

BIOLOGICAL SCIENCES

Biology encompasses the study of life and living organisms. Biology embraces a vast and rapidly expanding body of knowledge and inquiry, including:

- Biochemistry, cellular biology, and molecular biology
- Anatomy and physiology of cells, tissues, organs, and organ systems
- Evolution, natural history, and biodiversity of all forms of life
- Ecology of organisms, populations, communities and ecosystems

Biology draws on the physical sciences (chemistry, physics, mathematics, and earth sciences), as well as informational and behavioral sciences, for analysis and interpretation of life processes and interrelationships.

The study of biology provides an academic foundation for career and postgraduate opportunities in:

- Research (in academic, industrial, government, chemical, agriculture, pharmaceutical, and environmental labs)
- Education (teaching and graduate study)
- Healthcare (human medicine, dentistry, pharmacy, veterinary medicine, physical therapy, etc)

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 offer greater depth and specific information leading to proficiency and preparation for employment and other postgraduate activities.

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 and enhanced understanding.

Missouri S&T students who have received their B.S. degrees in biological sciences have an excellent record of success. Average performance on nationally normed achievement examinations has been very high, and acceptance of Missouri S&T students in professional schools of medicine, dentistry and pharmacy, and subsequent performance of our students in these schools, remains exceptional. Missouri S&T biological sciences graduates have been accepted into prestigious graduate study programs in many areas, including biochemistry, microbiology, immunology, molecular genetics and genetic engineering, marine biology, cell and mammalian physiology, human physiology, environmental science, plant physiology, and evolution. Employment opportunities are varied, and the prospects for graduates in the biological sciences remain promising. The educational experiences and depth of understanding gained by Missouri S&T biology students provide preparation and a competitive edge for a broad variety of jobs and graduate study programs.

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 Science courses.

Core Courses

BIO SCI 1201	Biological Sciences Freshman Seminar	1
BIO SCI 1113	General Biology	3
or BIO SCI 1213	Principles of Biology	
BIO SCI 1219	General Biology Lab	2
BIO SCI 1223	Biodiversity	3
BIO SCI 1229	Biodiversity Lab	1
BIO SCI 2213	Cell Biology	3
BIO SCI 2219	Cell Biology Laboratory	1
BIO SCI 2223	General Genetics	3
BIO SCI 2233	Evolution	3
BIO SCI 2263	Ecology	3
BIO SCI 4010	Seminar	1

Advanced courses, 2000 level or higher (at least one with laboratory and one 3000 or 4000 level)

Chemistry

CHEM 1310 & CHEM 1319 & CHEM 1320 & CHEM 1100	General Chemistry I and General Chemistry Laboratory and General Chemistry II and Introduction To Laboratory Safety & Hazardous Materials	9
CHEM 2210 & CHEM 2220	Organic Chemistry I and Organic Chemistry II	8

Mathematics & Physical Science

Various courses in mathematics, physics, and/or geology chosen in consultation with 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)

Computer Science/Statistics (Select one of the following:) 3-4

COMP SCI 1570 & COMP SCI 1580	Introduction To Programming and Introduction To Programming Laboratory	
or COMP SCI 197 & COMP SCI 198	Introduction To Programming Methodology and Programming Methodology Laboratory	
STAT 3111	Statistical Tools For Decision Making	
STAT 5425	Introduction to Biostatistics	

General Requirements for BA

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

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 & CHEM 2229	Organic Chemistry I Lab and Organic Chemistry II Lab	2
2 semesters of Physics and labs:		8-10
PHYSICS 1145 & PHYSICS 1119	College Physics I and General Physics Laboratory or PHYSICS 1111 General Physics I & PHYSICS 1119 and General Physics Laboratory	
PHYSICS 2145 & PHYSICS 2119	College Physics II and General Physics Laboratory or PHYSICS 2111 General Physics II & PHYSICS 2119 and General Physics Laboratory	

The following classes are highly recommended:

BIO SCI 3333	Human Anatomy and Physiology I	3
BIO SCI 3339	Human Anatomy Physiology I Lab	1
BIO SCI 3343	Human Anatomy and Physiology II	3
BIO SCI 3349	Human Anatomy and Physiology II Laboratory	1
CHEM 4610	General Biochemistry	3

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 have at least a 22 ACT, maintain a cumulative GPA of at least 2.5, and attain at least a 2.5 GPA average for all biology 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 emphasis area, even if they have completed all required course work.

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	3
ENGLISH 1160 or ENGLISH 3560	Writing And Research Technical Writing	3

SP&M S 1185	Principles Of Speech	3
At least one course in each of the following: Literature, Philosophy and Fine Arts		9
Social Sciences: 15 semester hours		
HISTORY 3530	History of Science	3
HISTORY 1100	Early Western Civilization	3
HISTORY 1200	Modern Western Civilization	3
POL SCI 1200	American Government	3
PSYCH 1101	General Psychology	3
Mathematics/Physical Science: 9 semester hours		
MATH 1103	Fundamentals Of Algebra	3
PHYSICS 1145	College Physics I	3
GEOLOGY 1110	Physical And Environmental Geology	3
Computer Science/Statistics: 3 semester hours		
3 semester hours of Computer Science or Statistics		3
Chemistry: 17 semester hours		
CHEM 1310 & CHEM 1319 & CHEM 1320 & CHEM 1100	General Chemistry I and General Chemistry Laboratory and General Chemistry II and Introduction To Laboratory Safety & Hazardous Materials	9
CHEM 2210 & CHEM 2220	Organic Chemistry I and Organic Chemistry II	8
Biological Sciences: 27 semester hours		
BIO SCI 1201	Biological Sciences Freshman Seminar	1
BIO SCI 1213 & BIO SCI 1219	Principles of Biology and General Biology Lab	5
BIO SCI 1223 & BIO SCI 1229	Biodiversity and Biodiversity Lab	4
BIO SCI 1173	Introduction to Environmental Sciences	3
BIO SCI 2213 & BIO SCI 2219	Cell Biology and Cell Biology Laboratory	4
BIO SCI 2223	General Genetics	3
BIO SCI 2233	Evolution	3
BIO SCI 2263	Ecology	3
BIO SCI 4010	Seminar	1
Education: 42 semester hours		
EDUC 1040	Perspectives In Education	2
EDUC 1104	Teacher Field Experience	2
EDUC 1164	Aiding Elementary, Middle And Secondary Schools	2
EDUC 1174	School Organization & Adm For Elementary & Secondary Teachers	2
EDUC 3216	Teaching Reading in Content Area	3
EDUC 3280	Teaching Methods And Skills In The Content Areas	6
EDUC 4298	Student Teaching Seminar	1
EDUC 4299	Student Teaching	12
ENGLISH 3170	Teaching And Supervising Reading and Writing	3
PSYCH 2300	Educational Psychology	3
PSYCH 3311	Psychological & Educational Development Of The Adolescent	3
PSYCH 4310	Psychology Of The Exceptional Child	3

Bachelor of Science Biological Sciences Degree Requirements

A minimum of 130 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:

BIO SCI 1201	Biological Sciences Freshman Seminar	1
BIO SCI 1113	General Biology	3
or BIO SCI 1213	Principles of Biology	
BIO SCI 1219	General Biology Lab	2
BIO SCI 1223	Biodiversity	3
BIO SCI 1229	Biodiversity Lab	1
BIO SCI 2213	Cell Biology	3
BIO SCI 2219	Cell Biology Laboratory	1
BIO SCI 2223	General Genetics	3
BIO SCI 2233	Evolution	3
BIO SCI 2263	Ecology	3
BIO SCI 4010	Seminar	1
Advanced biological sciences or approved course work in other departments for a total of 49 credit hours of biology-related classes to include at least one laboratory course from the following:		25
BIO SCI 3319	Microbiology Lab	
or BIO SCI 3339	Human Anatomy Physiology I Lab	
or BIO SCI 3349	Human Anatomy and Physiology II Laboratory	
or BIO SCI 4329	Molecular Genetics Laboratory	
19 semester hours of chemistry to include general chemistry		19
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 2219	and Organic Chemistry I Lab	
& CHEM 2220	and Organic Chemistry II	
& CHEM 2229	and Organic Chemistry II Lab	
2 semesters of College (Engineering) Physics and labs		8
PHYSICS 1145	College Physics I	
& PHYSICS 1119	and General Physics Laboratory	
or PHYSICS 1135	Engineering Physics I	
PHYSICS 2145	College Physics II	
& PHYSICS 2119	and General Physics Laboratory	
or PHYSICS 2135	Engineering Physics II	
Math and Statistics		8-9
MATH 1208	Calculus With Analytic Geometry I	
or MATH 1214	Calculus For Engineers I	
or MATH 1212	Business Calculus	
STAT 5425	Introduction to Biostatistics	
12 semester hours of humanities, excluding foreign language, and to include:		12
ENGLISH 1120	Exposition And Argumentation	
& ENGLISH 1160	and Writing And Research (entering students will normally take ENGLISH 1120 either semester of the first year)	
9 hours of social sciences, to include		9
HISTORY 1200	Modern Western Civilization (or equivalent)	
or HISTORY 1300	American History To 1877	
or HISTORY 1310	American History Since 1877	
or POL SCI 1200	American Government	
Total Credits		105-106

Elective credits: In consultation with his or her advisor, each student will elect sufficient additional courses to complete a minimum of 130 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>).

Ronald L Frank, Associate Professor
PHD Ohio State University

Chen Hou, Assistant Professor
PHD University of Missouri-Columbia

Yue-Wern Huang, Professor
PHD University of Wisconsin Madison

Melanie R Mormile, Professor
PHD University of Oklahoma, Norman

Dev K. Niyogi, Associate Professor
PHD University of Colorado Boulder

Julie A Semon, Assistant Professor
PHD Tulane University

Katie B Shannon, Associate Teaching Professor
PHD Harvard Medical School

Matthew Scott Thimgan, Assistant Professor
PHD The University of North Carolina at Chapel Hill

Ann E West, Adjunct Assistant Professor
PHD University of Colorado Boulder

David J Westenberg, Associate Professor
PHD University of California-Los Angeles

Terry J Wilson, Associate Teaching Professor
MASTER Missouri State University

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 1103 Microbes And Man -- Introductory Microbiology (LEC 3.0)

An introduction to the study of microorganisms in nature, especially as they affect humans. Consideration of the involvement of microorganisms in disease, decomposition, nutrition, agriculture, food processing and preservation, industrial applications and waste treatment.

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 1163 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 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 1201 Biological Sciences Freshman Seminar (RSD 1.0)

An introduction to the study of biology at Missouri S&T. Students will consider personal and professional opportunities within the various areas of biology and become acquainted with Biological Sciences faculty and departmental and campus facilities. Required of freshman Biological Sciences majors. Prerequisite: Biological Sciences 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 1219 General Biology Lab (LEC 1.0 and LAB 1.0)

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 1223 Biodiversity (LEC 3.0)

This course provides a survey of all life, but emphasizes diversity of eukaryotes including protists, fungi, plants, and animals. Emphasis is on form, function, ecology, and evolution of plants and animals and other organisms.

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 is on form, function, ecology, and evolution of plants and animals and other organisms. Prerequisite: Preceded or accompanied by Biodiversity (Bio Sci 1223).

BIO SCI 1943 Introduction to 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. Prerequisite: Any high school or college Biology course.

BIO SCI 1953 Introduction to Human Anatomy and Physiology II (LEC 3.0)

Second semester of a two-semester sequence of the study of the structure and function of human organ systems, including the endocrine, cardiovascular, lymphatic, respiratory, digestive, urinary and reproductive systems. Prerequisite: Bio Sci 1943.

BIO SCI 1983 Introduction to Biological Design and Innovation (LAB 3.0)

Students will identify problems in biomedical sciences, and then design and implement innovative solutions using advanced techniques. Students will present and defend their proposals and results. Prerequisite: Bio Sci 1993.

BIO SCI 1993 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. Prerequisite: Bio Sci 1953.

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 2233 Evolution (LEC 3.0)

A survey of the genetic and environmental mechanisms associated with organic evolution.

BIO SCI 2242 Cave Biology (LAB 1.0 and LEC 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 Bio Sci 1213.

BIO SCI 2252 Vegetation of the Ozarks (LEC 1.0 and LAB 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.

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 2333 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.

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 (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 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 3313 Microbiology (LEC 3.0)

General introduction to the culture and study of microorganisms, their physiology, structure, and contribution to biology. Prerequisite: Chem 1320.

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 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 of 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 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 0.0-6.0)

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 4333 Exercise Physiology (LEC 3.0)

Covers cardiovascular, pulmonary, and metabolic responses to aerobic and anaerobic muscular activities, work capacities, nutritional factors in performance, and role of exercise in health. Prerequisite: Bio Sci 1113 or Bio Sci 1213.

BIO SCI 4343 Comparative Chordate Anatomy (LEC 2.0 and LAB 2.0)

An integrated, comparative study of chordate 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 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 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 4383 Toxicology (LEC 3.0)

A study of natural and man-made toxicants, 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, Bio Sci 2223, at least Junior standing.

BIO SCI 4393 Immunology (LEC 3.0)

A study of the principles of immunology, including biological and biochemical aspects of the immune response, immunochemistry, serology, immunoglobulin and T-cell mediated allergies, tumor and transplantation immunology, autoimmune diseases, and the role of immunity in host defense. Prerequisites: Chem 2220 or Chem 4620 and Bio Sci 2213.

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 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 (IND 0.0)

(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 I (LEC 3.0)

The course will introduce senior undergraduate students to the principles and clinical applications of tissue engineering including the use of biomaterials scaffolds, living cells and signaling factors to develop implantable parts for the restoration, maintenance, or replacement of biological tissues and organs. Prerequisite: 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 5333 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 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 5433 Neurobiology (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 5463 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 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.