students with the knowledge to be able to diagnose common infectious diseases based on symptoms and test results. Usually offered in Spring semesters. (Cross-listed with BIOL 8835).

**Prerequisite(s):** BIOL 2140 or BIOL 2440 or BIOL 3240 or the equivalent, or by instructor permission. Not open to non-degree graduate students.

**BIOL 4030 SPECIAL TOPICS IN BIOLOGY (3 credits)**

A lecture and/or laboratory course for biology majors pertaining to a specific biological topic not available in the regular curriculum. Topics will be developed by individual faculty members reflecting their special interests and expertise. The course may be repeated for credit. (Cross-listed with BIOL 8036).

**Prerequisite(s):** Junior-senior, BIOL 1450 and BIOL 1750 with a grade of C- or higher.

**BIOL 4034 SPECIAL TOPICS IN BIOLOGY-LAB (1 credit)**

A laboratory course for biology majors pertaining to a specific biological topic not available in the regular curriculum, paired with a BIOL 8036/4030 Special Topics lecture course. Topics will be developed by individual faculty members reflecting their special interests and expertise. The course may be repeated for credit. (Cross-listed with BIOL 8046).

**Prerequisite(s):** Junior/senior, BIOL 1450 and BIOL 1750 with a grade of C- or higher.

**BIOL 4040 DIRECTED READINGS IN BIOLOGY (1-3 credits)**

A faculty directed study of a biological subject through selected readings, oral reports and a final written report. May be repeated up to a total of six hours for 4040 and 4050 combined.

**Prerequisite(s):** Junior-senior and written permission of instructor.

**BIOL 4050 SUPERVISED RESEARCH IN BIOLOGY (1-3 credits)**

Completion of a faculty supervised research project involving experimental design, data collection and analysis, and a final written report. May be repeated up to a total of six hours of BIOL 4040 and BIOL 4050 combined.

**Prerequisite(s):** Junior-senior and written permission of instructor.

**BIOL 4100 BIOGEOGRAPHY (3 credits)**

This course is intended as an introduction to biogeography, the study of the distribution and evolution of organisms across space and through time. Usually offered every year. (Cross-listed with BIOL 8106, GEOG 4100, GEOG 8106, GEOL 4100, GEOL 8106)

**Prerequisite(s):** BIOL 1450 and 1750 or GEOL 3100 or BIOL 3100, junior-senior.

**BIOL 4110 STATISTICS FOR BIOLOGICAL SCIENCES (4 credits)**

Introduction to statistical methods and software used to display, summarize, analyze, and interpret biological and medical data. (Cross-listed with BIOL 8116)

**Prerequisite(s):** BIOL 1450 and BIOL 1750 and MATH 1220, MATH 1130, or MATH 1530

**BIOL 4120 CONSERVATION BIOLOGY (3 credits)**

Study of biological diversity at the genetic, species and ecosystem levels, its values, and the factors that threaten it. We will explore the scientific basis of conservation biology and how it can be applied to the maintenance of biological diversity. Usually offered every year. (Cross-listed with BIOL 8126).

**Prerequisite(s):** BIOL 1450, 1750, 2140 and Junior-Senior in biology. Not open to non-degree graduate students.

**BIOL 4130 MOLECULAR GENETICS (4 credits)**

A lecture and lab course that explores the frontiers of molecular genetics research. Topics addressed will include DNA replication, gene function, gene expression, genetic manipulation, cloning, mutational analysis, genome sequencing, and epigenetics. Research techniques will include DNA/RNA isolation, PCR, cloning, gel electrophoresis, transgene generation, data analysis, and quantitative rtPCR. Students will get a solid grounding in scientific writing and presentations, as well as reading and assessing primary scientific literature. Lecture, discussion, and laboratory. (Cross-listed with BIOL 8136)

**Prerequisite(s):** BIOL 2140, 3020 and CHEM 2210 or 2260; or their equivalents. Must enroll in one lab section.

**BIOL 4140 CELLULAR BIOLOGY (4 credits)**

This course is a modern study of mammalian cell function. Focus will be placed on developing skills in experimental cellular biology. Material covered will include tissue culture techniques, cell staining applications, fluorescent microscopy, determination of gene expression, and high-throughput assay design. (Cross-listed with BIOL 8146)

**Prerequisite(s):** BIOL 2140, 3020 and CHEM 2210 or 2250. Junior or senior undergraduate standing Must enroll in laboratory section and lecture for this course. Not open to non-degree graduate students.

**BIOL 4150 CANCER BIOLOGY (3 credits)**

The etiology of cancers, differences between types of malignancies, oncogenes and genetic modifiers, treatments, susceptibility, and tumor-induced immunosuppression are discussed. This is an active course focused on inquiry-based learning and the purpose of this course is to provide students a foundation in cancer biology while applying tools learned through cell biology, genetics, and immunology courses. (Cross-listed with BIOL 8156).

**Prerequisite(s):** BIOL 3020 and BIOL 2140. Recommended: BIOL 3240.

**BIOL 4160 BIOINFORMATICS FOR BIOLOGISTS (3 credits)**

This course intends to introduce fundamental concepts in bioinformatics with an emphasis on how to use biological databases and computational tools to solve common bioinformatics problems in biology and biomedicine. The topics consist of sequence database access and searching, sequence alignment and phylogeny, functional prediction of DNA and protein sequences, and genome sequencing and annotation. Students are expected to learn fundamental concepts in bioinformatics and gain extensive experience with the use of bioinformatics analysis tools. (Cross-listed with BIOL 8166).

**Prerequisite(s):** BIOL 2140 Genetics; BIOL 3020 Molecular Biology of the Cell; Or Permission of instructor

**BIOL 4180 FRESHWATER ECOLOGY (4 credits)**

A study of the physical, chemical and biological relationships that serve to establish and maintain plant and animal communities in freshwater environments. (Cross-listed with BIOL 8186, ENVN 4180).

**Prerequisite(s):** BIOL 1450 and BIOL 1750, junior-senior, or permission of instructor. Must enroll in lab. Not open to non-degree graduate students.

**BIOL 4210 FIRE ECOLOGY (3 credits)**

Study of fire in ecosystems including characteristics of fire, effects on flora, fauna and the abiotic environment, and use in maintaining native ecosystems. May include two weekend field exercises. (Cross-listed with BIOL 8216)

**Prerequisite(s):** BIOL 3340, junior-senior.



**BIOL 4220 POPULATION BIOLOGY (4 credits)**

Population biology takes a conceptual approach to study the dynamics, ecology, genetics, and evolution of populations. Topics include the growth and regulation of populations, population interactions, selection on individuals and groups, mating systems, and life history evolution. Implications of these topics for areas such as the ecology and evolution of disease, conservation, and resource management will be highlighted. Concepts are reinforced through labs emphasizing interpretation of results from population simulations and the relationship between theory and experimentation in population biology. Usually offered in alternate years. (Cross-listed with BIOL 8226).

**Prerequisite(s):** BIOL 2140 and 3340, junior-senior, or permission of instructor

**BIOL 4230 EVOLUTION (3 credits)**

The course emphasizes the general principles of evolution, particularly focusing on evolutionary changes and the mechanisms of evolution (natural selection, gene flow, mutation and genetic drift) that apply to all or most organisms. The course covers micro- and macroevolution, speciation, and human evolution. Students will discover how scientists can learn about what has happened in the evolutionary past and the most common patterns of change (i.e., changes that have characterized various groups of organisms). (Cross-listed with BIOL 8236).

**Prerequisite(s):** BIOL 2140, junior-senior. Not open to non-degree graduate students.

**BIOL 4240 MARINE BIOLOGY (3 credits)**

An introduction to the marine environment, this course explores physical conditions of the ocean including ocean chemistry, salinity, waves and currents, and tides as well as the ecology of planktonic, nektonic and benthic organisms— their communities and environments. Impacts of humans on the marine environment will also be covered. (Cross-listed with BIOL 8246)

**Prerequisite(s):** BIOL 1750

**BIOL 4250 FIELD MARINE BIOLOGY (1 credit)**

This lab is a hands-on introduction to the marine environment using a field trip to the Gulf Coast. Students will observe first-hand examples of local marine habitats and organisms. Students will be required to take a trip to the Gulf Coast of Texas, Louisiana, Mississippi, and Alabama during Spring Break. Students will be required to provide their own basic camping and snorkeling gear. (Cross-listed with BIOL 8256)

**Prerequisite(s):** BIOL 1750, previous or concurrent enrollment in BIOL 4240 and permission of instructor.

**BIOL 4260 BEHAVIORAL ECOLOGY (3 credits)**

Behavioral ecology is the study of behavior from an evolutionary and ecological point of view. Through the integration of research at different organizational levels and the use of many different organisms, behavioral ecology is one of the most integrative fields in biological sciences. This course will provide an introduction to the basic concepts of behavioral ecology and the integrative approaches used in behavioral ecology. Further, the course will train students in critical reading and discussion of primary literature in writing and in an oral setting. (Cross-listed with BIOL 8266)

**Prerequisite(s):** For BIOL 4260: BIOL 2140 Genetics and BIOL 3340 Ecology; or permission by the instructor. Not open to non-degree graduate students.

**BIOL 4270 ANIMAL BEHAVIOR (3 credits)**

Behavior of diverse animals for the understanding of the relationships between nervous integration and the behavior manifested by the organism, as well as the evolution and adaptive significance of behavior as a functional unit. (Cross-listed with BIOL 8276, PSYC 4270, PSYC 8276)

**Prerequisite(s):** BIOL 1750 and PSYC 1010 or permission of instructor, junior-senior.

**BIOL 4280 ANIMAL BEHAVIOR LABORATORY (3 credits)**

Laboratory and field studies of animal behavior with an ethological emphasis. Classical laboratory experiences and independent studies will be conducted. (Cross-listed with BIOL 8286, PSYC 4280, PSYC 8286)

**Prerequisite(s):** PSYC 4270 or BIOL 4270 or PSYC 8276 or BIOL 8273. Not open to non-degree graduate students.

**BIOL 4290 NEUROETHOLOGY (3 credits)**

In the field of Neuroethology a major goal is to understand the neural bases of animal behaviors in a natural context. In this course students will investigate how behaviors are generated and modulated by the nervous system in organisms ranging from insects to mammals. We will explore the neural mechanisms underlying a variety of animal behaviors as they interact with their natural environment ranging from sensory perception of the world (e.g. echolocation, electrolocation), to locomotor movements (e.g. flying, swimming), to more complex behaviors (e.g. learning, memory). (Cross-listed with NEUR 4290, NEUR 8296, BIOL 8296, PSYC 8296).

**Prerequisite(s):** NEUR 1520, NEUR 1540 and BIOL 1750; or by permission of instructor. Not open to non-degree graduate students.

**BIOL 4320 HORMONES & BEHAVIOR (3 credits)**

In this course, students will examine the interaction between hormones, chemical messengers released from endocrine glands, and behavior in both human and animal systems. Methods for studying hormonal issues on behavior will be addressed. This course will provide students in psychology, biology, and related disciplines an understanding of how hormones affect sensory processing, motor activities, and processing of information in the central nervous system. (Cross-listed with BIOL 8326, PSYC 4320, PSYC 8326)

**Prerequisite(s):** PSYC 1010 and either BIOL 1020 or 1750. Not open to non-degree graduate students.

**BIOL 4410 WETLAND ECOLOGY AND MANAGEMENT (3 credits)**

This course will examine the principles and theory of wetland ecology with application towards wetland management and regulation. An interdisciplinary overview of physical, biological and regulatory aspects of wetlands will allow students to synthesize information from their backgrounds in geography, geology and ecology. Definitions, classifications, natural processes and functions of wetland environments will be presented. Labs concentrate on field techniques used to assess specific plant, animal, soil, and hydrological characteristics of wetlands. (Cross-listed with ENVN 4410 and BIOL 8416)

**Prerequisite(s):** BIOL 3340 or instructor permission.

**BIOL 4420 RESTORATION ECOLOGY (3 credits)**

Restoration Ecology examines how people assist with the recovery of ecosystems that have been degraded. The course will examine the theory and application of restoration ecology through lecture, discussion, field trips, and development of a restoration management plan for a degraded ecosystem near Omaha. The course will provide information and resources used by restoration and land management professionals to plan, implement, and manage restorations. (Cross-listed with BIOL 8426, ENVN 4420)

**Prerequisite(s):** Junior or Senior standing.

**BIOL 4440 PLANT PHYSIOLOGY (4 credits)**

A study of plant processes and functions with emphasis on photosynthesis, growth and development, metabolism and mineral nutrition. (Cross-listed with BIOL 8446)

**Prerequisite(s):** BIOL1450, BIOL1750, and CHEM2210 or CHEM2250; or permission of instructor.

**BIOL 4450 VIROLOGY (3 credits)**

A comprehensive course about viruses. The course will address principles of viral infection, virus-host interaction, viral evolution and viral disease processes. Cellular and molecular aspects of viral infection will be the primary focus. This will include examination of viral particles, viral multiplication cycles, regulation of gene expression, viral assembly and viral escape. Viral immunology, viral defenses, viral vaccines and antiviral compounds will also be addressed. Emerging viruses and current viral topics will be a major part of the course. Usually offered in Fall semester. (Cross-listed with BIOL 8456)

**Prerequisite(s):** Prerequisites are CHEM 2260 and 2274 or CHEM 2210 and 2214, BIOL 3020 and 2140. Recommended: Biochemistry.

**BIOL 4454 VIROLOGY LABORATORY (1 credit)**

A laboratory to accompany virology lecture. This course enables students to work with viruses in the laboratory and to conduct experiments using viral systems. Experimental design, data gathering, data analysis and manuscript writing will be integral parts of the course. The experiments include host cell characterization, viral infection, virus purification from infected cells, viral genome isolation and viral transfection. Sequence analysis and sequence comparison will also be introduced. Laboratory exercises will emphasize fundamental molecular biology techniques and instrumentation. Usually offered in Fall semester. (Cross-listed with BIOL 8454)

**Prerequisite(s):** Biology 4450 - Virology is a prerequisite or co-requisite.

**BIOL 4460 COMPARATIVE IMMUNOLOGY (4 credits)**

This course is an exploration of comparative immunology across kingdoms. There will be a strong focus on human as well as mouse immunology. Laboratory sessions require dissections to determine lymphoid anatomy of representative organisms. Samples will be prepared and analyzed using immunological techniques such as flow cytometry. (Cross-listed with BIOL 8466).

**Prerequisite(s):** BIOL 3240 or consent of the instructor. Two classroom sessions and one laboratory session per week. Permit code required to register. Not open to non-degree graduate students.

**BIOL 4490 MEDICINAL USES OF PLANTS (3 credits)**

A scientific study of the biochemical properties and physiological effects of medicinal plants, including their historical uses, current applications to varying systems of the human body, and pathways by which today's potent drugs have transitioned from wild flora. Usually offered Fall semesters of even-numbered years. (Cross-listed with BIOL 8496)

**Prerequisite(s):** BIOL 1450, 1750 and junior-senior.

**BIOL 4540 PRINCIPLES OF SYSTEMATICS (3 credits)**

A thorough study of phylogenetics, including tree inference techniques, proper interpretation of evolutionary relationships and character evolution, and applications to investigations in various fields of study. Usually offered in fall semesters of odd-numbered years.

**Prerequisite(s):** BIOL 1450 and 1750, junior-senior.

**BIOL 4550 MOLECULAR AND BIOMEDICAL BIOLOGY INTERNSHIP (3 credits)**

Practical laboratory experience for students in the bachelor's of science program in Molecular and Biomedical Biology. In consultation with the MBB adviser and principal investigators, students will select a research laboratory where they will carry out an independent investigation for one semester. Most placements will be at UNMC or UNO. Recommended: Biochemistry. Usually offered Fall, Spring, Summer.

**Prerequisite(s):** Prerequisite of at least one 4000 level BIOL laboratory course.

**BIOL 4560 BIOINFORMATICS INTERNSHIP (1-3 credits)**

This course is a practical experience for students in the Bachelor of Science program in Bioinformatics. In consultation with the bioinformatics adviser and principal investigators, students will select a research laboratory and conduct an independent research project in bioinformatics for one or two semesters. Students will write a report describing their research methods, project implementation, and results. The course is limited to Bioinformatics majors and does not satisfy any requirements for other programs in the Department of Biology.

**Prerequisite(s):** BIOL 2140 Genetics, BIOI 3500 Advanced Bioinformatics Programming, and Permission of Instructor. The course is for students in the Bachelor of Science program in Bioinformatics. Not open to non-degree graduate students.

**BIOL 4600 GIS APPLICATIONS FOR ENVIRONMENTAL SCIENCE (1 credit)**

This course introduces the use of geographic information systems (GIS) and other geospatial tools for work in the fields of environmental science, ecology, and natural resource management. The course will develop a working knowledge of the common software and hardware tools used by ecologists through hands-on projects. (Cross-listed with BIOL 8606, ENVN 4600)

**Prerequisite(s):** BIOL 3340 or permission of instructor.

**BIOL 4610 ENVIRONMENTAL MONITORING AND ASSESSMENT (3 credits)**

An interdisciplinary approach to techniques for the design and implementation of environmental inventory and monitoring schemes used to evaluate natural resources. Students work as teams to synthesize information from their backgrounds in geography, geology and ecology to evaluate the impacts of human actions on environmental quality following the framework for environmental assessments provided by the National Environmental Policy Act. Course is organized to accommodate variable needs of students with different backgrounds and career choices. Usually offered every year. Cross-listed with ENVN 4610, GEOG 4610, GEOG 8616, GEOL 4610, GEOL 8616.

**Prerequisite(s):** Permission of instructor.

**BIOL 4640 MOLECULAR MICROBIOLOGY (3 credits)**

This course will cover the diversity observed in genomes, molecules, structures, metabolism, and regulation observed in microorganisms with a focus on bacteria and Archaea. Usually offered Fall semesters. (Cross-listed with BIOL 8646).

**Prerequisite(s):** Prerequisites are BIOL 2140 and BIOL 3020 or equivalents. Not open to non-degree graduate students.

**BIOL 4644 MOLECULAR MICROBIOLOGY LAB (1 credit)**

This course will train students to perform techniques commonly used in microbiology labs, such as isolation of bacteria, staining of bacterial cells, use of different media, antibiotic susceptibility tests, polymerase chain reactions, and enzymatic assays. (Cross-listed with BIOL 8645).

**Prerequisite(s):** Prerequisites of BIOL 2140 and BIOL 3020 and either BIOL 3830/8835 or BIOL 4640/8646 prior or concurrent.

**BIOL 4650 BIOCHEMISTRY I (3 credits)**

A comprehensive introduction to biochemistry emphasizing: structure-function relationships for proteins, carbohydrates, lipids, and nucleic acids; protein purification; enzyme kinetics and mechanisms; membranes and membrane transport; carbohydrate metabolism including glycolysis, the citric acid cycle and oxidative phosphorylation; and important applications of thermodynamics and the properties of water to living systems. (Fall) (Cross-listed with BIOL 8656, CHEM 4650, CHEM 8656).

**Prerequisite(s):** CHEM 2260 and CHEM 2274; and either CHEM 2400 or BIOL 3020, all with a C- or better. Other comparable courses taken at accredited colleges or universities are acceptable. BIOL 4654 must be taken concurrently.

**BIOL 4654 BIOCHEMISTRY I LABORATORY (1 credit)**

A laboratory course to help integrate the concepts learned in biochemistry lecture with the development of biochemical laboratory skills including experimental design, data analysis, presentation of results and communication of scientific information, with a focus on formal instruction in journal-style writing and notebook skills. There is an emphasis on protein properties, including enzyme activity. Fulfills the third writing course requirement for students majoring in chemistry when NSCI 3940 and another approved laboratory course have been completed with a C- or better. (Fall) (Cross-listed with BIOL 8654, CHEM 4654, CHEM 8654).

**Prerequisite(s):** CHEM 2260 and CHEM 2274; and either CHEM 2400 or BIOL 3020, all with a C- or better. BIOL 4650 must be taken concurrently with BIOL 4654. CHEM 4650 must be taken concurrently with CHEM 4654.

**Distribution:** Writing in the Discipline Sequenced Course

**BIOL 4660 BIOCHEMISTRY II (3 credits)**

A continuation of the study of the structure and function of biomolecules and biochemical reactions with an emphasis on metabolism of carbohydrates, lipids, amino acids and nucleotides, and the chemistry of signal transduction and genetic information transfer. (Spring) (Cross-listed with BIOL 8666, CHEM 4660, CHEM 8666).

**Prerequisite(s):** CHEM 4650 and CHEM 4654 or BIOL 4650 and BIOL 4654. BIOL 4664 must be taken concurrently.

**BIOL 4664 BIOCHEMISTRY II LABORATORY (1 credit)**

A laboratory course to help integrate the concepts learned in Biochemistry II lecture with the development of biochemical laboratory skills, to gain practical experience in experimental design, data analysis, presentation of results and communication of scientific information, with a focus on formal instruction in journal-style writing and notebook skills. There is an emphasis on nucleic acid properties. Fulfills the third writing course requirement for students majoring in chemistry when NSCI 3940 and another approved laboratory course have been completed with a C- or better. (Spring) (Cross-listed with BIOL 8664, CHEM 4664, CHEM 8664).

**Prerequisite(s):** CHEM 4650 and CHEM 4654 or BIOL 4650 and BIOL 4654 with a C- or better. BIOL 4660 must be taken concurrently with BIOL 4664. CHEM 4660 must be taken concurrently with CHEM 4664.

**Distribution:** Writing in the Discipline Sequenced Course

**BIOL 4710 TOXICOLOGY (3 credits)**

An overview of the fundamentals of toxicology. Concepts include the dose-response relationship, absorption, distribution and excretion of toxicants, and the biotransformation of xenobiotics. Emphasis will be given to metals, pesticides, pharmaceutical compounds, chemical carcinogenesis and endocrine disruption. Usually offered Fall. (Cross-listed with BIOL 8716)

**Prerequisite(s):** CHEM 2210 or 2260 and BIOL 1750, BIOL 3020 or equivalent.

**BIOL 4730 VERTEBRATE ENDOCRINOLOGY (4 credits)**

An overview of the fundamentals of vertebrate endocrinology. Concepts include: the mammalian hypothalamus-pituitary system, the endocrinology of mammalian reproduction, the mammalian adrenal glands, endocrine disruption, endocrinology and metabolism. (Cross-listed with BIOL 8736)

**Prerequisite(s):** CHEM 2250, BIOL 1750, BIOL 3020 or equivalent. Not open to non-degree graduate students.

**BIOL 4740 ANIMAL PHYSIOLOGY (3 credits)**

An overview of the fundamentals of animal physiology. Concepts include: the physiology of nerve and muscle function, endocrine function, cardiovascular and respiratory function, oxygen and carbon dioxide delivery by the blood, and osmoregulation and excretion. The course is comparative in nature, including examples from humans, mammals, vertebrates and invertebrate animals. Usually offered Spring. (Cross-listed with BIOL 8746).

**Prerequisite(s):** BIOL 1450, BIOL 1750, and BIOL 2140 or permission of the instructor.

**BIOL 4760 GENOME TECHNOLOGY AND ANALYSIS (3 credits)**

This course will introduce the latest genome sequencing technologies and their broad applications in biology and medicine. Students will learn how genome sequencing is conducted by different platforms and obtain practical experience of how to use bioinformatics tools for genome analysis. Students are expected to be able to perform sequence analysis efficiently and interpret the results properly. (Cross-listed with BIOL 8766)

**Prerequisite(s):** BIOL2140 Genetics; or Permission of instructor

**BIOL 4780 VERTEBRATE ZOOLOGY (4 credits)**

A study of the general biology of the subphylum vertebrata including the morphology, anatomy, physiology and ecology of vertebrate representatives. (Cross-listed with BIOL 8786)

**Prerequisite(s):** Prerequisites are BIOL 1450, BIOL 1750, and junior-senior.

**BIOL 4790 MAMMALOLOGY (4 credits)**

The biology of mammals, including their evolution, functional morphology, physiology, ecology, zoogeography, behavior, classification and identification, with emphasis on North American groups. Field trips. Usually offered in alternate years. (Cross-listed with BIOL 8796)

**Prerequisite(s):** BIOL 1450, BIOL 1750, junior or senior standing. Must enroll in lab.

**BIOL 4800 INTERNSHIP IN ENVIRONMENTAL MANAGEMENT AND PLANNING (1-3 credits)**

Internship providing practical experience working with environmental organizations or government agencies for students interested in careers in environmental science and related fields. A proposed internship must be approved by the Environmental Studies Program prior to enrolling. Usually offered Fall, Spring, Summer. (Cross-listed with ENVN 4800)

**Prerequisite(s):** Permission of the Environmental Studies Program.

**BIOL 4810 BEHAVIORAL GENETICS (4 credits)**

This lecture and laboratory course will explore the interaction between behavior and genetics. Topics addressed will include research systems used in behavioral genetics research, ways of studying animal behavior, gene function, gene expression, genetic manipulation, genome sequencing, and bioinformatics. Research techniques will include behavioral observations, cognition assays, and traditional and cutting edge genetics research techniques and analyses (DNA/RNA isolation, PCR, gel electrophoresis, transgene generation, quantitative PCR, next generation sequencing). Students will design, conduct, analyze, and present semi-independent research projects over the course of the semester. (Cross-listed with NEUR 4810).

**Prerequisite(s):** BIOL 2140

**BIOL 4820 INTRODUCTION TO ENVIRONMENTAL LAW & REGULATIONS (3 credits)**

An introduction to environmental law and regulations intended for students pursuing careers in environmental sciences or related fields. The course emphasizes the origins, implementation, and enforcement of U.S. state and federal laws and regulations. Major federal environmental laws, covering air and water quality, solid and hazardous waste, pollution prevention and remediation, and natural resources will be discussed. Usually offered Fall semesters. (Cross-listed with ENVN 8826, ENVN 4820, GEOG 4820, GEOG 8826, PA 8826).

**Prerequisite(s):** Junior-senior or permission of the instructor.

**BIOL 4830 DEVELOPMENTAL GENETICS (2 credits)**

This course considers experimental approaches in developmental genetics and provides students with first-hand experience in laboratory techniques used in developmental genetics. (Cross-listed with BIOL 8836)

**Prerequisite(s):** Completion of, or concurrent registration in, BIOL 4850.

**BIOL 4840 HERPETOLOGY (4 credits)**

The biology of amphibians and reptiles, including their evolution, classification, anatomy, physiology, ecology, distribution and identification, with emphasis on North American groups. Methods for studying herptiles are examined. Usually offered in Spring semesters of even years. (Cross-listed with BIOL 8846).

**Prerequisite(s):** Prerequisites are BIOL 1450 and BIOL 1750. Must enroll in lab. Not open to non-degree graduate students.

**BIOL 4850 DEVELOPMENTAL BIOLOGY (3 credits)**

This course explores principles underlying the development of multicellular organisms, stressing the environmental, genetic, molecular, cellular, tissue, and evolutionary mechanisms of animal development. Usually offered once per year. (Cross-listed with BIOL 8856)

**Prerequisite(s):** Prerequisites are BIOL 1450, 1750, 2140, 3020, and CHEM 3650 or BIOL 4650 or CHEM 4650 and junior-senior status.

**BIOL 4860 COMPARATIVE GENOMICS (3 credits)**

This course will introduce fundamental concepts in genomics and genome comparison. Students will learn how genomes are constructed, how they evolve, how individual genomes are unique, and what genomic knowledge means in terms of human health and medicine. (Cross-listed with BIOL 8866)

**Prerequisite(s):** BIOL2140 Genetics; BIOL3020 Molecular Biology of the Cell; Or Permission of instructor. Not open to nondegree students.

**BIOL 4870 MOLECULAR AND CELLULAR NEUROBIOLOGY (3 credits)**

This course presents foundational topics in molecular and cellular neurobiology in the context of how the nervous system is functionally organized. Topics include: nervous system cell types and their subcellular organization; electrical properties of neurons and glia; energy metabolism and biochemistry of the brain; intra- and intercellular neuronal signaling; the regulation of gene expression in neuronal cells; synaptic plasticity; and how these are altered in disease. (Cross-listed with BIOL 8876, NEUR 4870, NEUR 8876).

**Prerequisite(s):** NEUR 1500, or both NEUR 1520 and NEUR 1540, or BIOL 3020, or permission of instructor.

**BIOL 4890 GENES, BRAIN, AND BEHAVIOR (3 credits)**

This course will evaluate the complex interaction between an organism's genome and neural activity pattern in the nervous system as related to behavior. In this course students will explore how changes in gene expression (allelic variants, epigenetics, differential regulation) and gene networks within neural tissue can reciprocally influence behaviors such as communication, foraging, reproduction, and cognition. (Cross-listed with NEUR 4890, NEUR 8896, BIOL 8896, PSYC 8896).

**Prerequisite(s):** NEUR 1520, NEUR 1540, and BIOL 2140. Or by permission of instructor. Not open to non-degree graduate students.

**BIOL 4940 ENTOMOLOGY (4 credits)**

The study of insects; their classification, morphology, physiology, behavior, life histories, ecology and evolution. (Cross-listed with BIOL 8946)

**Prerequisite(s):** BIOL 1450, BIOL 1750. Junior or Senior standing.

**BIOL 4960 ADVANCED GENETICS (3 credits)**

An in-depth consideration of topics in genetic analysis. Through reading and discussion of primary and secondary literature in genetics, students will develop a deeper understanding of genetic principles, including mutation, recombination, complementation, gene regulation, the genetic structure of populations and the genetic contributions to complex traits, and how these principles and associated methodologies, including next-generation sequencing and high throughput "-omics" approaches, can be used to gain insight into fundamental biological questions. (Cross-listed with BIOL 8966).

**Prerequisite(s):** BIOL 2140 and BIOL 3020 and concurrent enrollment or completion of either CHEM 3650 or CHEM 4610 or CHEM 4650 or BIOL 4650, or permission of the instructor.

**BIOL 4970 ADVANCED BOTANY (4 credits)**

Advanced Botany examines plant structures (cells, tissues, and organs) and their connections with plant functions (growth, reproduction, photosynthesis, respiration, and dispersal). Topics covered include energy metabolism, development and morphogenesis, genetics, ecology, and the latest in plant taxonomy and phylogeny, keeping students on the forefront of cutting-edge botanical research. In lab, students conduct activities such as dissecting plant organs, making microscope slides, and conducting plant-based experiments, using plants from the local area, from native Great Plains collections, and from around the world and grown in the greenhouse. Students compare and contrast both physiological and morphological adaptations to varying environments. (Cross-listed with BIOL 8976, ENVN 4970).

**Prerequisite(s):** BIOL 1750 and junior or senior student status or above or instructor permission.

**BIOL 4980 ORNITHOLOGY (4 credits)**

An introduction to the general biology of birds, including their anatomy, physiology, behavior, ecology, classification and identification, with emphasis on North American groups. Usually offered in alternate years. (Cross-listed with BIOL 8986)

**Prerequisite(s):** BIOL 1750.

**Distribution:** OBIOWRT3 - Tier III Biology Writing Course