Biology

Bachelor of Science
Pre-Medical Concentration
The Science of the Environment Concentration

Undergraduate Minor
Master of Science (http://catalog.uis.edu/graduate-students/clas/biology)

www.uis.edu/biology/
Email: bio@uis.edu
Office Phone: (217) 206-6630
Office Location: HSB 223

Departmental goals and objectives

The B.S. degree in Biology is designed to build a foundation in the biological sciences, to augment students’ learning skills, and to assist students in developing critical thinking and problem-solving skills applicable to scientific issues. It is the first professional degree in the discipline and prepares students for careers in biological sciences and/or graduate programs, as well as professional schools. The B.S. degree offers a balanced biology curriculum and opportunities for research experiences with a diversity of faculty conducting research in molecular, cellular, organismal biology and ecology. Scientific facilities available to students include a well-equipped building with DNA sequencers, molecular biology equipment, electron and fluorescent microscopes, a greenhouse, and other scientific equipment.

The goals of the foundational B.S. degree, and the more-specialized M.S. degree, are to prepare biology students for many career options, including laboratory and field technicians, scientific sales representatives, project managers in life science and allied health professions, and teachers at the secondary, community college, and university levels. Recent biology graduates have successfully continued their careers in research, medicine, dentistry, physical therapy, pharmacy, and veterinary medicine.

Internships and Undergraduate Research

Students can gain practical professional experience by participating in an internship through the Internships and Prior Learning (IPL) programs. Placements have included state agencies such as the Illinois State Museum, Illinois Environmental Protection Agency, Illinois Department of Transportation, SIU School of Medicine, and Lincoln Memorial Gardens. Students may also conduct research with Biology faculty members (BIO 400 ECCE: Undergraduate Research). These experiences can count toward a student’s ECCE Engagement requirements. Please note that courses can only count toward fulfillment of one requirement. BIO 400 can be used as either ECCE Engagement or a student’s BIO elective, but the same credits cannot be used for both. A student can take four credits of BIO 400 for his/her elective and an additional three credits of BIO 400 for ECCE Engagement if (s)he wants to fulfill both requirements through a research experience (seven credits total).

Undergraduate Honors in Biology

Biology majors with a cumulative GPA greater than 3.25 at UIS may elect to participate in the biology honors option. In addition to Biology Department and UIS requirements, honors students must maintain a minimum cumulative GPA of 3.25, successfully complete BIO 302 Honors Seminar, BIO 402 Biometrics, and BIO 400 ECCE: Undergraduate Research, and present their findings in a formal paper and public seminar (e.g., Student Arts & Research Symposium - StARS). Students must apply for participation in the honors program to the department chair, and obtain the approval of their faculty research advisor before beginning the program.

The Bachelor’s Degree

• Pre-Medical Concentration (http://catalog.uis.edu/undergraduate-students/clas/biology/premedical-concentration)
• The Science of the Environment Concentration (http://catalog.uis.edu/undergraduate-students/clas/biology/scienceoftheenvironment-concentration)

Required Courses

Students entering the major must have completed eight semester hours in general chemistry with laboratory, four semester hours in organic chemistry with laboratory, eight semester hours of biology courses (including general biology with laboratory), and one college-level mathematics course (college algebra is not recommended as it will not count toward UIS’ general education math requirement). The general chemistry and general biology courses taken need to be the introductory sequence for science majors. For students completing this course work at UIS, the required courses are:

BIO 141 Unity of Living Organisms 4
BIO 241 Biology of Organisms in the Environment 4
CHE 141 General Chemistry I 4
CHE 142 General Chemistry II 4
CHE 267 Organic Chemistry I 3
CHE 268 Organic Chemistry I Laboratory 1

Up to 12 semester hours of approved lower-division courses may be transferred from an accredited institution of higher education to make up deficiencies.

Transfer Courses

Transfer courses must have a grade of C or better (grades of C- or lower will not be accepted).

Advising

Students with junior and senior standing should meet with the College of Liberal Arts and Sciences Biology advisor before initial registration. The student should prepare a plan to ensure that all requirements are being met and discuss this plan with the college advisor. The department recommends that students take BIO 301 and CHE 267/CHE 268 Organic Chemistry I Laboratory no later than the fall of their junior year.

Students are expected to complete organic chemistry before taking cell biology. The department also recommends that CHE 322 Laboratory Techniques be taken as early as possible following completion of the introductory chemistry sequence. BIO 345 General Microbiology and BIO 346 General Microbiology Lab, BIO 351 Organismal Botany, BIO 361 Comparative Vertebrate Biology, and BIO 371 Principles Of Ecology can be taken in the junior year. In the senior year, students can take BIO 311 Cell Biology, BIO 381 Genetics and biology
electives. Cell biology can be taken earlier (e.g., junior year) assuming the organic chemistry requirement has been met. Pre-professional students (pre-med, pre-vet, pre-pharmacy, pre-dental) should meet with a Natural Science Division pre-professional advisor when planning their program. They should also consult the pre-professional website: www.uis.edu/preprofessional/.

**Grading Policy**

To be able to enroll in upper division courses, students must earn at least a C in BIO 141 and BIO 241. To earn a Biology degree, students must have at least a C (2.0) average in the required biology courses (including the biology elective). Because writing is a core skill for biologists, students must earn at least a C to receive credit in BIO 301. Those performing below this level (C- or lower) are required to retake the course.

**Degree Requirements**

**Prerequisite Courses (for upper division course work)**

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BIO 141</td>
<td>Unity of Living Organisms</td>
<td>4</td>
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<tr>
<td>BIO 241</td>
<td>Biology of Organisms in the Environment</td>
<td>4</td>
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<tr>
<td>CHE 141</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>CHE 142</td>
<td>General Chemistry II</td>
<td>4</td>
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<tr>
<td>CHE 267</td>
<td>Organic Chemistry I</td>
<td>3</td>
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<tr>
<td>CHE 268</td>
<td>Organic Chemistry I Laboratory</td>
<td>1</td>
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</table>

One semester of organic chemistry is a prerequisite for some biology core courses. Transfer students with credit equivalent to CHE 267 and CHE 268 can substitute general electives.

**Core Course Requirements**

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<thead>
<tr>
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<th>Hours</th>
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<tbody>
<tr>
<td>BIO 301</td>
<td>General Seminar (sophomore or junior year)</td>
<td>3</td>
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<tr>
<td>CHE 322</td>
<td>Laboratory Techniques (sophomore or junior year)</td>
<td>1</td>
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<tr>
<td>BIO 311</td>
<td>Cell Biology (suggested spring, junior or senior year)</td>
<td>4</td>
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<tr>
<td>BIO 345 &amp; BIO 346</td>
<td>General Microbiology and General Microbiology Lab (suggested fall, junior or senior year)</td>
<td>4</td>
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<td>BIO 351</td>
<td>Organismal Botany (suggested fall, junior year)</td>
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<td>BIO 361</td>
<td>Comparative Vertebrate Biology (suggested spring, junior year)</td>
<td>4</td>
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<td>BIO 371</td>
<td>Principles Of Ecology (suggested fall, junior year)</td>
<td>4</td>
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<tr>
<td>BIO 381</td>
<td>Genetics (suggested spring, senior year)</td>
<td>4</td>
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<tr>
<td>BIO elective (400- or 500-level, suggested senior year)</td>
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Total Hours 32

**Biology Minor**

A minor in Biology is designed for students who wish to increase their knowledge of biology, acquire a foundation in biological sciences, and develop critical thinking skills. Students may plan a broad-based minor, containing courses from each of the major organizational divisions of living things: cells, organisms, and communities. The minor may also focus on a particular aspect of biology such as botany, ecology, or molecular biology.

To earn a Biology minor, students must complete a minimum of 24 hours in biology, of which at least eight hours must be upper-division courses taken at UIS. Electives should be selected in consultation with a biology faculty member. Some upper-division courses have particular prerequisites other than general biology. The faculty advisor will ensure that each student is properly prepared.

**Core Courses**

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<td>General Microbiology</td>
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<td>BIO 346</td>
<td>General Microbiology Lab</td>
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<td>BIO 347</td>
<td>Medical Bacteriology</td>
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<td>Genetics</td>
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<td>BIO 391</td>
<td>Evolution</td>
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<td>BIO 400</td>
<td>ECCE: Undergraduate Research</td>
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<td>BIO 402</td>
<td>Biometrics</td>
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<td>BIO 428</td>
<td>Human Disease</td>
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<td>BIO 429</td>
<td>Human Anatomy and Physiology I</td>
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<tr>
<td>BIO 431</td>
<td>Human Anatomy and Physiology II</td>
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<tr>
<td>BIO 444</td>
<td>Aquatic Ecology</td>
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<td>BIO 445</td>
<td>Biology Of Water Pollution</td>
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<td>BIO 446</td>
<td>Restoration Ecology</td>
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<tr>
<td>BIO 447</td>
<td>Global Change Ecology</td>
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<tr>
<td>BIO 462</td>
<td>Conservation Biology</td>
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Total Hours 24

Equivalent courses are accepted.

**NOTE:** A minimum of eight hours of upper-division course work must be taken at UIS. Some upper-division courses have particular prerequisites other than general biology.

**Courses**

**BIO 106. Environmental Biology. 3 Hours.**

Examines ecological principles in relation to environmental problems. Emphasizes current environmental issues and possible solutions and courses of action. Course Information: Course is intended for non-science majors. This course fulfills a general education requirement at UIS in the area of Life Science without a Lab. (IAI Code: L1905).
BIO 107. Environmental Biology Lab. 1 Hour.
Optional lab for BIO 106. Course Information: Prerequisite: BIO 106 must be taken concurrently or have been completed with a passing grade. Course is intended for non-science majors. This course, along with BIO 106, fulfills a general education requirement at UIS in the area of Life Science with a Lab.

BIO 108. The New Age of Reproduction. 3 Hours.
As our understanding of how humans develop increases so does our ability to manipulate the developing human embryo. The technology has opened Pandora's Box of ethical issues which will be the focus of this course. This course is designed for freshmen or sophomores with little to no scientific background. Course Information: Course is intended for non-science majors. This course fulfills a general education requirement at UIS in the area of Life Science without a Lab.

BIO 111. Emiquon Stories. 4 Hours.
This course will bring first year undergraduates to UIS' Therkliden Field station at Emiquon, to the nearby Dickson Mounds Museum, to the ecologically restored Thompson Lake at the Emiquon Preserve, and to the place where Spoon River meets the Illinois River. Students will meet experts in wetlands restoration, history, biology, environmental science, archeology, literature, and art. These experts will present different perspectives and different stories about the Emiquon region past, present, and future. Course Information: This course fulfills a general education requirement at UIS in the area of Freshman Seminar and a general education requirement at UIS in the area of Life Science with a Lab.

BIO 141. Unity of Living Organisms. 4 Hours.
An introduction to the nature of life, including the cell doctrine, the basic physical phenomena of life; a consideration of bioenergetics and biosynthesis; cell reproduction; the gene concept and genetics; and the mechanism and evidence of organic evolution. Course Information: Prerequisite: Capital Scholar or instructor approval. This course is designed for science majors. Students must learn at least a C in this course. This course fulfills a general education requirement at UIS in the area of Life Science with a Lab. (IAI Code: L1 900L).

BIO 201. Basics of Human Anatomy and Physiology I. 4 Hours.
This is a non-majors course for students interested in learning about human anatomy and physiology. It is an introductory course for students to explore basic sciences related to health careers. This is part 1 of a 2 semester lecture and lab. This course fulfills a general education requirement at UIS in the area of Life Science with a Lab.

BIO 202. Basics of Human Anatomy and Physiology II. 4 Hours.
This is part 2 of a 2 semester lecture and lab course reviewing human anatomy and physiology. This is a non-majors course for students interested in learning about human anatomy and physiology. It is an introductory course for students to explore basic sciences related to health careers. This course fulfills a general education requirement at UIS in the area of Life Science with a Lab. Course Information: Prerequisite: BIO 201.

BIO 204. Introductions to Concepts of Human Physiology. 4 Hours.
This course is designed for students who are interested in having background in human physiology. It is a one semester lecture and laboratory course exploring the complex mechanisms by which homeostasis is maintained in the body. Practical examples will be used in the laboratory to illustrate the lecture concepts.

BIO 205. Introduction to Concepts of Human Anatomy. 4 Hours.
This course is designed for students who are interested in having background in human anatomy. It is a one semester lecture and laboratory course exploring the complex structural relationships in the body. Practical examples will be used in the laboratory to illustrate the lecture concepts.

BIO 206. Human Physiology Concepts. 3 Hours.
This course is designed for non-majors in the sciences to introduce the concepts basic to the physiology of the human body. It is a survey of the body's organ systems and how they function. The course is designed to give an overview of the topic so that a student will have some basic understanding of how their own body functions and responds to the everyday stresses to which it is subjected.

BIO 231. Applied Microbiology. 3 Hours.
A lecture course that explores microorganisms important to healthcare. Topics include microbial characteristics, genetics, growth and metabolism, mechanisms of disease transmission, immunity, antimicrobial treatment and resistance, a survey of pathogenic microbes and prevention of microbial disease. Clinical applications will be emphasized. Course Information: This course is designed for nursing students and other allied health fields; it does not fulfill the microbiology requirement for Biology and CLS majors.

BIO 232. Applied Microbiology Lab. 1 Hour.
This is an optional laboratory course to accompany Applied Microbiology lecture (BIO 231). It covers basic laboratory techniques used to identify and study microbes. Application to healthcare is emphasized. Course Information: Prerequisites: concomitant enrollment in or prior successful completion of BIO 231. Intended for students pursuing nursing and other allied health fields. It does not fulfill the microbiology laboratory requirement for Biology/CLS majors.

BIO 234. Introduction to Ecology for Non-Majors. 4 Hours.
This course introduces non-science students to the ecology through on-line lectures and lab experiences at the UIS Therkliden Field station at Emiquon. Core ecological principles include: Patterns of life, energy and ecosystems, populations, and human-ecological connections. Hands-on work in wetlands, rivers, lakes, forests, or prairies will be done. Course Information: Science majors should not enroll. This course fulfills a general education requirement at UIS in the area of Life Science with a Lab.

Part of the introductory biology sequence for science majors. Students will learn about the unity and diversity of life, including concepts of evolution, growth and development, behavior, and the interactions of organisms with their abiotic and biotic environments. Course Information: Students must earn at least a C in this course.

BIO 301. General Seminar. 3 Hours.
Development of writing skills and discussion of professional ethics. Mastery of library skills and ability to organize material demonstrated by production of a paper on a scientific topic of interest and a seminar based on that paper. Course Information: Same as CHE 301. Prerequisite: ENG 101 and ENG 102 or equivalents. COM 112 recommended. For the sophomore or junior year. Restricted to Chemistry and Biology majors.

BIO 302. Honors Seminar. 1 Hour.
Integrative seminar to share research methods and experiences and analyze procedures and protocols in research. Course Information: May be repeated up to 1 time(s).
BIO 305. Plants And Society with Lab. 2,4 Hours.
This course focuses on the uses of flowering plants and their importance in human affairs. The lectures include general background about plant form, function, reproduction, and classification. Uses of plants as sources of fruits, grains, legumes, medicines, herbs and spices, drinks, textile fibers, lumber, poisonous and psychoactive plants, and forages are studied in more detail. The lab component of the course includes experiments designed to reinforce the concepts and processes covered in lectures. Course Information: This course is for non-science majors and fulfills the general education requirement at UIS in the area of Life Science with a Lab.

BIO 306. Plants and Society without a Lab. 3 Hours.
This course focuses on the uses of flowering plants and their importance in human affairs. The lectures include general background about plant form, function, reproduction, and classification. Uses of plants as sources of fruits, grains, legumes, medicines, herbs and spices, drinks, textile fibers, lumber, poisonous and psychoactive plants, and forages are studied in more detail. Course Information: This course is for non-science majors and fulfills the general education requirement at UIS in the area of Life Science without a Lab (IAI Code: L1905).

BIO 311. Cell Biology. 4 Hours.
Molecular basis of structure and function of cells, with an emphasis on the mechanisms of biological processes. Laboratory integrates study of cellular processes with introduction to current research techniques and instrumentation. Recommended spring of senior year. Course Information: Prerequisites: One year of introductory biology, one year of introductory chemistry, organic chemistry and permission of instructor.

BIO 333. ECCE: 10,000 Years at Emiquon. 3 Hours.
The Emiquon site on the Illinois River floodplain has been inhabited for over 10,000 years. This course will study five communities and how they related to the land: Native Americans, European settlers, hunters and fisherman, farmers, and scientists and conservations. Students will gain perspectives from historians, archeologists, biologists, and ecologies. Course Information: No prerequisites. This course cannot be used for BIO major elective. This course fulfills an Engaged Citizenship Common Experience requirement at UIS in the area of U.S. Communities.

BIO 345. General Microbiology. 3 Hours.
Discussion of basic topics in microbial physiology, genetics, and ecology, along with an introduction to virology, immunology, and applied microbiology. Recommended fall of senior year. Course Information: Prerequisite: One year of introductory biology, one year of introductory chemistry.

BIO 346. General Microbiology Lab. 1 Hour.
Application of basic microbiological techniques to the identification and classification of microorganisms. Introduction and application of molecular genetic and immunological techniques to the study of various aspects of microbial physiology and ecology. Course Information: Prerequisite: Microbiology or concurrent enrollment in BIO 345.

BIO 347. Medical Bacteriology. 4 Hours.
Concise overview of pathogenic bacteriology. Includes discussion of techniques for culturing and identifying bacteria and an introduction to epidemiology. Required of clinical laboratory science students. Offered fall semester. Course Information: Same as CLS 347. Prerequisite: BIO 345 and BIO 346.

BIO 351. Organismal Botany. 4 Hours.
The main goal of this course is to study the structure and function of plants through the examination of anatomical and physiological processes. The course includes four main areas: plant morphology, plant physiology, plant diversity, and plant evolution. Course Information: One year of introductory biology. Recommended fall of junior year.

BIO 355. Medical Botany. 3 Hours.
Medical Botany looks at plants and botanical compounds used in traditional and contemporary medicine, examining their medicinal effects and biological mechanism. It is designed to teach the understanding and appreciation of the plant-based compounds that affect human health, not to encourage the practice of medicine or pharmacy. Course Information: Prerequisites: Students must have successfully completed one year of biology and one year of chemistry.

BIO 361. Comparative Vertebrate Biology. 4 Hours.
Comparative study of the evolutionary origins, embryological development, and functional anatomy of the various classes of vertebrates. Interrelatedness of form and function is stressed in both lecture and laboratory. Recommended spring of junior year. Course Information: Prerequisite: One year of introductory biology.

Structure and function of ecological systems including basic ecological principles and concepts. Applicable to individuals, populations, communities, and ecosystems. Laboratory involves outdoor and lab experiments. Course Information: One year of introductory biology. Recommended fall of senior year.

BIO 381. Genetics. 4 Hours.
Studies a range of topics including classical Mendelian analysis, chromosome structure and mapping, molecular genetics and recombinant DNA technology, culminating with an introduction to population genetics. Includes laboratory sessions to introduce students to problem-solving situations using the techniques of both classical and molecular genetics. Course Information: Prerequisite: One year of introductory biology, one year of introductory chemistry, microbiology, and organic chemistry. Recommended fall of senior year.

BIO 391. Evolution. 4 Hours.
Origin of life and history of development of living systems. Analysis of classical Darwinism, the Neo-Darwinian synthesis, and mechanisms of evolution, with emphasis on microevolutionary studies as an analytical tool. Course Information: Prerequisite: One year of introductory biology and successful completion of three biology courses required for this major.

BIO 399. Tutorial. 1-12 Hours.
Intended to supplement, not supplant, regular course offerings. Students interested in a tutorial must secure the consent of the faculty member concerned before registration and submit any required documentation to him or her. Course Information: May be repeated to a maximum of 12 hours.

BIO 400. ECCE: Undergraduate Research. 1-4 Hours.
Independent investigation of specific problem of interest to the student. Before enrolling, a student must select a faculty member from the biology department to direct and review the project. Research paper, formal seminar, or both may be required for credit. Offered each semester. Course Information: Restricted to BIO majors. May be repeated to a maximum of 4 hours. This course fulfills an Engaged Citizenship Common Experience requirement at UIS in the area of Engagement Experience.
BIO 401. Integrative Biology: Senior Seminar. 4 Hours.
This is the capstone course for Biology majors, students will apply the knowledge they have accumulated across their coursework towards study of a particular integrative topic. Students will focus on discussion and analysis of topics in biology, learn how to prepare a research report, give a formal research presentation, critique the work of their peers, and write a proposal outlining a potential investigation and deliver an oral presentation of their proposal.

BIO 402. Biometrics. 4 Hours.
Statistical analytical tools in biology and their application in developing strategies for experimental procedures and evaluation of results. Introduction to statistics software.

BIO 405. Modeling of Biological Systems. 4 Hours.
This course is designed to give senior undergraduate and graduate students the basic knowledge of modeling biological systems. The course will emphasize the basic concepts, principles, procedures, and techniques in modeling of biological systems. The STELLA software will be used to help students to learn how to model biological systems. Course Information: Prerequisites: a year of calculus (MAT 115 & MAT 116) or one semester of calculus (MAT 115) and one semester of applied statistics (MAT 121).

BIO 410. Topics in Biology. 1-4 Hours.
Study of a topic under investigation by contemporary biologists. Topic for a semester will be stated in the class schedule. Prerequisite: Dependent on topic. Course Information: May be repeated if topics vary.

BIO 411. Honors Senior Seminar. 4 Hours.
This is the capstone senior seminar course for Honors Biology majors. The aim of this course is for you to develop a final written thesis on your undergraduate research. You will also work on further developing your oral and presentation skills. You will be required to present your work publicly both orally and in poster format. Course Information: Prerequisites: BIO 400 and BIO 402 (can be taken concurrently).

BIO 422. Electron Microscopy. 4 Hours.
Theory and procedures of electron microscopy integrated with an understanding of ultrastructural morphology. Students develop competencies within three broad areas: material preparation, instrumentation, and information processing in both transmission and scanning electron microscopy. Emphasis on laboratory experience.

BIO 425. Medicinal Chemistry. 3 Hours.
Pharmacotherapy is defined as the treatment of disease through the administration of drugs. Medicinal chemistry is an introductory course in pharmacology that introduces the underlying principles of the mechanisms of actions of drugs used to treat diseases (pharmacodynamics), the properties of drugs (pharmacokinetics), and how they vary from individual to individual (pharmacogenetics). Course Information: Same as CHE 425.

BIO 428. Human Disease. 4 Hours.
Human diseases arise by the complex interaction between inherited genetic mutations and environmental influences. In this course we will examine the basis for a wide range of diseases including inherited syndromes, cancer, influenza, and HIV. Course Information: Prerequisite: BIO 141, Cell Biology or Genetics.

BIO 429. Human Anatomy and Physiology I. 4 Hours.
A review of human anatomy and physiology part one. Topics include review of basic anatomy of tissues based on the histological structure. This is followed by a review of anatomy and physiology systems presented in the organization by organ system of Roget's lectures to the Royal Society. This starts with integumentary systems, followed by the skeletal system, then the muscular system, and, closing the semester, a presentation of the nervous system. Course Information: Prerequisite: One year of general biology and one year of general chemistry.

BIO 431. Human Anatomy and Physiology II. 4 Hours.
A review of human anatomy and physiology, part two. Topics include a review of the anatomy physiology of tissues in the following organ systems. The course starts with the Endocrine system, followed by the cardiovascular system including a review of the components of blood, the lymphatic and corresponding immune systems, the respiratory system, the urinary system, and, closing the semester, a presentation of the reproductive system. Course Information: Prerequisite: BIO 429.

BIO 432. Introduction to Neuroscience. 3 Hours.
While neurobiology traditionally focuses on the biology of the nervous system, neuroscience is an interdisciplinary field that incorporates principles from biology, chemistry, mathematics and medicine to provide a more comprehensive overview of the nervous system. In order to understand how the nervous system is organized and functions to generate behavior, we will examine the central and peripheral nervous system in anatomical, electrophysiological, cellular, and molecular terms. Course Information: Same as CHE 432.

BIO 435. Invertebrate Biology. 4 Hours.
Comprehensive study of major and minor invertebrate phyla. Emphasis on morphology and adaptations, evolutionary relationships among groups. Laboratory includes field collections and study of specimens. Course Information: Prerequisite: One year of introductory biology.

BIO 444. Aquatic Ecology. 4 Hours.
Fundamentals of freshwater ecology, including abiotic-biotic interactions, aquatic ecosystems structure and function, and relationships among organisms. Lecture and laboratory. Course Information: Same as ENS 444. Prerequisite: Ecology or permission of instructor.

BIO 445. Biology Of Water Pollution. 4 Hours.
Effects of organic wastes, industrial chemicals, and non-point pollutants on aquatic fauna and flora and humans; detection and measurement of water pollution. Laboratory involves detection and measurement of water pollution by toxicity tests and field sampling. Course Information: Same as ENS 445. Prerequisite: Ecology or permission of instructor.

BIO 446. Restoration Ecology. 4 Hours.
Restoration Ecology is a relatively new and growing field of study in ecology. This course will examine the process of repairing damage caused by humans to the diversity and dynamics of ecosystems. The approach to study will be to consider examples (case studies) of successful projects, and explore design aspects to restoration. Students with a background in biology and chemistry are encouraged to attend. Course Information: Prerequisite: Ecology or permission of instructor.
BIO 447. Global Change Ecology. 4 Hours.
This course is designed to provide senior undergraduate and graduate students critical knowledge about global change ecology. This course will examine how global change influences composition, structure, processes, and functions of ecosystems as well as what we can do to mitigate the negative impacts caused by global change on ecosystem services. Course Information: Prerequisite: BIO 371 or equivalent with instructor permission.

BIO 448. Introduction to Immunology. 3 Hours.
Immunologic principles, concepts, and techniques will be discussed, including components of the immune system, cellular and humoral immune response, and antigen-antibody reactions. Human diseases related to compromised immunity will be introduced. Course Information: Same as CLS 448. Prerequisite: BIO 141 or equivalent.

BIO 449. Introductory Immunology Lab. 1 Hour.
Basic immunology and serology procedures with emphasis on medical laboratory diagnostic procedures. Course Information: Same as CLS 449. Prerequisite: BIO 141 or equivalent, CLS 448 or concurrent.

BIO 462. Conservation Biology. 4 Hours.
Covers biological principles related to biodiversity conservation and ecosystem management including the demography and genetics of extinction risk. Causes of biodiversity loss are explored and approaches to curb the losses. Course Information: Prerequisite: One year of Introductory Biology or Introductory Environmental Science. Ecology required.

BIO 475. General Biochemistry. 3 Hours.
This is an introductory one semester course in biochemistry that provides a foundation for the health sciences by investigating the simple molecular components of the cell to the complex dynamics of metabolism, and information transfer. Course Information: Same as CHE 475.

BIO 476. General Biochemistry Laboratory. 2 Hours.
This is a laboratory and supplemental discussion to CHE 475; General Biochemistry. The course will develop a competency with basic biochemical techniques, e.g. protein and DNA preparations. The course will also provide a more in depth coverage to the topics in CHE 475. Course Information: Same as CHE 476.

BIO 481. Human Anatomy and Physiology Lab I. 1 Hour.
This is a Lab section that is to accompany the lecture course BIO 429. Course Information: These courses are meant to be taken concurrently.

BIO 482. Human Anatomy and Physiology Lab II. 1 Hour.
This is a Lab section that is to accompany the lecture course BIO 431. Course Information: These courses are meant to be taken concurrently.

BIO 485. Advanced Biochemistry. 4 Hours.
This is an advanced one semester course in biochemistry that provides an in depth coverage of topics that expand upon the foundations established in CHE 475; General Biochemistry as well as explore developing areas of research in biochemistry. Course Information: Same as CHE 485.

BIO 499. Tutorial. 1-12 Hours.
Intended to supplement, not supplant, regular course offerings. Students interested in a tutorial must secure the consent of the faculty member concerned before registration and submit any required documentation to him or her. Course Information: May be repeated to a maximum of 12 hours.

BIO 502. Biological Research and Policy I. 2 Hours.
First part of a two-course sequence. Must be taken during the first fall semester of graduate enrollment. An introduction to graduate studies that emphasizes graduate student responsibilities, introduction to faculty advisers and research topics, development of library research skills, conceptualization of a topic and course of study for the M.S. thesis or non-thesis option, and completion of a professional presentation. Course Information: Prerequisite: Biology graduate standing. Restricted to Biology.

BIO 503. Biological Research and Policy II. 2 Hours.
Second part of a two-course sequence. Must be taken in the spring semester immediately after enrollment in BIO 502. Students complete introduction to graduate studies and extend their skills in library research, professional presentation, and research study design. Students select a research adviser and thesis/non-thesis advisory committee, as well as develop and present a draft proposal of their master's closure (either thesis or non-thesis.) Course Information: Prerequisite: Biology graduate standing and BIO 502. Restricted to Biology.

BIO 510. Topics In Biology. 1-4 Hours.
Intensive study of a topic under investigation by contemporary biologists. Description of topic for a given semester will be stated in course schedule. Offered every semester. Prerequisite: Dependent on topic. Course Information: May be repeated if topics vary.

BIO 551. Advanced Cell Biology and Molecular Biology. 4 Hours.
Critical analysis of selected concepts in eukaryote cell and molecular biology, a subject of intense current scientific inquiry. Focuses on modern technology in the study of molecular mechanisms of eukaryote cell functions. Course Information: Prerequisite: BIO 311 or permission of instructor.

BIO 561. Advanced Microbiology. 4 Hours.
Selected advanced topics that may vary in response to student need but include aspects of microbial physiology such as growth, metabolism, photosynthesis, and genetics. Independent laboratory project required. Course Information: Prerequisite: BIO 345 or permission of instructor.

BIO 571. Advanced Ecology and Evolution. 4 Hours.
Critical review of contemporary ecological concepts, mainly through analysis and discussion of primary references. Course Information: Prerequisite: Introductory Ecology and Evolution.

BIO 576. Master's Project Continuing Enrollment. 0 Hours.
Refer to NOTE in course description for BIO 575. Course Information: May be repeated.

BIO 580. Independent Research. 1-6 Hours.
Student may enroll for 1 to 6 hours of graduate research with the permission of a biology faculty member. Course Information: May be repeated to a maximum of 6 hours.
**BIO 583. Closure Exam Preparation. 4 Hours.**
The course is designed to help the student prepare for the comprehensive exam, which is the capstone experience for students who have selected the non-thesis degree option. Students should not register for this course until their final semester. They should also consult with their academic advisor regarding the exams in addition to enrolling in this course. Preparation for the oral and written exams is done in consultation with the student's academic advisor. To pass the exam, students will need to earn at least a B on both the written and the oral tests (grades of B- or lower will not be accepted). NOTE: Students who fail either the oral or written portions of the exam must register for BIO 584 (zero credit hours: one billable hour) and will have to wait until the following semester to retake the exam that they failed. Students who fail either portion for the second time will be dismissed from the program. Course Information: Prerequisite: Graduate core courses; some may be taken concurrently.

**BIO 584. Closure Examination Continuing Enrollment. 0 Hours.**
Students who have not successfully completed the oral and written portions of the comprehensive closure exams in BIO 583 must enroll in this course. May be repeated. This course encourages students to maintain contact with the department and allows them to use campus facilities such as the library and computer centers while preparing to take the department's master's degree closure exam. Students must enroll for zero credit hours (one billable hour) during each regular (fall and/or spring) semester. Students are given two opportunities to pass both the oral and written portions of the exam. Students who fail either portion two times will be dismissed from the program.

**BIO 585. Master's Thesis. 2,4 Hours.**
A research effort involving collection and analysis of original data (e.g., field or laboratory experiments). Conducted under supervision of a faculty adviser and advisory committee. Thesis proposal must be approved by the graduate committee before enrolling in this course. NOTE: If the thesis is not completed by the time eight hours are accrued in BIO 585 in continuing enrollment, students must register for BIO 586 for zero credit hours (one billable hour) in all subsequent semesters until the thesis is complete. Course Information: May be repeated to a maximum of 8 hours. Prerequisite: Permission of instructor. Restricted to Biology. Restricted to Graduate students.

**BIO 586. Master's Thesis Continuing Enrollment. 0 Hours.**
Refer to NOTE in course description for BIO 585. Course Information: May be repeated.

**BIO 599. Tutorial. 1-12 Hours.**
Intended to supplement, not supplant, regular course offerings. Students interested in a tutorial must secure the consent of the faculty member concerned before registration and submit any required documentation to him or her. Course Information: May be repeated to a maximum of 12 hours.