

Biology

The Department of Biology offers courses of study leading to the degrees of Bachelor of Science (B.S.) and Master of Science (M.S.). Students may also obtain a Minor in Biology or a Minor in Biomathematics. Apply to NEIU!

The Bachelor of Science in biology (<https://www.neiu.edu/academics/college-of-arts-and-sciences/departments/biology/bachelor-of-science-biology-degree/>) is designed to prepare students for:

1. Master's Degree or Ph.D. programs in biology, including biomedical sciences, genetics, molecular biology, and ecology;
2. health professional degree programs, including in medicine, dentistry, optometry, nursing, pharmacy, physical therapy, and veterinary medicine;
3. Master of Arts in Teaching programs to obtain licensure to teach biology to high school students; or
4. career opportunities in research, biomedical sciences, agriculture, industry, government, and academic institutions.

The graduate program leading to the Master of Science degree meets 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 or to degree programs in health professions.

Our advisors are available to speak with you.

- Undergraduate students: we offer daily advising. Gain advice about recommended elective courses appropriate for your particular career goals and about requirements for graduation. Please email BiologyAdvising@neiu.edu to obtain the advising schedule.
- Graduate students: please contact Dr. Michael Stern, m-stern2@neiu.edu, for questions about admission to the M.S. degree program in Biology or about graduate program requirements.
- Interested in pursuing professional training in medicine, dentistry, pharmacy, optometry, physical therapy, or other health-related professions? Meet with the Director of Pre-Professional Advising, David Nissim-Sabat (d-nissimsabat@neiu.edu) for guidance on recommended courses and the application process.
- At the Student Center for Science Engagement, you may gain additional advice about careers, graduate studies, internships, and research opportunities. Visit them in BBH-235 or contact scse@neiu.edu.
- For information about earning a license to teach biology at the high-school level, contact Vanessa King, v-king@neiu.edu, Student Support Specialist in the Goodwin College of Education.

Follow us on Facebook (<https://www.facebook.com/NEIUBiology/>), Instagram (<https://www.instagram.com/neiubiology/>), and Twitter (<https://twitter.com/NEIUBiology/>). Our handle is @NEIUBiology.

Northeastern's Bachelor in Biology (<https://www.neiu.edu/academics/college-of-arts-and-sciences/departments/biology/bachelor-of-science-biology-degree/>) prepares you for careers in medicine and healthcare, environmental restoration and conservation, lab and research settings, and much more. You'll observe and conduct experiments, and learn skills on data gathering, analysis and reporting.

Would you like more information about our major or minors? Biology advisors are happy to help! Please email BiologyAdvising@neiu.edu to arrange an advising appointment.

- Major in Biology (<http://catalog.neiu.edu/arts-sciences/biology/biology/>)
- Minor in Biology (<http://catalog.neiu.edu/arts-sciences/biology/minor-biology/>)
- Minor in Biomathematics (<http://catalog.neiu.edu/arts-sciences/biology/minor-biomathematics/>)

New: The Major in Biology (<http://catalog.neiu.edu/arts-sciences/biology/biology/>) now offers an Accelerated Teaching Track, for students planning a career in high school teaching. The Accelerated Teaching Track allows twelve credit hours to apply toward both the Bachelor of Science in Biology degree and the Master of Arts in Teaching- Secondary Education degree (<https://www.neiu.edu/academics/daniel-l-goodwin-college-of-education/departments/educational-inquiry-curriculum-studies/master-of-arts-teaching-secondary-education/>). This provides a pathway for qualified students to move seamlessly from the B.S. in Biology to the M.A.T. in Secondary Education graduate program, and to obtain teacher licensure in a shorter time period. Students interested in pursuing this option should meet with an academic advisor early in the B.S. program to maximize the benefits and to determine eligibility to apply. Contact Dr. Jennifer Slate, Biology Department Chair at jeslate@neiu.edu for more information.

Interested in the graduate program in biology? Our graduates achieve careers in health sciences, genetics, microbiology, biotechnology, ecology, and other biological disciplines. They are employed in industry, in governmental and non-profit organizations, and in teaching. Many continue on to medical, veterinary, or other health professional programs or pursue a Ph.D. Take this next step in advancing your career potential today!

Click below for more information and contact the Biology Graduate Program Advisor, Dr. Michael Stern at m-stern2@neiu.edu or at BioGradPrograms@neiu.edu (biogradprograms@neiu.edu).

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

Please visit the biology faculty & staff (<https://www.neiu.edu/academics/college-of-arts-and-sciences/departments/biology/faculty-and-staff/>) page to learn about our teaching and research interests.

Jennifer Slate, Professor and **Biology Department Chair**
Elyse Bolterstein, Associate Professor
Tom Campbell, Senior Instructor
Jorge Cantú, Associate Professor and **Director of Student Center for Science Engagement**
Steve Frankel, Senior Instructor
Pamela Geddes, Professor and **Biology Department Co-Associate Chair**
Nawaf A. Habib, Senior Instructor
John M. Kasmer, Associate Professor and **Environmental Science Program coordinator**
Gretchen E. Lyons, Senior Instructor
Shubhangee M. Mungre, Professor
Angela C. Nugent, Instructor
Kara Nuss, Senior Instructor
Corey Palmer, Instructor
Cheryl Park, Senior Instructor
Frederick R. Prete, Senior Instructor
Joel Olfelt, Professor
Marijo Readey, Senior Instructor
Beth A. Reinke, Associate Professor
Kayla Rihani, Senior Instructor
Emily Rumschlag-Booms, Associate Professor
Aaron Schirmer, Professor and **Biology Department Co-Associate Chair**
Emina Stojkovič, Professor
Michael Stern, Professor and **Biology Graduate Program Advisor**
John N. Thomas, Associate Professor
Cindy Voisine, Professor
Israel Contreras Avila, Administrative Aide
Kip Conwell, Laboratory Manager
Sara Crow, Natural Sciences Technical Assistant

ADVISING HELP: *Need guidance on which courses to choose, help with registration, or information on graduation requirements?* Undergraduate students should email BiographyAdvising@neiu.edu and graduate students should email BioGradPrograms@neiu.edu (biogradprograms@neiu.edu) to make an appointment with an advisor.

BIO-100. Introduction To Biology. 3 Hours.

This course addresses the structures and functions of living things with emphasis on human physiology and the propagation of life, covering major biological concepts and principles. Topics include functions of cell components, how organisms obtain and process energy, genetics and inheritance, and evolution. Laboratory exercises emphasize scientific methods, hypothesis testing and data interpretation, and include required dissection. Lecture and laboratory. (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-109A. First Year Experience: Exotic Species In Chicago. 3 Hours.

Global trade and travel spreads microbes, plants and animals across great distances and over previously insurmountable barriers. 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, review examples of how ecological principles are being applied to control them, and examine the ecological and economic impacts. 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 to see Chicago from the perspective of urban ecologists. Lecture, laboratory, and field trips.

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.

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 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300) 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 (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-201. General Biology I. 4 Hours.

The first course of the general biology series focuses on the cell and molecular 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 methods, hypothesis testing, data interpretation, and writing. These exercises include experience with basic techniques such as microscopy, biological assays, and gel electrophoresis. Lecture and laboratory. Can be taken concurrently with BIO-250.

BIO-202. General Biology II. 4 Hours.

In this second course of the general 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 methods, hypothesis testing, data interpretation, and writing. These exercises include surveys of major groups of organisms and dissections. Lecture and laboratory. Can be taken concurrently with BIO-250.

BIO-250. Essential Skills For Biologists. 2 Hours.

Students will gain proficiency with basic biological skills that will be further developed in upper-division biology courses. These skills include hypothesis development, experimental design and execution, analyzing and presenting data, scientific record-keeping, communication and library research skills, methods and units of scientific measurement, and lab safety. Can be taken concurrently with BIO-201 or BIO-202.

BIO-300A. Foods And Drugs: Biology And Society. 3 Hours.

This course explores the biological effects of food and drugs. Topics include, but are not limited to, the structures, types, and metabolism of various macronutrients (carbohydrates, fats, proteins) and legal and illegal substances (opioids, alcohol, cannabinoids). The course also covers relevant aspects of human physiology; the role of foods and drugs in causing, treating, and preventing disease; and critiques of current and historical views on food and drugs. Although it doesn't count as an elective toward the biology major or minor, this course fulfills the boundary crossing (ELE-X) requirement for graduation.

BIO-301. Cell Biology. 4 Hours.

Basic molecular and cellular processes. Structures of biomolecules. Energetics: enzymes, photosynthesis, respiration. Genetic control: chromatin, DNA replication, RNA transcription and regulation, protein synthesis. Cell functions, including: protein secretion; cell membrane structure; transport and surface interactions; cell cycle; cell motility; cell growth; cell origins. Lecture and laboratory.

Prerequisite: BIO-201 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C) and CHEM-211 with a minimum grade of C.

BIO-302. Design In Nature. 3 Hours.

Design in Nature will explore the ways evolution has led to various structures, behaviors, and body forms and will use these same processes to develop bio-inspired creative works. Special emphasis will be placed on a biological perspective and how this can inform the design process. The course introduces topics in a workshop format, where students will work individually and in teams in both the field and in a studio environment to explore ideas and develop creative works. Although it doesn't count as an elective toward the biology major or minor, this course fulfills the boundary crossing (ELE-X) requirement for graduation.

Prerequisite: (100 - 399 or 100A - 399Z).

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 phage/viral genetics, the chromosomal and molecular basis of heredity, and population genetics. Lecture and laboratory.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C).

BIO-305. Writing Intensive Program:General Ecology. 4 Hours.

In an introduction to the basic concepts of ecology, students will examine the factors and interactions that determine the distribution and abundance of species at the individual, population, community, and ecosystem levels. Students will satisfy the writing intensive requirement by developing persuasive arguments supported by data, writing a primary research paper, creating graphs to present experimental results, and keeping a field and laboratory notebook. Lecture, laboratory, and fieldwork, with up to two field trips scheduled on a Friday, Saturday, or Sunday.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C) and ENGL-102 with a minimum grade of C.

BIO-306. Botany Of Desire. 3 Hours.

Humans desire plant products like sugar, drugs, soothing aromas, and oxygen. Satisfying these needs can provide food, oppress peoples, or create healing environments. Students will develop a working knowledge of plants by studying them from seed to flower, growing them in the greenhouse or in gardens, and designing ways of using plants to meet community needs. Culturally relevant examples of how plants and humans have changed each other will show how plants have revolutionized life on Earth. Although it doesn't count as an elective toward the biology major or minor, this course fulfills the boundary crossing (ELE-X) requirement for graduation.

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.

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 with a minimum grade of C.

BIO-310. Evolution. 3 Hours.

This course will examine the evolutionary history of life on Earth, and the mechanisms (both Darwinian and non-Darwinian) that lead to evolutionary change. Students will interpret diagrams showing evolutionary relationships and will use modeling techniques and statistical analyses to investigate changes in populations over generations. The study of evolution is relevant to students interested in many areas of science, including medicine and human health, genetics, biological anthropology, paleontology, ecology, biogeography, animal behavior, environmental science, and conservation.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C.

BIO-311. History of Science. 3 Hours.

This course will outline development of the scientific method and knowledge of the natural sciences from ancient civilization to the present. Students will examine the great diversity of cultural contributions, from many different parts of the world, to the historical development of modern science. Particular attention will be paid to the disciplines of astronomy, biology, chemistry, mathematics, philosophy, and physics. The prerequisite requirement for this course is a minimum of eight credits at the 200-level or above in STEM.

Prerequisite: BIO-201 with a minimum grade of C and (BIO-202 with a minimum grade of C or CHEM-211 with a minimum grade of C or ESCI-211 with a minimum grade of C or MATH-275 with a minimum grade of C or PHYS-201L with a minimum grade of C or PHYS-206L with a minimum grade of C).

BIO-315. Communicating Science. 3 Hours.

Students will explore the basics of communicating science to non-scientists, scientists, and interested stakeholders. Through discussions, group work, and individual assignments, students will practice techniques associated with writing, presenting, and sharing biology and biological results. The assignments consist of formal and informal writing, presentations, and graphical design products. The prerequisite requirement for this course is a minimum of eight credits at the 200-level or above in STEM. This class is also offered at the 400-level for graduate credit.

Prerequisite: (BIO-201 with a minimum grade of C or CHEM-211 with a minimum grade of C or PHYS-201L with a minimum grade of C or PHYS-206L with a minimum grade of C) and (BIO-202 with a minimum grade of C or CHEM-212 with a minimum grade of C or PHYS-202L with a minimum grade of C or PHYS-207L with a minimum grade of C or ESCI-211 with a minimum grade of C).

BIO-318. Human Anatomy And Physiology I. 4 Hours.

In the first of a two-course series in human anatomy and physiology, students examine the integumentary, skeletal, muscular, and nervous systems. Interrelationships between structures and functions at the macroscopic and microscopic levels of organization are covered. In the laboratory component, students examine and identify each system through cadavers, models, slides, and physiology-based experiments. Medical terminology is covered and the pathological conditions of each system are discussed, including recent advances in treatment. Lecture and laboratory.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C.

BIO-319. Human Anatomy And Physiology II. 4 Hours.

In the second of a two-course series in human anatomy and physiology, students examine the cardiovascular, respiratory, digestive, urinary, and genital systems. Interrelationships between structures and functions at the macroscopic and microscopic levels of organization are covered. In the laboratory component, students examine and identify each system through cadavers, models, slides, and physiology-based experiments. Medical terminology is covered and the pathological conditions of each system are discussed, including recent advances in treatment. Lecture and laboratory.

Prerequisite: BIO-301 with a minimum grade of C and BIO-318 with a minimum grade of C.

BIO-320. Animal Kingdom. 4 Hours.

The animal kingdom will be explored through the anatomy, physiology, and developmental histories of the major animal clades. Students will examine the ecological significance of select clades and the niches and adaptations found among the major animal phyla. Our dynamic understanding of the relationships between the branches of the animal kingdom will be investigated through both cladistics and the traditional Linnaean approach. Lecture and laboratory.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C).

BIO-322. Invertebrate Zoology. 4 Hours.

This course surveys the diversity of invertebrates, which are the vast majority of animal life. Students will examine the development, physiology, reproduction, and evolutionary relationships among the invertebrate animals and our evolving understanding of invertebrate anatomy and physiology. The class will investigate the diverse biomechanical adaptations of animal life and use select phyla to explore their potential for biomimetic applications in medicine, industry, and design. Lecture and laboratory.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C).

BIO-323. Entomology. 4 Hours.

Insects, their identification, classification, habits and ecological relationships are examined, with special emphasis on insects common to the Chicago area. Materials are introduced for a foundation in forensic, medical, agricultural, and environmental entomology. It includes an exploration of insects as disease vectors, the mechanisms of insect control, and integrated pest management. Lecture, laboratory, and fieldwork.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C).

BIO-324. Ornithology. 4 Hours.

Ornithology is the study of birds, one of the most spectacular, successful, and best-studied animal groups. This course will survey the evolution, physiology, ecology, and behavior of birds. Labs will include field trips to watch and identify birds in their natural habitats and dissections to better understand their physiology and functional morphology. Lecture, laboratory, and fieldwork.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C).

BIO-325. Local Fauna. 4 Hours.

This course provides a survey of local animal groups in various ecosystems in the region, with an emphasis on field identification of vertebrate taxa. Class will regularly meet off-campus, and may have up to two field trips scheduled on a Friday, Saturday, or Sunday. Lecture, laboratory, and fieldwork. In addition to stated prerequisites, General Ecology (BIO-305) is recommended.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C).

BIO-326. Animal Parasitology. 4 Hours.

Taxonomy, anatomy, physiology and significance of parasitic and parasitoid organisms and their hosts are explored. The course examines host-parasite interactions, distribution of parasites across ecosystems, and effects of their presence and life cycles and on the surrounding environment. The class also explores the diversity of human parasitic infections, their impact on the economy, and our changing understanding of what constitutes a "parasite." Lecture and laboratory.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a 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.

Prerequisite: BIO-150 with a minimum grade of C and BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C.

BIO-328. Animal Behavior. 3 Hours.

Comparative ethology with an emphasis on understanding the impact of adaptation, evolutionary history, anatomy, physiology, and developmental processes on the behaviors of animals. Topics include learning, intelligence and emotional impacts, social organization, and physiological integrating mechanisms.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a 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.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a 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.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C.

BIO-332. Local Flora. 4 Hours.

This course provides a study of local plant species and ecosystems, with emphasis on phylogenetic relationships, systematics, and ecological relationships. Also included will be the geological processes and history that have shaped the region. Focus will be on species that are flowering during the semester that the course is taught, usually summer. Lecture, laboratory, and field trips.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a 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 chemicals are examined. Areas of emphasis will be on how the biology/chemistry of the plant determines its use to humans, plant domestication and use from cultures world-wide, and how plants have shaped human societies.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C.

BIO-334. Biology Of Fungi. 4 Hours.

Fungi, a distinct kingdom of unicellular and filamentous organisms, have tremendous importance to medicine and to the environment. Drugs from antibiotics to immunosuppressants are produced by fungi. Fungi play essential roles as decomposers as well as parasites and symbionts. Fungi also have significant economic importance in the food and beverage industries. In this subdiscipline of microbiology, students will examine all aspects of fungal biology, including laboratory culture, natural history, morphogenesis, genetics and physiology, and health applications. Lecture and laboratory.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C).

BIO-340. Molecular Biology. 4 Hours.

This course is designed for upper-level undergraduates and builds on Cell Biology and General Genetics. Molecular biology is rapidly advancing the fields of biomedical and agricultural sciences. Understanding the chemistry of DNA, RNA and proteins has allowed scientists to manipulate these macromolecules to more fully understand cellular functions, treat human diseases and engineer more viable crops and livestock. The course will 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.

Prerequisite: BIO-202 with a minimum grade of C and (BIO-301 with a minimum grade of C or BIO-303 with a minimum grade of C) and CHEM-211 with a minimum grade of C.

BIO-341. General Microbiology. 4 Hours.

Students examine the diversity of microorganisms and viruses and their impacts on health and the environment. Topics include taxonomy and identification, ultrastructure and function, nutrition and growth, physiology, metabolism, molecular genetics, host-microbial interactions, immunology, ecology, and biotechnology. Laboratory safety and techniques related to the isolation, staining, identification, morphology and growth characterization, and control of microorganisms are practiced. Lecture and laboratory.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C.

BIO-342. Pathogenic Microbiology. 3 Hours.

Students examine the distinctive cellular and molecular properties that make some microorganisms pathogenic in humans, including their mechanisms of infection, how they replicate, the diseases they cause, how they are diagnosed, as well as treatment and control options.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and BIO-341 with a 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, plaques assays, DNA cloning and expression of heterologous genes 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.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a 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.

Prerequisite: BIO-150 with a minimum grade of C and BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and BIO-301 with a 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.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and BIO-341 with a 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.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and BIO-305 with a minimum grade of C and (MATH-187 with a minimum grade of C or MATH-275 with a 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.

Prerequisite: BIO-150 with a minimum grade of C and BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and BIO-305 with a minimum grade of C.

BIO-351. Biology Of Algae. 4 Hours.

In this subdiscipline of microbiology, students will examine a diverse group of photosynthetic organisms with emerging biotechnological potential. The evolution, physiology, and ecology of algae provide the basis for advances in medicine, food production, and environmental protection. In field trips to wetlands, lakes, and rivers, students will investigate local environmental problems and their solutions. Students will design and conduct original research projects involving identification and study of algal taxa. The course qualifies as a botany elective for undergraduate students. It is also offered at the 400-level for graduate credit. Lecture, laboratory, and fieldwork.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C).

BIO-352. Aquatic Biology. 4 Hours.

Aquatic organisms have complex behaviors and interactions with their environment. Animals, plants, and microbes also serve as biological indicators of water quality. Course topics include physiology, energy flow, nutrient cycling, ecology, and restoration and management of aquatic resources. Students will apply what they learn to understand the impact of water resources to health and society. In hands-on field and laboratory exercises, students will sample aquatic systems, measure important limnological variables, and interpret data. There will be several field trips to local lakes, rivers, and wetlands, and students will design and conduct original research projects. Lecture, laboratory, and fieldwork.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and (BIO-250 with a minimum grade of C or BIO-150 with a minimum grade of C) and CHEM-211 with a minimum grade of C.

BIO-356. Microbial Ecology. 3 Hours.

Recommended for students interested in medicine or the environment, this course focuses on the essential roles played by Bacteria, Archaea, and Fungi in the world around us and within us. 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).

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C.

BIO-357. Community Ecology. 3 Hours.

This course applies our understanding of ecological communities and their organizing principles to conservation biology and the restoration of degraded ecosystems. Examples from marine, terrestrial, and freshwater communities will be addressed through active discussion of the primary literature. This course may be taken for graduate credit.

Prerequisite: BIO-305 with a minimum grade of C.

BIO-358. Biogeography. 3 Hours.

This course covers the geographic distribution of living organisms and the biological principles underlying this distribution, including the evolutionary patterns of dispersal in both fossil and contemporary species. Biogeography has important implications toward understanding conservation management, economic production, and public health. Discussions and papers will include an overview of the history of biogeography through current techniques and theories. This class is also offered at the 400-level for graduate credit.

Prerequisite: BIO-202 with a 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.

Prerequisite: BIO-150 with a minimum grade of C and BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and BIO-305 with a minimum grade of C and MATH-275 with a minimum grade of C.

BIO-360. Vertebrate Physiology. 4 Hours.

Functions and interrelationships of organ systems. Lecture and laboratory.

Prerequisite: BIO-150 with a minimum grade of C and BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C.

BIO-361. Human Genetics. 4 Hours.

This course 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. This class is also offered at the 400-level for graduate credit. Lecture and laboratory.

Prerequisite: BIO-303 with a minimum grade of C.

BIO-362. Biochemistry. 4 Hours.

Biochemistry examines the chemistry that underlies the biological processes common to all living organisms. The course will explore the chemical nature of the four major biological molecules and the processes that drive their activities. Topics include the structures of proteins, nucleic acids, carbohydrates, and lipids, and processes that include thermodynamics, acid-base reactions, catalysis, and energetics. This class is also offered at the 400-level for graduate credit. Lecture and laboratory.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C and CHEM-231 with a minimum grade of C.

BIO-363. Immunology. 4 Hours.

Students will examine the role of cells and organs of the 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. This class is also offered at the 400-level for graduate credit. Lecture and laboratory.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C.

BIO-364. Endocrinology. 4 Hours.

Hormones play a huge role in daily function and in health. Endocrinology focuses on the study of hormones and other signaling molecules and their functions in growth and reproduction, mood control, and metabolism. Human and animal examples will be discussed, making the course relevant to students interested in careers in healthcare, veterinary science, and conservation fields. This class is also offered at the 400-level for graduate credit. Lecture and laboratory.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C and CHEM-231 with a minimum grade of C.

BIO-365. Neurobiology. 4 Hours.

This course provides 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. This class is also offered at the 400-level for graduate credit. Lecture and laboratory.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C.

BIO-366. Cancer Biology. 3 Hours.

The molecular and cellular basis of cancer are examined. 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. This class is also offered at the 400-level for graduate credit.

Prerequisite: BIO-301 with a minimum grade of C and BIO-303 with a minimum grade of C.

BIO-367. Developmental Biology. 4 Hours.

This course examines 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 health professions. This class is also offered at the 400-level for graduate credit. Lecture and laboratory.

Prerequisite: BIO-301 with a minimum grade of C and BIO-303 with a 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, students will focus on the methods and techniques used in gathering and interpreting genomic and proteomic data to answer questions important to modern day biology. This class is also offered at the 400-level for graduate credit.

Prerequisite: BIO-303 with a minimum grade of C.

BIO-372. Biochemistry Of Metabolism. 3 Hours.

This course focuses on the processing of carbohydrates, lipids, proteins, and nucleotides, offering a mechanistic view of metabolic pathways related to each macromolecule group, including feedback control. Topics 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. This class is also offered at the 400-level for graduate credit.

Prerequisite: BIO-362 with a minimum grade of C or CHEM-362 with a minimum grade of C.

BIO-380D. Topics In Biology:Microbial Genetics. 3 Hours.

Prerequisite: BIO-150 with a minimum grade of C and BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C and BIO-341 with a minimum grade of C.

BIO-380E. Topics In Biology:Introductory Bryology. 3 Hours.

Prerequisite: BIO-150 with a minimum grade of C and BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C.

BIO-380H. Topics In Biology: Sensory Mechanisms. 3 Hours.

This course is designed for students interested in learning how organisms (including humans) detect, process and respond to sensory stimuli such as light, odors, touch, taste, and sound. Students will also learn about the mechanisms used by a wide range of organisms to sense both their internal and external environments. This comparative approach will emphasize common principles of sensory coding and transduction as well as unique strategies used to address specific biological needs. Lectures and associated readings will focus on physiological, neurobiological and behavioral analyses to understand both the proper functioning and dysfunction of sensory systems.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a 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.

Students will integrate knowledge gained from courses taken throughout the biology major to explore topics of particular interest to them through writing and oral presentation. Students will also have the opportunity to further develop and obtain feedback on career preparation materials such as a resume, cover letter, and personal statement. This course fulfills the capstone requirement for the biology major.

BIO-391. Internship In Biology. 3 Hours.

Through an internship in the biological sciences, students gain laboratory or field experience at an off-campus site. Students engage in research or industry projects, guided by a faculty advisor and a site supervisor. Requirements include submission of the planned internship project, a review of relevant literature, and presentation of the project results in a written report and symposium presentation. This course fulfills the capstone requirement for the biology major.

BIO-392. Independent Research I. 2 Hours.

In this first of a two-course series, students engage in a field or laboratory study of a biology topic or question. 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, and presentation of the project in either podium or poster format. Successful completion of both BIO-392 and BIO-393 will fulfill the capstone requirement for the biology major.

BIO-393. Independent Research II. 2 Hours.

In this second of a two-course series, students engage in a field or laboratory study of a biology topic or question. 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, and presentation of the project in either podium or poster format. Successful completion of both BIO-392 and BIO-393 will fulfill the capstone requirement for the biology major.

BIO-394. Seminar In Teaching Of Biology. 3 Hours.

Under the direction of a faculty mentor, students gain experience as peer leaders in the classroom. Students assist in designing and presenting lecture material and in designing, setting up, and directing laboratory exercises. As they help develop curricular and assessment materials, they integrate knowledge and skills learned in prior courses. Students should identify a faculty mentor to advise and guide this teaching experience no later than the term before they register for the course. 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.**

This course will introduce students to the use of basic and advanced spreadsheet applications to model a wide variety of ecological and evolutionary processes and systems. Graphing capabilities, complex nested functions, and advanced software functions including writing macros, sampling from statistical distributions, using lookup tables will be used extensively. 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. Students are expected to have completed coursework in ecology and statistics before taking this course.

Prerequisite: BIO-405 with a 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.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-413. Evolutionary Biology. 3 Hours.

This course provides a comprehensive analysis of evolutionary patterns in both fossil and contemporary species. Topics addressed 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-405 with a minimum grade of C.

BIO-414. Comparative Biology Of Aging. 3 Hours.

This course provides a comparative analysis of aging, longevity, and mortality patterns in diverse prokaryotic and eukaryotic species. Topics addressed 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-405 with a minimum grade of C.

BIO-415. Animal Behavior. 3 Hours.

This course provides 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-405 with a minimum grade of C.

BIO-415G. Communicating Science. 3 Hours.

Students will explore the basics of communicating science to non-scientists, scientists, and interested stakeholders. Through discussions, group work, and individual assignments, students will practice techniques associated with writing, presenting, and sharing biology and biological results. The assignments consist of formal and informal writing, presentations, and graphical design products.

Prerequisite: (BIO-201 with a minimum grade of C or CHEM-211 with a minimum grade of C or PHYS-201L with a minimum grade of C or PHYS-206L with a minimum grade of C) and (BIO-202 with a minimum grade of C or CHEM-212 with a minimum grade of C or PHYS-202L with a minimum grade of C or PHYS-207L with a minimum grade of C or ESCI-211 with a minimum grade of C).

BIO-421. Biochemical Genetics. 3 Hours.

This course 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-405 with a minimum grade of C.

BIO-424. Analysis Of Development. 3 Hours.

This course provides an analysis of the 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-405 with a 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.

This course provides students with 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-405 with a minimum grade of C.

BIO-428. Current Topics In Human Genetics. 3 Hours.

This course provides an 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-405 with a 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.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-450. Foundations Of Ecology. 3 Hours.

Students will engage in readings and discussions of foundational papers in ecology, and classic case studies of field and laboratory experiments in ecology. The readings will provide an overview of the development of ecology as a science, look at the major debates in ecology, and examine the development of both theory and methodologies in ecology. Students will also present and discuss contemporary papers in light of these historical contexts. Students are expected to have completed coursework in ecology before taking this course.

Prerequisite: BIO-405 with a 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-405 with a minimum grade of C.

BIO-451G. Biology Of Algae. 4 Hours.

In this subdiscipline of microbiology, students will examine a diverse group of photosynthetic organisms with emerging biotechnological potential. The evolution, physiology, and ecology of algae provide the basis for advances in medicine, food production, and environmental protection. In field trips to wetlands, lakes, and rivers, students will investigate local environmental problems and their solutions. Students will design and conduct original research projects involving identification and study of algal taxa.

Prerequisite: BIO-201 with a minimum grade of C and BIO-202 with a minimum grade of C.

BIO-452. Quaternary Ecology. 4 Hours.

This course provides an 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-405 with a 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 to 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-405 with a 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.

Prerequisite: BIO-303 with a minimum grade of C and BIO-305 with a minimum grade of C.

BIO-455. Restoration Ecology. 3 Hours.

This course explores how ecological research and concepts can be applied to the restoration of disturbed ecosystems. It will take into account current trends and challenges in restoring populations, communities and ecosystems. Students are expected to have completed coursework in ecology prior to taking this course.

Prerequisite: BIO-405 with a 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.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-458G. Biogeography. 3 Hours.

This course covers the geographic distribution of living organisms and the biological principles underlying this distribution, including the evolutionary patterns of dispersal in both fossil and contemporary species. Biogeography has important implications toward understanding conservation management, economic production, and public health. Discussions and papers will include an overview of the history of biogeography through current techniques and theories.

Prerequisite: BIO-202 with a minimum grade of C.

BIO-461G. Human Genetics. 4 Hours.

This course 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.

Prerequisite: BIO-303 with a 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 with a minimum grade of C.

BIO-462G. Biochemistry. 4 Hours.

Biochemistry examines the chemistry that underlies the biological processes common to all living organisms. The course will explore the chemical nature of the four major biological molecules and the processes that drive their activities. Topics include the structures of proteins, nucleic acids, carbohydrates, and lipids, and processes that include thermodynamics, acid-base reactions, catalysis, and energetics.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C and CHEM-231 with a minimum grade of C.

BIO-463. Plant Biochemistry. 3 Hours.

This 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 and discussion. Students are expected to have completed coursework in biochemistry or plant physiology prior to taking this course.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-463G. Immunology. 4 Hours.

Students will examine the role of cells and organs of the 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.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C.

BIO-464. Biochemistry And Molecular Biology Methods. 4 Hours.

This is a graduate-level lecture and laboratory course that provides training in essential experimental methods used in modern Biochemistry and Molecular Biology, including both wet-lab and computer analysis tools, while reviewing basic structure and function of biological molecules. Students are expected to have completed coursework in biochemistry or molecular biology prior to taking this course.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-464G. Endocrinology. 4 Hours.

Hormones play a huge role in daily function and in health. Endocrinology focuses on the study of hormones and other signaling molecules and their functions in growth and reproduction, mood control, and metabolism. Human and animal examples will be discussed, making the course relevant to students interested in careers in healthcare, veterinary science, and conservation fields. Lecture and laboratory.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C and CHEM-231 with a minimum grade of C.

BIO-465G. Neurobiology. 4 Hours.

This course provides 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.

Prerequisite: BIO-202 with a minimum grade of C and BIO-301 with a minimum grade of C.

BIO-466G. Cancer Biology. 3 Hours.

The molecular and cellular basis of cancer are examined. 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.

Prerequisite: BIO-301 with a minimum grade of C and BIO-303 with a minimum grade of C.

BIO-467G. Developmental Biology. 4 Hours.

This course examines 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 health professions.

Prerequisite: BIO-301 with a minimum grade of C and BIO-303 with a minimum grade of C.

BIO-468G. 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, students will focus on the methods and techniques used in gathering and interpreting genomic and proteomic data to answer questions important to modern day biology.

Prerequisite: BIO-303 with a minimum grade of C.

BIO-470A. Seminars In Biology. 1 Hour.**BIO-471. Comparative Animal Physiology. 3 Hours.**

This seminar course explores selected topics in the physiology of vertebrate (including human) and invertebrate animals, with an emphasis on the basic principles of physiology placed within an evolutionary and ecological context. Our perspective will be integrative, exploring physiological processes from the cellular to the organismal level of analysis. In addition, we will discuss the ways in which understanding physiology informs our understanding of, and behavior toward the human and non-human animals with which we interact daily. Course meetings will include foundational lectures, student presentations, and group discussions.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-472G. Biochemistry Of Metabolism. 3 Hours.

This course focuses on the processing of carbohydrates, lipids, proteins, and nucleotides, offering a mechanistic view of metabolic pathways related to each macromolecule group, including feedback control. Topics 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.

Prerequisite: BIO-362 with a minimum grade of C or CHEM-362 with a minimum grade of C or BIO-462G with a minimum grade of C or CHEM-462G with a minimum grade of C.

BIO-475. Advanced Immunology. 3 Hours.

This course examines 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-405 with a minimum grade of C.

BIO-4821. Independent Investigations. 1 Hour.

Students registering for this course will conduct a 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 with a minimum grade of C.

BIO-4822. Independent Investigations. 2 Hours.

See course description for BIO-4821. This is a 2-credit version of BIO-482.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-4823. Independent Investigations. 3 Hours.

See course description for BIO-4821. This is a 3-credit version of BIO-482.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-485L. Advance Topics In Biology: Applied & Environmental Microbiology. 3 Hours.**BIO-491. Seminar In Biology. 1 Hour.**

In this seminar experience, students select a specific topic of interest to them, research the topic, and give an oral presentation on the topic to a peer group. Time commitment is approximately 2 hrs per week. Departmental approval is required.

Prerequisite: BIO-405 with a 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 with a minimum grade of C.

BIO-5902. Library Thesis Hours. 2 Hours.

See course description for BIO-5901. This is a 2-credit version of BIO-590.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-5903. Library Thesis Hours. 3 Hours.

See course description for BIO-5901. This is a 3-credit version of BIO-590.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-5991. Research Thesis Hours. 1 Hour.

This course is for students conducting research and writing a thesis to fulfill the requirements of the Research Thesis Option in the M.S. program in Biology. Students may register for 1-4 credits of BIO-599 per term; a total of 6 credits of BIO-599 is required for the Research Thesis Option. All BIO-599 credits must be earned within the equivalent of 2 academic years.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-5992. Research Thesis Hours. 2 Hours.

See course description for BIO-5991. This is a 2-credit version of BIO-599.

Prerequisite: BIO-405 with a minimum grade of C.

BIO-5993. Research Thesis Hours. 3 Hours.

See course description for BIO-5991. This is a 3-credit version of BIO-599.

Prerequisite: BIO-405 with a minimum grade of C.