The biological sciences is a field that encompasses the study of all life and living organisms. Students who are interested in biology have opportunities to pursue a wide range of careers and academic pursuits. Students have the choice of pursuing a bachelor of science (B.S.) or bachelor of arts (B.A.) degree option, with elective coursework in one of three focal areas: 1) cell and molecular biology, 2) ecology, environment and conservation, or 3) health sciences.

The core curriculum required of all biological sciences majors consists of basic course work in introductory biology, biodiversity, cellular biology, evolution, genetics, and ecology. A variety of advanced courses in focal areas offer greater depth, and preparation for employment or many postgraduate opportunities.

Cell and Molecular Biology - Students who are interested in cellular and molecular biology and genetics will find a variety of rewarding career opportunities in public, government, corporate and private agency positions. Individuals with a BS or BA can find careers in fields such as biotechnology, microbiology, cell biology, and neuroscience conducting both basic and applied research. More advanced opportunities are available to students who choose to pursue training in master's and Ph.D. programs after receiving their bachelor's degree in biological sciences.

Ecology, Environment and Conservation - Students who are interested in ecology, environment and conservation biology will find rewarding career opportunities with public and government agencies, companies, contractors, environmental organizations, and more. Job descriptions may include field or lab data collection, natural resource management, policy development and enforcement, and consultancy. Students may also be interested in advanced studies in a variety of fields at the master's or Ph.D.-level, or advanced professional training in fields like environmental law and public policy.

Health Sciences - Students who are interested in health sciences may choose, upon graduation, to pursue professional studies in a variety of rewarding health professions, such as medicine, dentistry, pharmacy, physical therapy, physician assistant, chiropractic, public health, or veterinary medicine, to name a few. Upon graduation, students may also be interested in pursuing a master's or Ph.D. degree in a health science field.

At Missouri S&T, faculty members active in research teach biological sciences courses. Classes are small, providing exceptional opportunity for discussion and individual attention. Most undergraduate students participate in research, learning techniques and developing skills that will prepare them for postgraduate opportunities. A background in mathematics and physical sciences, together with supporting course work in the humanities and social sciences, provides a well-rounded educational experience.

The biological sciences department offers bachelor of science and bachelor of arts degrees. Most students pursue a B.S. degree, which prepares students for careers in biology or postgraduate study including medical school, graduate school, and other options. Two emphasis areas are also offered under the B.A. option: pre-medicine and secondary education.

### Bachelor of Arts

#### Biological Sciences Degree Requirements

Specific requirements for the B.A. degree in biological sciences include a minimum of 120 semester hours of credit, including 30 hours of biology core courses. A "C" or better is required for all Biological Sciences courses.

<table>
<thead>
<tr>
<th>Core Courses</th>
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<tbody>
<tr>
<td>BIO SCI 1201 Biological Sciences Freshman Seminar</td>
<td>1</td>
<td></td>
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<tr>
<td>BIO SCI 1113 General Biology</td>
<td>3</td>
<td></td>
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<tr>
<td>or BIO SCI 1213 Principles of Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO SCI 1219 General Biology Lab</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>BIO SCI 1223 Biodiversity</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIO SCI 1229 Biodiversity Lab</td>
<td>1</td>
<td></td>
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<tr>
<td>BIO SCI 2213 Cell Biology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>BIO SCI 2219 Cell Biology Laboratory</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BIO SCI 2223 General Genetics</td>
<td>3</td>
<td></td>
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<tr>
<td>BIO SCI 2263 Ecology</td>
<td>3</td>
<td></td>
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<tr>
<td>BIO SCI 3233 Evolution</td>
<td>3</td>
<td></td>
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<tr>
<td>BIO SCI 4010 Seminar</td>
<td>1</td>
<td></td>
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<tr>
<td>Advanced courses, 2000 level or higher (at least one with laboratory and one 3000 or 4000 level)</td>
<td>9</td>
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#### Chemistry

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<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>CHEM 1310 General Chemistry I</td>
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<td></td>
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<tr>
<td>&amp; CHEM 1319 and General Chemistry Laboratory</td>
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<td></td>
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<tr>
<td>&amp; CHEM 1320 and General Chemistry II</td>
<td></td>
<td></td>
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<tr>
<td>&amp; CHEM 1100 and Introduction To Laboratory Safety &amp; Hazardous Materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 2210 Organic Chemistry I</td>
<td>6</td>
<td></td>
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<tr>
<td>&amp; CHEM 2220 and Organic Chemistry II</td>
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</tbody>
</table>

#### Mathematics & Physical Science

Various courses in mathematics, physics, and/or geology chosen in consultation with an academic advisor. (Note: Proficiency in College Algebra must be demonstrated by a grade of "C" or better in a College Algebra course or by examination)

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>STAT 3111 Statistical Tools For Decision Making</td>
<td>4</td>
<td></td>
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<tr>
<td>STAT 3425 Introduction to Biostatistics</td>
<td>4</td>
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#### General Requirements for BA

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>English Composition</td>
<td>6</td>
<td></td>
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<tr>
<td>ENGLISH 1120 Exposition And Argumentation</td>
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<tr>
<td>One additional composition course</td>
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<tr>
<td>Western Civilizations</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>HISTORY 1100 Early Western Civilization</td>
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<tr>
<td>HISTORY 1200 Modern Western Civilization</td>
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<tr>
<td>Foreign Language (three semesters of a foreign language)</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Humanities (including one class in each of literature, philosophy, and fine arts)</td>
<td>12</td>
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<tr>
<td>Social Sciences (including classes in two of the following three subjects: economics, political science, psychology)</td>
<td>12</td>
<td></td>
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</tbody>
</table>

**Elective credits:** In consultation with his or her advisor, each student will elect sufficient additional courses to complete a minimum of 120 credit hours.
Bachelor of Arts
Biological Sciences
Pre-Medicine Emphasis Area
Degree Requirements

The student will fulfill the requirements for a bachelor of arts in biological sciences as outlined above. The following classes are also required:

- CHEM 2219 Organic Chemistry I Lab
- CHEM 2229 and Organic Chemistry II Lab
- 2 semesters of Physics and labs: PHYSICS 1145 College Physics I & PHYSICS 2145 College Physics II or PHYSICS 1135 Engineering Physics I or PHYSICS 2135 Engineering Physics II

The following classes are highly recommended:

- BIO SCI 3333 Human Anatomy and Physiology I
- BIO SCI 3339 Human Anatomy Physiology I Lab
- BIO SCI 3343 Human Anatomy and Physiology II
- BIO SCI 3349 Human Anatomy and Physiology II Laboratory
- CHEM 4610 General Biochemistry

Bachelor of Arts
Biological Sciences
Secondary Education Emphasis Area
Degree Requirements

You may earn a B.A. degree in biological sciences from Missouri S&T and certification to teach at the secondary level in the schools of Missouri with this emphasis area. This program can be completed in four academic years, and student teaching is arranged with public schools within 30 miles of the Rolla campus.

Students interested in this emphasis area should consult with the advisor for biological sciences education majors in the biological sciences department.

In order to successfully complete this emphasis area, students must maintain a cumulative GPA of at least 2.75, and attain at least a 3.0 GPA average for all biology courses and professional education courses. Current Missouri S&T or transfer students who wish to pursue this emphasis area must meet both these GPA requirements to be accepted into the program. Students must also meet all requirements listed under the teacher education program in this catalog. Students who do not meet all the teacher certification requirements will not be eligible for the secondary education program in this degree.

A degree in this emphasis area requires 131 credit hours. The required courses are provided below. A minimum grade of "C" is required by the department in all biological sciences courses counted toward this degree.

**Humanities: 18 semester hours**
- ENGLISH 1120 Exposition And Argumentation
- ENGLISH 1160 Writing And Research
- or ENGLISH 3560 Technical Writing
- SP&S S 1185 Principles Of Speech
- At least one course in each of the following: Literature, Philosophy and Fine Arts

**Social Sciences: 15 semester hours**
- PSYCH 5310 History Of The Exceptional Child
- PSYCH 3310 Developmental Psychology

**Bachelor of Science
Biological Sciences
Degree Requirements**

A minimum of 124 credit hours is required for a Bachelor of Science degree in Biological Science.

A minimum grade of "C" is required for each Biological Science course used to fulfill the B.S. degree requirements.

These requirements for the B.S. degree are in addition to credit that is received for basic ROTC.

The Biological Science B.S. degree must include 49 semester hours of biological sciences course work, to include:

- HISTORY 3530 History of Science
- HISTORY 1100 Early Western Civilization
- HISTORY 1200 Modern Western Civilization
- POL SCI 1200 American Government
- PSYCH 1101 General Psychology

**Mathematics/Physical Science: 9 semester hours**
- MATH 1103 Fundamentals Of Algebra
- PHYSICS 1145 College Physics I
- or PHYSICS 1150 Introductory Astronomy
- GEOLOGY 1110 Physical And Environmental Geology

**Computer Science/Statistics: 3 semester hours**
- 3 semester hours of Computer Science or Statistics

**Chemistry: 17 semester hours**
- CHEM 1310 General Chemistry I
- & CHEM 1319 and General Chemistry Laboratory
- & CHEM 1320 and General Chemistry II
- & CHEM 1100 and Introduction To Laboratory Safety & Hazardous Materials
- CHEM 2210 Organic Chemistry I
- & CHEM 2220 and Organic Chemistry II

**Biological Sciences: 27 semester hours**
- BIO SCI 1201 Biological Sciences Freshman Seminar
- BIO SCI 1213 Principles of Biology
- or BIO SCI 1113 General Biology
- BIO SCI 1219 General Biology Lab
- BIO SCI 1223 Biodiversity
- BIO SCI 1229 Biodiversity Lab
- BIO SCI 1173 Introduction to Environmental Sciences
- BIO SCI 2213 Cell Biology
- & BIO SCI 2219 and Cell Biology Laboratory
- BIO SCI 2233 General Genetics
- BIO SCI 2263 Ecology
- BIO SCI 3233 Evolution
- BIO SCI 4010 Seminar

**Education: 42 semester hours**
- EDUC 1040 Perspectives In Education
- EDUC 1164 Teacher Field Experience I
- EDUC 1164 Teacher Field Experience II
- EDUC 1174 School Organization and Administration For Teachers
- EDUC 3216 Teaching Reading in Content Area
- EDUC 3280 Teaching Methods and Skills in Content Areas
- EDUC 4298 Student Teaching Seminar
- EDUC 4299 Student Teaching
- ENGLISH 3170 Teaching And Supervising Reading and Writing
- PSYCH 2300 Educational Psychology
- PSYCH 3310 Developmental Psychology
- PSYCH 4310 Psychology Of The Exceptional Child
Students majoring in biological sciences are eligible to pursue a minor in bioinformatics. See the description of the bioinformatics minor here (http://catalog.mst.edu/undergraduate/degreeprogramsandcourses/bioinformaticsminor).

### Undergraduate Certificate in BioInnovation

The Biological Sciences Department offers a unique course, BIO SCI 3783, that combines biology with entrepreneurship. Students use their scientific knowledge to create a novel biological product. Throughout the process, students interact with marketing experts, patent attorneys, regional biogenerators, funding agencies, and entrepreneurs.

The purpose of a Certificate in BioInnovation will be to further engage students who enroll in the Biological Design and Innovation course with training in entrepreneurship and advanced, innovative biological courses. Students who complete the prescribed coursework in this area will be recognized with a certificate.

In order to receive a Certificate in BioInnovation, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Once admitted to the program, a student will be given three years to complete the program.

To be awarded a certificate in BioInnovation, a student must meet the following requirements:

**Required Course:**
- BIO SCI 3783 Biological Design and Innovation I 3

**One of the following:**
- BUS 1110 Introduction to Management and Entrepreneurship 3
- BUS 5980 Business Models for Entrepreneurship and Innovation 3
- IS&T 5251 Technological Innovation Management and Leadership 3
- MKT 5310 Digital Marketing and Promotions 3

**Two of the following:**
- BIO SCI 3110 Introduction to Biomedical Engineering 3
- CHEM SCI 5210 Introduction to Biomedical Engineering 3
- CHEM SCI 3483 Biomedical Problems 3
- CHEM SCI 5329 Molecular Genetics Laboratory 2
- BIO SCI 5373 Stem Cell Biology 3
- BIO SCI 4666 Nanobiotechnology 3
- CHEM SCI 3110 Biotechnology 3
- CHEM SCI 5240 Tissue Engineering 3
- CHEM SCI 4630 Introduction to Bio-Nanotechnology 3
- CHEM SCI 4681 Chemistry And Inherent Properties Of Polymers 3

**Elective credits:** In consultation with his or her advisor, each student will elect sufficient additional courses to complete a minimum of 124 credit hours.

### Biological Sciences Minor Curriculum

A student wishing to minor in biological sciences must take a minimum of 20 hours of biological sciences course work. This course of study should include at least one laboratory or field course, at least two courses at the 3000 level or above, and be approved by a BioSci faculty advisor.

### Bioinformatics Minor

Students majoring in biological sciences are eligible to pursue a minor in bioinformatics. See the description of the bioinformatics minor here (http://catalog.mst.edu/undergraduate/degreeprogramsandcourses/bioinformaticsminor).

**Bioinformatics Minor Curriculum**

Students majoring in biological sciences are eligible to pursue a minor in bioinformatics. See the description of the bioinformatics minor here (http://catalog.mst.edu/undergraduate/degreeprogramsandcourses/bioinformaticsminor).
An introduction to the study of biology at Missouri S&T. Students will present and defend their proposals and results.

**BIO SCI 1983 Introduction to Biological Design and Innovation** (LEC 3.0)
A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms. An in-depth study of the fundamental principles governing all living organisms from the molecular to the population level. Required for Biological Sciences majors. Cannot also receive credit for Bio Sci 1113. Prerequisite: Biological Science majors only.

**BIO SCI 1982 Introduction to Biomedical Problems** (LEC 3.0)
Problem based learning approach to issues in medical science. Students will work in groups and individually to answer problems related to diagnostic testing and evaluation of diseases and other medical conditions.

**BIO SCI 1213 Principles of Biology** (LEC 3.0)
A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms. An in-depth study of the fundamental principles governing all living organisms from the molecular to the population level. Required for Biological Sciences majors. Cannot also receive credit for Bio Sci 1113. Prerequisite: Biological Science majors only.

**BIO SCI 1173 Introduction to Environmental Sciences** (LEC 3.0)
An introduction to environmental science, with an emphasis on biological aspects of current environmental problems. Topics range from chemical toxicity to global climate change. Environmental challenges facing local species and ecosystems will be emphasized.

**BIO SCI 1001 Special Topics** (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

**BIO SCI 1133 General Biology** (LEC 3.0)
A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms. Prerequisite: Entrance requirements.

**BIO SCI 1135 Biotechnology in Film** (LEC 3.0)
Popular films that use biology-based plots influence society by disseminating facts and providing misinformation. Popular movies serve as the basis for discussing the biotechnology behind popular movie plots and examining the relationship between public perceptions and biotechnology.

**BIO SCI 1113 General Biology** (LEC 3.0)
A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms. Prerequisite: Entrance requirements.

**BIO SCI 1113 Principles of Biology** (LEC 3.0)
A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms. An in-depth study of the fundamental principles governing all living organisms from the molecular to the population level. Required for Biological Sciences majors. Cannot also receive credit for Bio Sci 1113. Prerequisite: Biological Science majors only.

**BIO SCI 1219 General Biology Lab** (LAB 1.0 and LEC 3.0)
The laboratory work accompanying general biology consists of experiments designed to supplement and extend lectures in General Biology and Principles of Biology. Prerequisite: Preceded or accompanied by either Bio Sci 1113 or Bio Sci 1213.

**BIO SCI 1219 Biodiversity Lab** (LAB 1.0)
This lab course is designed to accompany instruction in the Biodiversity class. Lab and field explorations of the varieties of life, with an emphasis on form, function, ecology, and evolution of plants and animals and other organisms. Prerequisite: Preceded or accompanied by Biodiversity (Bio Sci 1223).

**BIO SCI 1229 Biodiversity Lab** (LAB 1.0)
This lab course is designed to accompany instruction in the Biodiversity class. Lab and field explorations of the varieties of life, with an emphasis on form, function, ecology, and evolution of plants and animals and other organisms. Prerequisite: Preceded or accompanied by Biodiversity (Bio Sci 1223).

**BIO SCI 1213 Principles of Biology** (LEC 3.0)
A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms. An in-depth study of the fundamental principles governing all living organisms from the molecular to the population level. Required for Biological Sciences majors. Cannot also receive credit for Bio Sci 1113. Prerequisite: Biological Science majors only.

**BIO SCI 1213 Principles of Biology** (LEC 3.0)
A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms. An in-depth study of the fundamental principles governing all living organisms from the molecular to the population level. Required for Biological Sciences majors. Cannot also receive credit for Bio Sci 1113. Prerequisite: Biological Science majors only.

**BIO SCI 1213 Principles of Biology** (LEC 3.0)
A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms. An in-depth study of the fundamental principles governing all living organisms from the molecular to the population level. Required for Biological Sciences majors. Cannot also receive credit for Bio Sci 1113. Prerequisite: Biological Science majors only.
**BIO SCI 2001 Special Topics** (LEC 1.0 and LAB 2.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

**BIO SCI 2213 Cell Biology** (LEC 3.0)
The structure and function of eukaryotic and prokaryotic cells. Emphasis on macromolecules, organelles, metabolic pathways, bioenergetics, cell signaling, the cell cycle, and gene expression. Prerequisites: Preceded or accompanied by CHEM 1320.

**BIO SCI 2219 Cell Biology Laboratory** (LAB 1.0)
Laboratory course to accompany Cell Biology (BIO SCI 2213). Laboratory work includes microscopy, biochemical assays, enzymology, and genetic analysis (PCR, mapping, electrophoresis, transfection, sequencing). Prerequisite: Preceded or accompanied by BIO SCI 2213.

**BIO SCI 2223 General Genetics** (LEC 3.0)
The study of the principles of heredity and reasons for variation in living organisms. Includes Mendelian principles, molecular, population, and evolutionary genetics with examples from a diverse array of species. Prerequisite: Bio Sci 1113 or 1213.

**BIO SCI 2242 Cave Biology** (LEC 1.0 and LAB 1.0)
In Cave Biology, we will study cave organisms and cave ecosystems. We will cover such topics as growth of speleothems, caves as a natural laboratory, behavior of cave animals, and regressive characteristics of cave species. We will investigate the relationship between Karst topography (caves, springs, sinkholes) and underground water contamination. Prerequisites: Any Geology, Environmental Engineering, or Biological Sciences class except Bio Sci 1201.

**BIO SCI 2243 Sleep: Function and Dysfunction** (LEC 3.0)
Students will learn the genes, proteins, and anatomy that govern sleep regulation. The course will also cover how sleep deprivation changes the body and degrades health and performance as well as sleep disorders that may disrupt sleep. Prerequisite: Bio Sci 1113 or 1213.

**BIO SCI 2252 Vegetation of the Ozarks** (LAB 1.0 and LEC 1.0)
The Vegetation of the Ozarks class is an intense, outdoor educational experience focusing on the plants and plant communities of the Missouri Ozarks. The five day long course teaches participants to identify much of the flora of the region and provides practice and instruction in the use of dichotomous keys for plant identification. Prerequisites: Bio Sci 1213 or Bio Sci 1113.

**BIO SCI 2263 Ecology** (LEC 3.0)
Relationships between organisms and the environment. Topics include the influence of environmental factors on individual organisms, population dynamics, interspecific associations, and entire ecosystems. Prerequisite: Bio Sci 1113 or Bio Sci 1213 or Bio Sci 1223.

**BIO SCI 2264 Field Ecology** (LEC 1.0 and LAB 1.0)
Field-based class designed to teach students applications of ecological research. Students will study distribution and abundance of organisms in aquatic and terrestrial systems in the Ozarks. Class includes lectures and field sampling in the Rolla area. Prerequisite: Any Bio Sci course.

**BIO SCI 2233 Nutrition** (LEC 3.0)
This introductory course provides an overview of the principles of nutritional science. Topics include the description and functions of nutrients, how nutrients are digested and absorbed, effects of nutrient imbalances, food sources, nutrient interactions, dietary guidelines, and the role of nutrition in weight management, health and disease. Prerequisites: Bio Sci 1113 or Bio Sci 1213.

**BIO SCI 2353 Zoology** (LEC 3.0)
Survey class that explores the diversity of animal life. Emphasis on the morphology, physiology, development, ecology, and phylogeny of animals and protozoans.

**BIO SCI 2359 Zoology Laboratory** (LAB 1.0)
Bio Sci 2359 is designed to accompany Bio Sci 2353 and consists of laboratory and field explorations of the diversity of animal life. Prerequisite: Preceded or accompanied by Bio Sci 2353.

**BIO SCI 2372 Issues in Public Health** (LEC 3.0)
Issues in Public Health investigates chronic and infectious diseases and the impact of globalization on such diseases, environmental toxins, and controversies in public health. Students will develop an awareness of current public health issues and trends in order to make informed arguments and personal choices. Prerequisite: Bio Sci 1113 or Bio Sci 1213.

**BIO SCI 2383 Plant Biology** (LEC 3.0)
An intermediate class covering plant form and function. Topics include the cellular structures unique to plants, their life cycles, and the mechanisms they use to survive, reproduce, and convert solar energy into a form usable by all other organisms. Prerequisite: Bio Sci 1113 or Bio Sci 1213 or Bio Sci 1223.

**BIO SCI 2389 Plant Biology Laboratory** (LAB 1.0)
Bio Sci 2389 is designed to accompany Bio Sci 2383 and consists of experiments that will supplement and extend the lectures in Bio Sci 2383. Among the topics to be covered are photosynthesis, diversity, respiration, anatomy and development, hormones, and transpiration. Prerequisites: Bio Sci 1219, preceded or accompanied by Bio Sci 2383.

**BIO SCI 3000 Special Problems** (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

**BIO SCI 3001 Special Topics** (LAB 0.0 and LEC 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

**BIO SCI 3110 Introduction to Biomedical Engineering** (LEC 3.0)
This course will provide an introduction to the interdisciplinary field of biomedical engineering. The molecular, cellular, physiological and engineering principles that govern the field will be covered. Applications will include biomaterials, tissue engineering, biomechanics, bioimaging, bioinstrumentation, bio-nanotechnology and artificial organs. Prerequisite: Junior standing or above. (Co-listed with Cer Eng 3110 and Chem Eng 3210).
**BIO SCI 3233 Evolution** (LEC 3.0)
A survey of the genetic and environmental mechanisms associated with organic evolution. Prerequisites: Bio Sci 2223.

**BIO SCI 3313 Microbiology** (LEC 3.0)
General introduction to the culture and study of microorganisms, their physiology, structure, and contribution to biology. Prerequisite: Chem 1320 and Bio Sci 2213.

**BIO SCI 3319 Microbiology Lab** (LAB 2.0)
General introduction to the techniques used for the culture and identification of microorganisms, their physiology, structure, and contribution to biology. Prerequisite: Preceded or accompanied by Bio Sci 3313.

**BIO SCI 3333 Human Anatomy and Physiology I** (LEC 3.0)
First semester of a two-semester sequence dealing with the structure and function of human organ systems. Includes the study of cells, tissues, and the integumentary, skeletal, muscular and nervous systems. Prerequisites: BIO SCI 1113 or BIO SCI 1213; BIO SCI 2213.

**BIO SCI 3339 Human Anatomy and Physiology I Lab** (LAB 1.0)
Laboratory accompanying Human Anatomy and Physiology I (Bio Sci 3333). This course may be taken separately at a later date. Prerequisite: Preceded or accompanied by Bio Sci 3333.

**BIO SCI 3343 Human Anatomy and Physiology II** (LEC 3.0)
Second semester of a two-semester sequence dealing with the study of the structure and function of human organ systems, including the endocrine, cardiovascular, lymphatic, respiratory, digestive, urinary and reproductive systems. Prerequisites: BIO SCI 1113 or BIO SCI 1213; BIO SCI 2213.

**BIO SCI 3349 Human Anatomy and Physiology II Laboratory** (LAB 1.0)
Laboratory accompanying Human Anatomy and Physiology II (Bio Sci 3343). This course may be taken separately at a later date. Prerequisite: Preceded or accompanied by Bio Sci 3343.

**BIO SCI 3353 Comparative Vertebrate Anatomy** (LAB 2.0 and LEC 2.0)
An integrated, comparative study of vertebrate structures and systems, with emphasis on evolution, development and function. Includes examination of gross anatomy and histology of selected forms. Prerequisites: Bio Sci 1223, Bio Sci 1229.

**BIO SCI 3353H Comparative Vertebrate Anatomy - Honors** (LAB 2.0 and LEC 2.0)

**BIO SCI 3483 Biomedical Problems** (LEC 3.0)
This course will use a problem-based learning approach to examine biological aspects of various medical conditions. Students will work in groups and individually to answer problems related to diagnostic testing and evaluation of diseases and other medical conditions. Prerequisites: Bio Sci 3333 or 3343.

**BIO SCI 3783 Biological Design and Innovation I** (LAB 3.0)
Students identify significant problems in biological/biomedical sciences, and then design and implement innovative solutions using advanced techniques. Students present and defend proposals and results. Prerequisite: At least two 2000 level or higher Biology courses.

**BIO SCI 4001 Special Topics** (LEC 0.0 and LAB 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

**BIO SCI 4010 Seminar** (RSD 1.0)
Students will work in groups to propose, research, develop, complete, and present service-learning projects that are related to the biological sciences. Prerequisites: Senior standing.

**BIO SCI 4099 Undergraduate Research** (IND 1.0-3.0)
Designed for the undergraduate student who wishes to engage in research. Not for graduate credit. Not more than six credit hours for graduation credit. Subject and credit to be arranged with the instructor. Prerequisite: Consent of instructor.

**BIO SCI 4313 Introduction to Environmental Microbiology** (LEC 3.0)
Environmental Microbiology is an interdisciplinary study of how microorganisms can impact humans and applied to solve problems such as water treatment and environmental cleanup of contaminants. This course differs from Bio Sci 6313 as no NSF-style report or presentation is required. Prerequisite: Bio Sci 3313.

**BIO SCI 4323 Molecular Genetics** (LEC 3.0)
A study of the properties and functions of DNA that make this macromolecule unique in the universe. Examples of replication, transcription, translation, repair, and regulation will be examined in viruses, prokaryotes, and eukaryotes. Prerequisites: Bio Sci 2223 and Bio Sci 2213.

**BIO SCI 4329 Molecular Genetics Laboratory** (LAB 2.0)
This course provides experience in the use of a variety of DNA manipulation techniques that are common to molecular studies. These include DNA extraction, restriction mapping, Southern blotting, recombinant plasmid construction, DNA sequencing and analysis, and polymerase chain reaction. Prerequisite: Preceded or accompanied by Bio Sci 4323.

**BIO SCI 4343 Introduction to Geomicrobiology** (LEC 3.0)
Microorganisms have profound effects on the environment around them and have influenced biochemical and mineralogical processes throughout time. This course will explore the impact microorganisms have on geological processes. Prerequisites: Bio Sci 4323.

**BIO SCI 4353 Cancer Cell Biology** (LEC 3.0)
Advanced biology course examining cellular processes that go awry during tumorigenesis. We will discuss cell cycle controls, signal transduction pathways, DNA repair, telomerase, apoptosis, cell migration and adhesion that are altered in cancer cells. Prerequisite: Bio Sci 2213.

**BIO SCI 4353H Cancer Cell Biology-Honors** (LEC 3.0)
**BIO SCI 4363 Freshwater Ecology** (LEC 3.0)
The ecology of streams, lakes, and wetlands. The course will cover the physical and chemical characteristics of freshwater environments, the diversity of life in freshwaters, biogeochemical processes, and threats to freshwater systems. Prerequisite: Bio Sci 2263.

**BIO SCI 4373 Stem Cell Biology** (LEC 3.0)
This course will cover the fast-moving field of stem cell biology. Topics include: development and organogenesis, regeneration and repair, stem cell types and sources, pluripotency and reprogramming, stem cells and cancer, therapeutics, and ethics. Prerequisites: Bio Sci 2213.

**BIO SCI 4383 Toxicology** (LEC 3.0)
A study of natural and man-made toxics, various possible routes of exposure, absorption, distribution, biotransformation, specific target sites, and mechanisms involved in elicitation of toxic effects, as well as detoxification and excretion. Prerequisites: Bio Sci 2213, at least Junior standing.

**BIO SCI 4423 Introduction to Astrobiology** (LEC 3.0)
An overview of the origins of life on early earth and the possibility of life on extraterrestrial bodies will be examined in this course through lectures and journal articles. The techniques that astrobiologists use to investigate the possibility of life beyond earth will be explored. Assessment will be based on exam performance and participation in class. Prerequisites: Bio Sci 2213 or Bio Sci 3313.

**BIO SCI 4433 Genomics** (LEC 3.0)
This course offers a general overview of the field of genomics. Topics covered include genome sequencing and annotation, transcriptomics, proteomics, metabolomics, genomic variation, and an overview of human, and several animal, plant, and microbial genome projects. Prerequisite: Bio Sci 4323.

**BIO SCI 4493 General Virology** (LEC 3.0)
An overview of the field of virology, including plant, animal, and bacterial viruses. Discussions will include morphology, classification, virus-host interactions, genetics, clinical and industrial aspects of viruses, and viruses as model systems for basic biological studies. Prerequisites: Bio Sci 1113 or 1213; Bio Sci 2213, 3313, Chem 1310, 1320, 2210.

**BIO SCI 4493H General Virology-Honors** (LEC 3.0)
An intermediate course in cellular neurobiology. Emphasis will be placed on the unique properties of neurons and other excitable cells. Topics covered include the structure and biophysical properties of neurons, synaptic transmission, neurochemistry, signal transduction, neuropharmacology and neurodevelopment. Prerequisite: Bio Sci 2213.

**BIO SCI 4563 Global Ecology** (LEC 3.0)
This class covers ecological topics at large scales, emphasizing global scales. Topics include global energy balance, biogeochemical cycles of water, carbon, nitrogen, and other biologically important elements, and global biodiversity. Students will focus on primary literature related to global ecology. Prerequisite: Bio Sci 2263.

**BIO SCI 4666 Nanobiotechnology** (LEC 3.0)
Nanotechnology has emerged to change human economy and society in many aspects. Applications of nanotechnology in life science is termed nanobiotechnology. This course describes recent development of nanobiotechnology in basic biological research as well as biomedical applications. Prerequisite: Bio Sci 2213 or Bio Sci 2223.

**BIO SCI 5000 Special Problems** (IND 0.0-6.0)
Graduate problems or readings on specific subjects or projects in the department. Prerequisite: Consent of the instructor.

**BIO SCI 5001 Special Topics** (LEC 0.0 and LAB 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

**BIO SCI 5010 Graduate Seminar** (RSD 0.0-6.0)
Presentation and discussion of current topics in Applied and Environmental Biology.

**BIO SCI 5040 Oral Examination** (Variable)
After completion of all other program requirements, oral examinations for on-campus M.S./PH.D students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

**BIO SCI 5099 Graduate Research** (IND 0.0-15)
Investigation of an advanced nature leading to the preparation of a thesis or dissertation.

**BIO SCI 5210 Biomaterials I** (LEC 3.0)
This course will introduce senior undergraduate students to a broad array of topics in biomaterials, including ceramic, metallic, and polymeric biomaterials for in vivo use, basic concepts related to cells and tissues, host reactions to biomaterials, biomaterials-tissue compatibility, and degradation of biomaterials. Prerequisite: Senior undergraduate standing. (Co-listed with Chem Eng 5200, MS&E 5310).

**BIO SCI 5240 Tissue Engineering** (LEC 3.0)
The course will use problem-based case studies to introduce junior and senior undergraduate students to the principles and clinical applications of tissue engineering. Topics include the use of biomaterials, scaffolds, cells, and external factors to develop implantable parts for the restoration, maintenance, or replacement of tissues and organs. Prerequisite: Junior or Senior standing. (Co-listed with MS&E 5210).

**BIO SCI 5313 Pathogenic Microbiology** (LEC 3.0)
A study of medically important microorganisms. Students will learn about the properties that enable organisms to cause disease as well as the disease process within the host. Special emphasis will be placed on recent advances in the molecular genetics of host pathogen interaction. Prerequisite: Bio Sci 2213 or Civ Eng 2601.
**BIO SCI 5323 Bioinformatics** (LEC 3.0)
The course will familiarize students with the application of computational methods to biology, as viewed from both perspectives. It will introduce problems in molecular, structural, morphological, and biodiversity informatics, and will discuss principles, algorithms, and software to address them. Prerequisites: A grade of "C" or better in both one of Bio Sci 1113 or Bio Sci 1213 and one of Comp Sci 1570 and Comp Sci 1580 or Comp Sci 1971 and Comp Sci 1981. (Co-listed with COMP SCI 5700).

**BIO SCI 5343 Biology of Aging** (LEC 3.0)
We will discuss the proximate and ultimate mechanisms of aging, and review a few leading theories of aging with the emphases on oxidative stress and life history tradeoffs. We will take the comparative approach to study aging across species, and the interventions that extend animals' lifespan, and explore why they may or may not work on humans. Prerequisites: Bio Sci 2213.

**BIO SCI 5353 Developmental Biology** (LEC 3.0)
Study of the patterns of development of the vertebrate embryo, the molecular mechanisms of tissue induction, and interactions among developing tissues. Prerequisite: Bio Sci 2213.

**BIO SCI 5423 Advanced Biodiversity** (LEC 3.0)
This course focuses on the enhancement and reduction of biodiversity and modern techniques of measuring and monitoring it. Topics include biogeography, community structure, competition, predation, food webs, geology-biology relationships, environmental change, and human impact. Additional costs and a week-long field trip are required. Prerequisite: Bio Sci 2233 or Bio Sci 2263.

**BIO SCI 5533 Pharmacology** (LEC 3.0)
The basic principles of drug action, pharmacokinetics, pharmacodynamics and toxicity. We will emphasize the actions of drugs used to treat cardiovascular and nervous system disorders. Students will review the primary literature to prepare both written and oral reports on drug actions. Prerequisite: Bio Sci 2213.