The Department of Biology currently offers courses of study leading to the degrees of Bachelor of Science and Master of Science. The broadly-based requirements of the major are designed to prepare students for:

1. advanced studies in biology, biomedical sciences, environmental biology, ecology and applied ecology;
2. professional training in medicine, dentistry, optometry, chiropractic, pharmacy, veterinary medicine and other health professions;
3. teaching of biology in secondary schools; or
4. career opportunities in research, biomedical sciences, agriculture, industry, government, and academic institutions.

The graduate program leading to the Master of Science degree is also flexible, and can meet the needs of:

1. students seeking additional training and/or research experience in order to obtain employment that requires post-baccalaureate training,
2. current high-school teachers and other professionals who seek advancement in their careers or who want to stay current in the field, and
3. students interested in completing an M.S. before going on to a doctoral program.

Students interested in completing a major in biology are strongly urged to declare the major early and seek advisement from a departmental advisor.

It is particularly important to note that students who complete the major in Biology are exempted from having to take any courses in the Natural Sciences distribution area of the General Education Program.

In addition, students should be aware that a maximum of 18 credit hours of biology courses can be accepted toward the Biology Major in transfer credits, and a maximum of three courses can be transferred to satisfy biology electives. A maximum of 9 credit hours of transfer credits can be accepted toward the Biology Minor (in practice three courses). In order for introductory biology courses taken at another institution to be accepted in place of BIO-201 or BIO-202, they must be specifically designated as being courses for Biology majors. Students seeking to transfer courses from other institutions should have their coursework evaluated by an advisor in Biology at the time they declare the major or minor.

NOTE – Beginning in the Fall semester of 2007:
In order to register for Biology courses which apply toward the Major or Minor, students must demonstrate proficiency in Reading Comprehension, Writing, and Math and be eligible to register for College Level courses in these subjects. Students may demonstrate proficiency by placing into College Level courses on the Accuplacer Tests offered through Testing Services at NEIU; by completing appropriate coursework with a “C” or better; or through ACT scores. Please see pre-requisites for BIO-150 (http://catalog.neiu.edu/search/?P=BIO-150) for a complete list of how these proficiencies can be satisfied.

Students are encouraged to take ENGL-101, ENGL-102, CHEM-211 as early as possible in their academic careers as successful completion of both ENGL courses is required for WIP: General Ecology (a core course), and CHEM-211 is required for Cell Biology (another core course). Likewise, completing MATH-187 or MATH-275 early on will help students with the quantitative aspects of many Biology courses, and MATH-187 will satisfy the pre-requisite requirement for the Physics courses that are required by the major.

- Major in Biology (http://catalog.neiu.edu/arts-sciences/biology/biology)
- Minor in Biology (http://catalog.neiu.edu/arts-sciences/biology/minor-biology)
- Master of Science in Biology (http://catalog.neiu.edu/arts-sciences/biology/master-science-biology)

John M. Kasmer, Ph.D., Associate Professor, Chair
Elyse Bolterstein, Ph.D., Assistant Professor
Jorge Cantú, Ph.D., Assistant Professor
Pamela Geddes, Ph.D., Associate Professor
Mary Kimble, Ph.D., Professor
Shubhangee Mungr, Ph.D., Professor
Joel Olfelt, Ph.D., Professor
Emily Rumschlag-Booms, Ph.D., Assistant Professor
Aaron Schirmer, Ph.D., Associate Professor
Jennifer Slate, Ph.D., Professor
Michael Stern, Ph.D., Professor
Emina Stojković, Ph.D., Associate Professor
John N. Thomas, Ph.D., Associate Professor
Cindy Voisine, Ph.D., Associate Professor
**BIO-100. Introduction To Biology. 3 Hours.**
This course addresses the problems of living things with emphasis on human physiology and the propagation of life, covering major biological concepts and principles. The course consists of lectures and labs; labs include required dissection. (the course does not fulfill major or minor requirements in biology.).

**BIO-104. The Changing Natural Environment. 3 Hours.**
A biological approach to understanding the natural environment. This course introduces basic ecological principles including biogeochemical cycling, energy flow, the origins of biodiversity, and population growth; considers how humans interact with natural systems; examines the origins of contemporary environmental issues, including the role of humans in contributing to environmental changes; and explores potential solutions to environmental issues that are based on biological and ecological principles. Lecture only. (Does not fulfill major or minor requirements in biology.).

**BIO-105. Environmental Biology Lab. 1 Hour.**
This course provides a field and laboratory experience to accompany the MS Concepts Minor Section of "Changing Natural Environment". Data collected in the field and laboratory will be used for analysis in the paired MATH-147 course in statistics and probability. The field and lab course will focus on the process of science-from exploratory and inquiry based laboratory field work to scientific communication and presentation skill. Technology will be threaded throughout the course. Topics include diversity and viability in nature, ecosystem services, and flows of matter and energy. This course is linked to BIO-104 and MATH-147.

**Prerequisites:** (BIO-100 minimum grade of C or BIOL-100 minimum grade of C) and (MATH-180 minimum grade of C or MATH-199A minimum grade of C).

**Corequisites:** BIO-104, MATH-147.

**BIO-107. The Effects of Food & Drugs. 3 Hours.**

**BIO-109A. First Year Experience: Alien Invasions Of Chicago. 3 Hours.**
Global trade and travel has been responsible for spreading microbes, plants and animals across great distances and previously insurmountable barriers, and many of these species, once introduced into a new area become ecological invaders. Species that become invasive have strong negative impacts, both economic and ecological, so a great deal of resources are dedicated to controlling or removing them. This course will survey the diversity of species that have invaded ecological communities in the Chicago area, look at the factors that allowed them to become invasive, look at the ways in which these invaders have had negative ecological and economic impacts in the region, and review examples of how ecological principles have been and are being applied to control them. Students will meet with local experts in the field, in order to get first-hand experience with some of the more infamous invasive species and see Chicago from the perspective of urban ecologists.

**BIO-150. Essential Skills For Biologists. 2 Hours.**
A practical approach to providing students with the basic skill they will be expected to have in upper-division biology courses, including lab safety; methods and units of scientific measurement; scientific record-keeping, communication and library research skills; and summarizing and presenting data. Lecture and laboratory with a significant web-based component.

**Prerequisites:** (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 45 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120) and (ESL-120 or ELP-099 or NEIU English Placement Writing 7 - 9 or ENGL-101 - 102 or (Accuplacer WritePlacer 4 and Accuplacer Sentence Skills 095 - 120) or (Accuplacer WritePlacer 8 - 8 and Accuplacer Sentence Skills 020 - 120)) and (READ-095 - 116 or ACT Reading 20 - 36 or NEIU English Placement Reading 5 - 9 or Accuplacer Reading Comp 080 - 120).

**Corequisite:** BIO-201.

**BIO-199. Topics In Teaching Middle School Biology. 4 Hours.**

**Corequisite:** MATH-145.

**BIO-201. General Biology I. 4 Hours.**
The first course of our introductory biology series focuses on the organismal aspects of biology, including: the basic structure of animal and plant cells; intracellular organelles; metabolic pathways; the cell cycle; and basic genetics. Laboratory exercises emphasize scientific method and writing, and include experience with basic techniques such as microscopy, biological assays, and gel electrophoresis. Lecture and laboratory.

**Prerequisites:** (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 45 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120) and (ESL-120 or ELP-099 or NEIU English Placement Writing 7 - 9 or ENGL-101 - 102 or (Accuplacer WritePlacer 4 and Accuplacer Sentence Skills 095 - 120) or (Accuplacer WritePlacer 5 - 8 and Accuplacer Sentence Skills 020 - 120)) and (MATH-145).

**Corequisite:** BIO-150.

**BIO-202. General Biology II. 4 Hours.**
In this second course of our introductory biology series we introduce the diversity of life in the context of evolutionary theory, studying biological processes at levels of organization ranging from populations to ecosystems. Laboratory exercises emphasize scientific method and writing and include surveys of major groups of organisms and dissections. Lecture and laboratory.

**Prerequisites:** BIO-150 minimum grade of C and (BIO-201 minimum grade of C or BIOL-102 minimum grade of C).
BIO-299. Ecology Concepts. 3 Hours.
This course provides a foundation in core ecology concepts as they relate to the practice of middle school teaching. A quantitative perspective will be stressed and topics will be analyzed using tools from calculus, technology, concepts and agent modeling whenever possible. Course will focus on scientific inquiry methodology and process, from exploratory and inquiry-based laboratory and field work to scientific communication and presentation skills. Topics include population growth, competition, and flows of matter and energy. This course is linked to MATH-380.
Prerequisites: BIO-100 minimum grade of C or BIOL-100 minimum grade of C and (BIO-104 minimum grade of C or BIOL-104 minimum grade of C) and (MATH-380 minimum grade of C or MATH-199X minimum grade of C).

BIO-301. Cell Biology. 4 Hours.
Prerequisites: (BIO-201 minimum grade of C or BIOL-102 minimum grade of C) and BIO-150 minimum grade of C and CHEM-211 minimum grade of C.

BIO-303. General Genetics. 4 Hours.
This course is designed to provide students with a comprehensive background in genetics including classical/Mendelian genetics, bacterial and phange/viral genetics, the chromosomal and molecular basis of heredity, and population genetics. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-305. Writing Intensive Program: General Ecology. 4 Hours.
An introduction to the basic concepts of ecology. Study of the factors/interactions that determine the distribution and abundance of species at the individual, population, community, and ecosystem levels. You will satisfy the writing intensive requirement by writing in a variety of discipline-specific formats. Lecture, laboratory, and fieldwork, with up to two field trips scheduled on a Friday, Saturday, or Sunday.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and ENGL-101 minimum grade of C and ENGL-102 minimum grade of C.

BIO-307A. Interdisciplinary Research Skills I. 3 Hours.
This course provides an introduction to a set of topics that are at the forefront of research in the sciences. The course is structured around a series of modules, each covering a topic that is among the most significant in the fields of Biology, Mathematics and Psychology (see course schedule below). The modules, while complete in themselves, will also draw connections between scientific disciplines, and explore the inter-relationships between them.
Prerequisite: BIO-307A minimum grade of C or BIO-307 minimum grade of C.

BIO-308. Interdisciplinary Research Skills II. 3 Hours.
In this second course of our research skills series we introduce a set of topics that are at the forefront of research in the natural sciences with emphasis on quantitative analysis and interpretation of research articles. The course is structured around a series of modules, each covering a topic in the fields of Biology and/or Mathematics. The modules, while complete in themselves, will also draw connections between scientific disciplines, and explore the inter-relationships between them. The modules will vary depending on the assigned faculty to teach this course.
Prerequisite: BIO-307A minimum grade of C or BIO-307 minimum grade of C.

BIO-310. Evolution. 3 Hours.
A reading/lecture/discussion course on the facts, theories and principles of organic evolution. Lecture only.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-311. History of Science. 3 Hours.
Development of the scientific method and knowledge of the natural sciences from ancient civilization to the present. Lecture only.

BIO-318. Human Anatomy and Physiology I. 4 Hours.
This is the first course in a two course series of human anatomy and physiology. It will provide a foundation of anatomical terms and explain structure-function relationships of tissues and organs. The course will focus on the anatomy and physiology of integumentary, skeletal, muscular and nervous systems. Interaction and regulation of various systems to maintain homeostasis will be studied. In the lab component, students will get hands-on experience with a human cadaver. They will examine and identify each system studied in class. Wherever possible, histology of tissues will be studied. Pathological conditions of each system will be discussed, including recent advances in treatment.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C.

BIO-319. Human Anatomy and Physiology II. 4 Hours.
This is the second course in a two course series of human anatomy and physiology. The course will focus on the anatomy and physiology of respiratory, circulatory, digestive, urinary, reproductive and endocrine systems. Interaction and regulation of these systems to maintain homeostasis will be studied. In the lab component, students will study human cadaver as well as anatomical models. Wherever possible, histology of tissues will be studied. Pathological conditions of each system will be discussed, including recent advances in treatment.
Prerequisites: BIO-318 minimum grade of C and BIO-301 minimum grade of C.

BIO-320. Animal Kingdom. 4 Hours.
Anatomy, physiology, classification and phylogeny of animals. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.
BIO-322. Invertebrate Zoology. 4 Hours.
Taxonomy and comparative morphology of the major phyla of invertebrates, organisms that comprise about 95% of animal life. Topics include life histories of representative species. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-323. Entomology. 4 Hours.
Insects, their identification, classification, habits and ecological relationships with special emphasis on those common to the Chicago area. Lecture, laboratory and fieldwork.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-324. Ornithology. 4 Hours.
Birds, their identification, classification, habits and ecological relationships with special emphasis on those common to the Chicago area. Lecture, laboratory and fieldwork.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-325. Local Fauna. 4 Hours.
Taxonomy and field identification characteristics of local animal groups with emphasis on collecting organisms in selected ecosystems in the region. Both major invertebrate and vertebrate taxa are surveyed; organisms collected in the field are studied in the laboratory. Student prepare a collection of labeled organisms. Lecture, laboratory and fieldwork.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-326. Animal Parasitology. 4 Hours.
Taxonomy, anatomy, physiology and significance of parasitic animals; host-parasite interactions; distribution of parasites throughout the world; examination of their life cycles, and prophylaxis and therapy of parasitic infections. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-327. Mammalian Anatomy. 4 Hours.
Gross architectural elements of the mammalian body, with emphasis upon correlation of form and function. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-328. Animal Behavior. 3 Hours.
Comparative ethology in the animal kingdom and its adaptive significance based upon the evolution of form and function of the nervous system, sense organs and effector organs. Topics include instinct, learning, intelligence, social organization and their physiological integrating mechanisms. Lecture only.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-330. Plant Anatomy And Morphology. 4 Hours.
Plants are a diverse and important group of organisms. In this course students compare the morphology and anatomy of vascular and nonvascular plants, use scientific method to answer a question about plants using microscopy and other anatomical or morphological techniques, and communicate results of their studies to classmates. The course includes instruction in plant identification techniques and in taxonomic methods. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-331. Plant Physiology. 4 Hours.
Physiochemical basis of plant life, emphasizing life processes of major significance to the seed plants. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C.

BIO-332. Local Flora. 4 Hours.
The study of local plant species, with emphasis on phylogenetic relationships, systematics, ecological relationships and economic or ethnobotanic uses. Focus will be on species that are flowering during the semester that the course is taught, usually summer or fall. Lecture, laboratory and field trips.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-333. Economic Botany. 3 Hours.
Plants of particular economic significance to humans as sources of food, fibers, flavoring agents, drugs and industrial chemical; horticultural plants; the role of economic plants in past and modern society. Lecture Only.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-334. General Mycology. 4 Hours.
The study of fungi, a distinct kingdom of unicellular and filamentous organisms. Fungi have tremendous ecological importance playing essential roles as decomposers as well as parasites and symbionts. Fungi also have significant economic importance in the food and beverage industries. This course covers all aspects of fungal biology, including laboratory culture, natural history, morphogenesis, genetics and physiology. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.
BIO-340. Molecular Biology. 4 Hours.
This course is designed for upper level undergraduates and builds on Genetics and Cell Biology. Molecular biology is rapidly advancing the fields of biomedical sciences and agricultural sciences. Understanding the chemistry of DNA, RNA and proteins has allowed scientists in biomedical and agricultural sciences the ability to manipulate these macromolecules to more fully understand cellular functions, treat human diseases and engineer more viable crops and live stock. This course is designed to provide students with a broad understanding of molecular biology as well as teach modern molecular biology techniques routinely used in research labs, forensics labs and hospital diagnostic labs. Lecture and Laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C and BIO-303 minimum grade of C.

BIO-341. General Microbiology. 4 Hours.
Study of the taxonomy and identification, ultrastructure and function, nutrition and growth, physiology, metabolism, molecular genetics, host-microbial interactions, immunology, ecology and biotechnology of microorganisms and viruses. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C.

BIO-342. Pathogenic Microbiology. 3 Hours.
Systematic study of the distinctive cellular and molecular properties of pathogenic microorganisms including bacteria, fungi, viruses and protozoans. Mechanisms of infection, diagnosis, treatment and control of these microorganisms. Lecture only.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-341 minimum grade of C.

BIO-343. Virology. 4 Hours.
The course is designed to give students a background of animal, plant and bacterial viruses with further emphasis on animal viruses. Topics covered will include but are not restricted to, replication strategies and life cycle, molecular mechanisms of infection, virus host interactions, viral evasion of body’s immune response and various pathological conditions. Laboratory exercises will include growth and isolation of virus, plaque assays, DNA cloning and expression of heterologous gene using a viral vector. Upon completion of the course, students will have a knowledge base useful towards medical or other health related careers. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-341 minimum grade of C.

BIO-344. Vertebrate Histology. 4 Hours.
This course will focus on the basic characteristics and identification of the primary vertebrate tissues, as well as their organization into organ systems. Where appropriate microanatomy will be integrated with organ functions. Examination of microscope slides, light micrographs, and electronmicrographs of tissues and organs will be used in the study of vertebrate histology. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C.

BIO-345. Emerging Infectious Diseases. 3 Hours.
Emerging infectious diseases are those that have not previously been seen and those that are re-emerging after having been controlled. This course will provide an introduction to significant emerging infectious diseases in humans. Through a combination of lecture, discussion, and in-class activities, this course will focus on factors that contribute to emerging infectious diseases, mechanisms of disease transmission, as well as analysis of specific diseases, their associated diagnosis and prevention.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-341 minimum grade of C.

BIO-346. Parasites And Human Health. 3 Hours.
In-depth study of the major helminth, protozoan, and arthropod parasites of humans. The course will compare these organisms to other human pathogens and provide insight into their unique historical and contemporary importance at the individual host, population, and global scales. Using a mathematical epidemiological approach, this course is designed to give students a hands-on experience with topics including transmission, pathology, immunology, and distributions of parasites within and among human hosts. The course will also provide students with a broad understanding of diagnosis, control, treatment, and prevention. Lecture. Prerequisites: BIO-150, BIO-201, BIO-202, BIO-305, MATH-187 OR MATH-275. BIO-326 recommended.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-305 minimum grade of C and (MATH-187 minimum grade of C or MATH-275 minimum grade of C).

BIO-350. Plant Ecology. 4 Hours.
An introduction to how the concepts of ecology have been developed for and applied to plant systems. This course is an extension of General Ecology and emphasizes not only the ways in which general principles have been applied to plants, but also concepts and methodology unique to plants. Lecture, laboratory and fieldwork.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-305 minimum grade of C.

BIO-351. Phycology. 4 Hours.
By studying the biology of algae, students will examine the complex ecological interactions of algae with their environments, the roles that algae have played in the evolution of life, and the increasing uses of algae in biotechnology. There will be several sampling trips to wetlands, lakes, and streams, including a Friday or Saturday field trip outside of Cook County. Students will design and conduct original research projects involving identification and study of algal taxa. The course fulfills the undergraduate requirement for a botany elective and can also be taken for graduate credit. Lecture, laboratory, and fieldwork.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.
BIO-352. Aquatic Biology. 4 Hours.
Students will study the biological processes that occur in freshwaters, the measurement of those processes, and the interaction of biological processes with water chemistry. Students will learn to collect quantitative ecological samples through field work in area lakes and rivers and they will analyze the biological organisms and related water chemistry of their samples upon return to the lab. Students will design and conduct original research projects. There will be several field trips, including a Friday or Saturday field trip outside of Cook County. Lecture, laboratory and fieldwork.
Prerequisites: CHEM-211 minimum grade of C and BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-356. Microbial Ecology. 3 Hours.
This course focuses on the essential roles played by Bacteria, Archaea, and Fungi in the world around us and within us, and is recommended for students interested in environmental science, ecology, or medicine. The course builds on fundamental biological and ecological principles; explores ways that microbial communities are similar to plant and animal communities, and ways in which they are unique; examines microbial drivers of major biogeochemical cycles and ecosystem services; characterizes relationships of microbes with other organisms; and considers the history of microbial interactions with humans, as antagonists (diseases), symbionts (microbiomes), and tools (food and biofuels). Lecture only.
Prerequisite: BIO-305 minimum grade of C.

BIO-357. Community Ecology. 3 Hours.
The course is designed for upper-level undergraduates and graduate students who are generally interested in ecology, conservation biology, and restoration ecology. Specifically, the course focuses on community ecology, an area of ecology that emphasizes how the interrelationships among several species within an area determine the structure and function of ecological communities within an ecosystem. The course explores the attributes that characterize communities as well as their organizing principles. In addition, the course covers approaches to their study and the implications they have on ecosystems. Throughout the course, examples from marine, terrestrial, and freshwater communities will be used to address the conceptual basis of the class. This class relies heavily on active discussion of primary literature (current and classic) as well as in-depth writing on selected topics.
Prerequisite: BIO-305 minimum grade of C.

BIO-358. Biological Geography. 3 Hours.
Geographic distribution of living organisms and the biological and geological principles underlying this distribution. Lecture only.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-305 minimum grade of C.

BIO-359. Ecological Methods. 4 Hours.
Field and laboratory methodology for the ecologist. Includes instruction on experimental design, quantitative sampling, data acquisition and interpretation as well as the preparation of project reports. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-305 minimum grade of C and MATH-275 minimum grade of C.

BIO-360. Vertebrate Physiology. 4 Hours.
Functions and interrelationships of organ systems. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C.

BIO-361. Human Genetics. 4 Hours.
This course is designed for upper level undergraduate and graduate students, builds on General Genetics, and emphasizes human medical genetics. Topics covered include but are not restricted to: known human genetic disorders; use of karyotyping, microsatellite analysis and sequencing in the diagnosis of genetic disorders; use of pedigrees, epidemiological and molecular studies in the identification of genetic contributions to multifactorial conditions and diseases. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-303 minimum grade of C.

BIO-362. Biochemistry. 4 Hours.
Chemistry and metabolism of carbohydrates, proteins, nucleic acids, lipids, vitamins and minerals associated with animal and plant life. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C and CHEM-231 minimum grade of C.

BIO-363. Immunology. 4 Hours.
The goals of the course are to study the role of cells and organs of immune system in health and disease. Topics covered will include but are not restricted to innate and adaptive immunity, molecular mechanisms of antibody diversity, major histocompatibility complex, complement system, immunodeficiency, allergies, immunology of cancer and organ transplantation. Recent developments in techniques and immunotherapies will also be discussed. The course will give the students theoretical and practical knowledge applicable to medical and other health related fields.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C.

BIO-364. Endocrinology. 4 Hours.
The study of hormones and other signaling molecules and their functions in growth control, maintaining homeostasis and reproduction. Lecture and laboratory.
Prerequisites: CHEM-231 minimum grade of C and BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-360 minimum grade of C.
BIO-365. Neurobiology. 4 Hours.
This course is designed for upper level undergraduate and graduate students. An in depth examination of nervous systems in vertebrates and invertebrates. Topics covered include but are not restricted to: excitable membrane physiology, synaptic mechanisms, and neuronal organization with emphasis on the integrative aspects of neural function. Lecture and laboratory. (Recommended one Physiology course - Bio 318, Bio 319, Bio 331 or Bio 360).
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C.

BIO-366. Cancer Biology. 3 Hours.
This course is designed for upper level undergraduate and graduate students and emphasizes the molecular and cellular basis of cancer. Topics covered include epidemiology of cancer, genetics of cancer, molecular mechanisms behind cancer, impact of viruses on human cancer development, and the biochemistry of cancer. Lecture only.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C and BIO-303 minimum grade of C.

BIO-367. Developmental Biology. 4 Hours.
This course is designed for upper level undergraduate and will build on concepts covered in introductory biology using skills and knowledge gained in Cell Biology and Physiology. We will look at patterns of normal and abnormal development in the embryo emphasizing development interactions between cells and systems and how these systems are disrupted during development leading to birth defects. The course is designed to give students the basic knowledge needed to go on into research or professional school. Lecture and laboratory.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-301 minimum grade of C and BIO-303 minimum grade of C.

BIO-368. Genomics and Proteomics. 3 Hours.
Genomics and Proteomics involves the use of high throughput methods and state of the art techniques, databases, and computations to generate, organize, explore, and analyze large data sets of DNA and/or protein sequence. This course will provide an introduction to the fields of genomics and proteomics. Through a combination of lecture, discussion, and hands on activities this course will focus on the methods and techniques used in gathering and interpreting genomic and proteomic data to answer questions important to various aspects of modern day biology.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-303 minimum grade of C.

BIO-372. Biochemistry Of Metabolism. 3 Hours.
Biochemistry of Metabolism is lecture-based course that focuses on the processing of carbohydrates, lipids, proteins, and nucleotides. This course will offer a mechanistic view of metabolic pathways related to each macromolecule group, including feedback control. Each section will be linked to clinical situations and will incorporate current primary research literature in the field of metabolism. Quantitative analysis of chemical reactions, bioenergetics, thermodynamics and interpretation of research articles will be incorporated as part of the lectures.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-303 minimum grade of C.

BIO-380D. Topics In Biology:Microbial Genetics. 3 Hours.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C and BIO-341 minimum grade of C.

BIO-380E. Topics In Biology: Introductory Bryology. 3 Hours.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-380H. Topics In Biology: Sensory Mechanisms. 3 Hours.
Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

BIO-381. Independent Study I. 1 Hour.
Library study of a biological topic, including a thorough literature search and production of a review paper on the chosen topic.

BIO-382. Independent Study II. 2 Hours.
(See BIO-381 for description and prerequisites.).

BIO-383. Independent Study III. 3 Hours.
(See BIO-381 for description and prerequisites.).

BIO-390. Biology Senior Seminar. 3 Hours.
This course is intended for students who are within two semesters of graduation. The goals of the course are to provide students with the opportunity to explore topics of particular interest to them, in greater depth than is usually possible within the context of topic specific courses and to assess whether students are able to integrate knowledge gained from different courses and/or disciplines. As part of the course, students will be required to take the MFAT. THIS COURSE FULFILLS THE CAPSTONE REQUIREMENT FOR THE BIOLOGY MAJOR.

BIO-391. Internship In Biology. 3 Hours.
Field or laboratory experience at an off-campus site guided by a faculty advisor, and a site supervisor. Requirements include; submission of a summary of the planned intern project and results, including a review of the relevant literature; presentation of the project in either podium format. Students are also required to take the MFAT. THIS COURSE FULFILLS THE CAPSTONE REQUIREMENT FOR THE BIOLOGY MAJOR.

BIO-392. Independent Research I. 2 Hours.
Field or laboratory study of a biological topic or question to be carried out over the course of 1-2 terms. Requirements include; design and execution of the research project; review of relevant scientific literature; production of a scientific style paper describing the project and results; presentation of the project in either podium or poster format. Students will also be required to take the MFAT. THIS COURSE FULFILLS THE CAPSTONE REQUIREMENT FOR THE BIOLOGY MAJOR.
BIO-393. Independent Research II. 2 Hours.
Field or laboratory study of a biological topic or question to be carried out over the course of 1-2 terms. Requirements include; design and execution of the research project; review of relevant scientific literature; production of a scientific style paper describing the project and results; presentation of the project in either podium or poster format. Students will also be required to take the MFAT. THIS COURSE FULFILLS THE CAPSTONE REQUIREMENT FOR THE BIOLOGY MAJOR.

BIO-394. Seminar In Teaching Of Biology. 3 Hours.
This course will provide students with the opportunity to gain practical experience with methods of post-secondary teaching in the biological sciences. Students will participate in preparation, presentation and grading of lecture, laboratory and assessment materials. Students are required to identify a faculty mentor to advise and guide the teaching experience no later than the term before he/she registers for the course. As part of the course, students will be required to take the MFAT. THIS COURSE FULFILLS THE CAPSTONE REQUIREMENT FOR THE BIOLOGY MAJOR.

BIO-405. Biological Literature. 3 Hours.
Overview of scientific communication in biology with the focus on the researching, critiquing, and synthesizing of primary scientific literature. Other activities may include, but are not limited to writing grant proposals, presenting research, creating scientific posters, participating in peer review, and engaging in professional development to help further students' careers in biology.

BIO-408. Environmental Biology for Middle School Teaching. 4 Hours.

BIO-411. Spreadsheet Modeling In Ecology & Evolution. 3 Hours.
Use of basic and advanced spreadsheet applications to model a wide variety of ecological and evolutionary processes and systems. Extensive use of graphing capabilities, complex nested functions, and advanced software functions including writing macros, sampling from statistical distributions, using lookup tables, etc. Students will complete independent projects in which they generate their own models using data from the literature and present their results both orally and in writing. Extensive work outside of the classroom will be required.

Prerequisite: BIO-305 minimum grade of C.

BIO-412. Chronobiology. 3 Hours.
Most living organisms display oscillations in many biological, physiological, and behavioral processes. These oscillations confer adaptive advantages for survival on a planet that revolves on its axis once every 24 hours. Chronobiology is the study of these adaptations. Through a combination of group activities, discussion, and lecture this course focuses on the physiologic and genetic generation of 24 hour rhythms, as well as the behavioral and physiological processes that they control in various species.

BIO-413. Evolutionary Biology. 3 Hours.
Comprehensive analysis of evolutionary patterns in both fossil and contemporary species. Studies include an overview of the history of evolutionary biology, Hardy-Weinberg equilibrium assumptions about non-evolving systems, Darwinian and non-Darwinian mechanisms of evolutionary change, the Biological Species Concept and alternative species definitions, pre-zygotic and post-zygotic mechanisms of speciation, and current views on the origin and natural history of life on Earth.

Prerequisite: BIO-202 minimum grade of C.

BIO-414. Comparative Biology Of Aging. 3 Hours.
Comparative analysis of aging, longevity, and mortality patterns in diverse prokaryotic and eukaryotic species. Studies include an overview of the history of biological gerontology, life-table construction and analysis, populational and physiological measurements of senescence, theoretical models of aging and longevity, use of vital statistics mortality data, biochemistry of free-radicals and antioxidant molecules, and therapeutic intervention to prolong lifespan in various species.

Prerequisite: BIO-301 minimum grade of C.

BIO-415. Animal Behavior. 3 Hours.
Advanced study and analysis of selected topics within the field of Animal Behavior with emphasis on topics that are currently at the forefront of the discipline. Depending on the term, the course may emphasize studies of animal behavior within an ecological, evolutionary and/or neuroethological context.

Prerequisite: BIO-360 minimum grade of C.

BIO-421. Biochemical Genetics. 3 Hours.
Explores the biochemistry of the genetic material and the cell's ability to replicate, transcribe and translate genetic information. Recent discoveries in gene manipulation are discussed. Lecture and discussion.

Prerequisite: BIO-303 minimum grade of C or BIOL-380 minimum grade of C.

BIO-424. Analysis Of Development. 3 Hours.
Analysis of mechanisms underlying developmental processes in the embryo and adult organisms with special emphasis on the role of the genes in development. Lecture only.

Prerequisite: BIO-303 minimum grade of C.

BIO-425. Animal Models of Human Disease. 3 Hours.
Because of the ethical and logistical challenges of studying disease using human subjects, biologists use model organisms and model systems to understand the underlying mechanisms responsible for diseases, and to identify potential treatments and cures. Through lecture, literature research, and discussion this course will examine examples of how animal models are being used in biomedical research. Systems covered include mammalian species, non-mammalian vertebrate species, and invertebrate species. Course may be repeated for credit with permission from the Graduate Advisor.
BIO-427. Current Topics In Genetics. 3 Hours.
Advanced study and analysis of selected topics within the field of Genetics, with emphasis on topics that are at the forefront of advances in the discipline. Course may be repeated for credit one time with permission from the Graduate Advisor.
Prerequisite: BIO-303 minimum grade of C.

BIO-428. Current Topics In Human Genetics. 3 Hours.
Advanced study and analysis of selected topics within the field of Human Genetics, with emphasis on topics, such as the Human Genome and HapMap projects, epistasis, etc., that are at the forefront of advances in our understanding of human heredity, development and disease.
Prerequisite: BIO-303 minimum grade of C.

BIO-441. Biology Of Viruses. 3 Hours.
The structure and replication of viruses, strategies of host defense and viral evasion, and use of viruses in biotechnology. RNA- as well as DNA-viruses will be included. Current research papers will be discussed to make students aware of advances being made in the field.

BIO-447. Current Topics In Cell Biology. 3 Hours.
Advanced study and analysis of selected topics within the field of Cell Biology, with emphasis on topics that are at the forefront of advances in the discipline. Course may be repeated for credit one time with permission from the Graduate Advisor.
Prerequisites: BIO-301 minimum grade of C and BIO-303 minimum grade of C.

BIO-450. Foundations Of Ecology. 3 Hours.
Readings and discussions of foundational papers in ecology, and classic case studies of field and laboratory experiments in ecology. Overviews of the development of ecology as a science, major debates in ecology, and the development of both theory and methodologies in ecology will be presented. Students will also present and discuss contemporary papers in light of these historical contexts.
Prerequisite: BIO-305 minimum grade of C.

BIO-451. Biological Diversity. 3 Hours.
The course covers contemporary and historical patterns of biodiversity, current hypotheses for local, regional and global diversity trends, diversity case studies from plant and animal communities in aquatic and terrestrial systems. Lecture and discussion.
Prerequisite: BIO-305 minimum grade of C.

BIO-452. Quaternary Ecology. 4 Hours.
Introduction to the principles and techniques of paleoecology with emphasis on the effects of global and regional climate/environmental change on ecosystems, communities, and populations during the Quaternary Period. Lecture and laboratory.
Prerequisite: BIO-305 minimum grade of C or ESCI-312 minimum grade of C.

BIO-453. Conservation Biology. 3 Hours.
This course will explore how ecological theory (including mathematical models), principles, and methodologies are applied to the conservation of populations, species, communities, and landscapes. Covered topics include biodiversity, the demographic and genetic structure of populations, population viability analysis, the problems that small populations face, extinction as a historical and contemporary process, current tools applied in conservation (e.g., GIS, molecular tools), and the application of ecological principles nature reserve design and ecosystem management. Students will read extensively from the primary literature, lead class discussions, and solve applied and quantitative problems.
Prerequisite: BIO-305 minimum grade of C.

BIO-454. Conservation Genetics. 3 Hours.
Advanced study of genetic theory and practice applied to the conservation of organisms. Current primary literature will be incorporated into the course through written assignments and discussions. Current conservation genetic techniques and computer-based data analysis methods will be practiced in the laboratory.
Prerequisites: BIO-303 minimum grade of C and BIO-305 minimum grade of C.

BIO-455. Restoration Ecology. 3 Hours.
Application of ecological research and concepts to restoration of disturbed ecosystems. Current trends and challenges in restoring populations, communities and ecosystems.
Prerequisite: BIO-305 minimum grade of C.

BIO-456. Bio-Environmental Analysis. 3 Hours.
Individual and group field projects providing experience in techniques appropriate to the analysis of natural communities and their environmental components. Studies include contrasts between selected natural areas and similar ones altered by humans. A summary interpretive paper, using data acquired, is required from each student. Lecture, laboratory, and fieldwork.

BIO-457. Current Topics In Ecology & Evolution. 3 Hours.
This course provides graduate students with an opportunity to explore a current topic in ecology and evolutionary biology from a variety of perspectives and scales, ranging from theory to molecular biology to community ecology. Each semester will be organized around a single book or edited volume. Students will read, present, and lead discussions on chapters from the selected book, along with related papers chosen from the recent primary literature. Students may take the course twice for credit, as long as the focal topic of the course is different.
Prerequisites: BIO-301 minimum grade of C and BIO-303 minimum grade of C and BIO-305 minimum grade of C.
BIO-462. Enzymology. 3 Hours.
The course covers enzymes as protein catalysts. The structure of a biological catalyst as discerned by x-ray diffraction, chemical modification, nuclear magnetic resonance, and kinetic studies is analyzed and related to function. Lecture, demonstration, discussion, and laboratory.
Prerequisite: BIO-362 minimum grade of C.

BIO-463. Plant Biochemistry. 3 Hours.
The course focuses on metabolic pathways of particular importance to plants, such as photosynthesis, the dissemination of starch, nitrogen fixation, and the formation of certain secondary products. Also covered are metabolic pathways common to plants and other groups of organisms and phytohormonal control. Lecture only.
Prerequisite: BIO-362 minimum grade of C.

BIO-464. Biochemistry And Molecular Biology Methods. 4 Hours.
A graduate level lecture and lab course that provides training in essential experimental methods used in modern Biochemistry and Molecular Biology, including computer analysis tools, while reviewing basic structure and function of biological molecules.
Prerequisite: BIO-362 minimum grade of C or BIO-340 minimum grade of C.

BIO-470A. Seminars In Biology. 1 Hour.

BIO-471. Comparative Animal Physiology. 3 Hours.
Physiological and biochemical evolution of animals with emphasis on the range and variety of physiological mechanisms and processes involved in adaptations to special habits and habitats. Lecture and laboratory.
Prerequisite: BIO-360 minimum grade of C.

BIO-475. Advanced Immunology. 3 Hours.
Contemporary issues in immunology, related to diversity in immune response. Lecture and discussion of current papers on inheritance of immune response, tolerance, cancer immunology and immunotherapy. Lecture and discussion.
Prerequisite: BIO-301 minimum grade of C.

BIO-4721. Independent Investigations. 1 Hour.
Field or laboratory study of a biological topic or question, to be carried out over the course of 1-2 terms. Requirements include two or more of the following: design and execution of the research project; review of relevant scientific literature; production of a scientific style paper describing the project and results; presentation of the project in either podium or poster format. No more than 3 credits of BIO-482 can be applied to the requirements for the Biology MS.
Prerequisite: BIO-405 minimum grade of C.

BIO-4722. Independent Investigations. 2 Hours.
See course description for BIO-4821.
Prerequisite: BIO-405 minimum grade of C.

BIO-4823. Independent Investigations. 3 Hours.
See course description for BIO-4821.
Prerequisite: BIO-405 minimum grade of C.

BIO-485L. Advance Topics In Biology: Applied & Environmental Microbiology. 3 Hours.

BIO-491. Seminars In Biology. 1 Hour.
Students select a specific topic of interest to them. They research the topic and give an oral presentation on the topic to a peer group. Time commitment is approximately 2 hrs per week.
Requirement: Departmental approval.

BIO-4994. Research Thesis. 4 Hours.
Guidance of students conducting research and writing a thesis to fulfill requirements for the Master of Science degree in Biology, Option II. Students may register for 1-4 credits per term with a 6 credits required for Option I of the Biology M.S. All BIO-499 credits must be earned within the equivalent of 2 academic years.
Prerequisite: BIO-405 minimum grade of C.

BIO-5901. Library Thesis Hours. 1 Hour.
Guidance of students conducting literature/library research and writing a Thesis to fulfill requirements for the Master of Science degree in Biology, Option II. Students may register for 1-3 credits per term with a minimum of 4 credits required for Option II of the Biology M.S. All BIO-590 credits must be earned within the equivalent of 2 academic years.
Prerequisite: BIO-405 minimum grade of C.

BIO-5902. Library Thesis Hours. 2 Hours.
See course description for BIO-5901.
Prerequisite: BIO-405 minimum grade of C.

BIO-5903. Library Thesis Hours. 3 Hours.
See course description for BIO-5901.
Prerequisite: BIO-405 minimum grade of C.
BIO-5991. Research Thesis Hours. 1 Hour.
Guidance of students conducting research and writing a thesis to fulfill requirements for the Master of Science degree in Biology, Option II. Students may register for 1-4 credits per term with a 6 credits required for Option I of the Biology M.S. All BIO-599 credits must be earned within the equivalent of 2 academic years.
Prerequisite: BIO-405 minimum grade of C.

BIO-5992. Research Thesis Hours. 2 Hours.
See course description for BIO-5991.
Prerequisite: BIO-405 minimum grade of C.

BIO-5993. Research Thesis Hours. 3 Hours.
See course description for BIO-5991.
Prerequisite: BIO-405 minimum grade of C.