**BIOLOGY (BIOL)**

**BIOL 1010 - Essentials of Biology**  
Credit(s): 3 Credits  
Essentials of Biology is a non-majors general biology course without a laboratory. The topics that will be covered include biological molecules, cell structure and function, cellular metabolism, cell division, genetics, evolution, the diversity of life, and ecology.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1090 - Biodiversity & Conservation**  
Credit(s): 4 Credits  
Introduction to aspects of conservation of natural and managed ecosystems, as well as human environments. Foundations and applications of genetics and ecology of populations. Population growth and demographics, with special emphasis on human population and the implication on the sustainable use and management of resources and ecosystems. A continuation of BIOL-1040 for Conservation Biology students.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1100 - Introduction to Biology**  
Credit(s): 4 Credits  
This course will examine an introduction to the biochemistry of life, cellular biology and energy metabolism, development, genetics, and evolution. These biological principles will be introduced with an emphasis on the inquiry nature of the scientific process and the relevance of biology to students lives.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1140 - Our Living Environment**  
Credit(s): 3 Credits  
Environmental problems treated within a framework of fundamental ecological principles. For non-science majors.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1150 - Genetics and Human Diversity**  
Credit(s): 3 Credits  
Genetics and evolution, emphasis on human populations and forces acting to change the genetic structure of human populations; mutation and natural selection.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1200 - Ecological Issues and Society**  
Credit(s): 3 Credits  
This SLU Inquiry course provides scientific insights into a variety of popular press topics and everyday decisions about ecological issues. Topics include population harvesting, lawn and garden decisions, and global warming. For non-science majors.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1240 - Principles of Biology I**  
Credit(s): 3 Credits  
First semester of the two-semester Principles of Biology sequence. Students learn about chemical and molecular basis of living organisms, cell structure and function, gene structure, expression and heredity, animal anatomy and physiology, and animal development. In addition to learning concepts in biology, students practice critical thinking and problem-solving.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1245 - Principles of Biology I Laboratory**  
Credit(s): 1 Credit  
This course covers experimental approaches used in molecular and cellular biology, genetics, and animal physiology. Students will learn to use scientific instruments and techniques implemented in these fields. Students will propose and test hypotheses, collect and analyze data, represent data visually, and practice written and oral scientific communication skills.  
**Prerequisite(s):** BIOL 1240* or BIOL 1931*  
* Concurrent enrollment allowed.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1260 - Principles of Biology II**  
Credit(s): 3 Credits  
Second semester of the two-semester Principles of Biology sequence. Students learn fundamental principles of evolution, the diversity of life, plant biology and ecology. In addition to learning scientific concepts in biology, students practice critical thinking and problem-solving.  
**Prerequisite(s):** BIOL 1260*  
* Concurrent enrollment allowed.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1265 - Principles of Biology II Laboratory**  
Credit(s): 1 Credit  
This course covers the basic experimental approaches used in studying evolution, ecology, and community biology. Students will be taught how to use scientific instruments and laboratory techniques implemented in these fields. Students will learn to propose and test hypotheses and to collect, analyze and present data. In addition, they will gain experience in written and oral scientific communication skills.  
**Prerequisite(s):** BIOL 1260*  
* Concurrent enrollment allowed.  
**Attributes:** Natural Science Req (A&S)

**BIOL 1340 - Diversity of Life**  
Credit(s): 3 Credits  
This course will provide an overview of the diversity of life on Earth, as well as the diversity of the human species. Important local, national, and international issues and policies related to biodiversity and conservation will be discussed. For non-science majors.  
**Attributes:** International Studies-Health, Natural Science Req (A&S)

**BIOL 1360 - Concepts of Biology**  
Credit(s): 3 Credits  
A one-semester course covering scientific methodology and the basic concepts of biology ranging from the chemical to the ecological levels of organization. For non-science majors.  
**Restrictions:** Enrollment limited to students in the Schol for Professional Studies college.  
**Attributes:** Natural Science Req (A&S)
BIOL 1375 - Introduction to Cellular Biology  
Credit(s): 3 Credits  
This course explores the basic concepts of cellular biology and genetics, stressing molecular structure, cellular interactions, energy metabolism, and heredity. These principles will be introduced through the scientific method of research and applied to the relevance of biology to global issues. Interpretive and analytical skills explored through the scientific method can be applied to future academic course work and in professional settings.  
Restrictions:  
Enrollment limited to students in the Schl for Professional Studies college.  
Attributes: Prof. Studies Students Only  

BIOL 1385 - Introduction to Ecology and Evolution  
Credit(s): 3 Credits  
This course explores the basic concepts of ecology and evolution, through phylogenetic relationships, organismal form and function, biological interactions and conversation biology. These principles will be introduced through the scientific method of research and applied to the relevance of biology to global issues. Interpretive and analytical skills explored through the scientific method of research and applied to the relevance of biology to global issues. Interpretive and analytical skills explored through the scientific method can be applied to future academic course work and in professional settings.  
Restrictions:  
Enrollment limited to students in the Schl for Professional Studies college.  
Attributes: International Studies-Health, Prof. Studies Students Only  

BIOL 1400 - Biology of Health and Disease  
Credit(s): 3 Credits  
Topics include: nature of life, chemical basis of life, basic foodstuffs, vitamins, diseases caused by microbes, plants, and animals, drugs and the mind, and biology and the future of humanity. For non-science majors.  
Attributes: Natural Science Req (A&S)  

BIOL 1405 - Biology of Health and Disease  
Credit(s): 3 Credits  
Topics include: nature of life, chemical basis of life, basic foodstuffs, vitamins, diseases caused by microbes, plants, and animals, drugs and the mind, and biology and the future of humanity.  
Attributes: International Studies-Health, Prof. Studies Students Only  

BIOL 1410 - Biological Basis of Health  
Credit(s): 3 Credits  
This course examines relationships between basic biological information and a wide range of health-related topics and issues. Topics include: the chemistry of life and nutrition; molecules, cells and metabolism; diseases caused by bacteria and viruses; effects of drugs. For non-science majors.  
Attributes: Natural Science Req (A&S)  

BIOL 1450 - Drugs We Use and Abuse  
Credit(s): 3 Credits  
This course introduces students to the physiology of the human body, i.e., how different systems, such as cardiovascular, respiratory, and nervous systems, work, as well as some basic cell biology. The course additionally covers the basic pharmacology of different drugs used in our society (both legal and illicit), how they are processed by the body's systems, and how the drugs affect the body. This course is intended for non-science majors.  
Attributes: Natural Science Req (A&S)  

BIOL 1460 - Exercise and Health  
Credit(s): 3 Credits  
The course will explore exercise metabolism, how the body responds and adapts to exercise, and the health implications of physically active and sedentary lifestyles. For non-science majors.  
Attributes: Natural Science Req (A&S)  

BIOL 1500 - Plants and People  
Credit(s): 3 Credits  
This course will give students an appreciation of the importance of plants in human society. An overview of plant form and function, investigates economic and social aspects of plants, and cultural aspects of human plant use. For non-science majors.  
Attributes: Natural Science Req (A&S)  

BIOL 1510 - Exploring Animal Behavior  
Credit(s): 3 Credits  
This course introduces non-majors to the science of animal behavior. Topics include understanding how animals decide where to eat, where to live, how to fight, and with whom to mate. For non-science majors.  
Attributes: Natural Science Req (A&S)  

BIOL 1640 - Microbes, History and Society  
Credit(s): 3 Credits  
This course will take an integrative/exploratory approach to examine how microbes have shaped world history, impacted our food chain, posed health threats (bioterrorism and AIDS), and how microbes may guide our future. For non-science majors.  
Attributes: Natural Science Req (A&S)  

BIOL 1700 - Plants and Cultural Diversity  
Credit(s): 3 Credits  
An introduction to economic botany and ethnobotany through the uses of plants in medicine, nutrition, religion, and recreation in different cultures, including a minimum of three field trips to the Missouri Botanical Garden. For non-science majors.  
Attributes: Natural Science Req (A&S)  

BIOL 1750 - Introduction to Evolutionary Process and Thought  
Credit(s): 3 Credits  
This course is an introduction for non-majors to life and its diversity from an evolutionary perspective. Students will learn fundamental concepts such as natural selection, genetic drift, phylogeny and co-evolution, and apply them to the relevance to societal issues ranging from conservation biology to medicine.  
Attributes: Natural Science Req (A&S)  

BIOL 1930 - Special Topics  
Credit(s): 3 Credits (Repeatable for credit)  
Attributes: Natural Science Req (A&S)  

BIOL 1931 - Special Topics  
Credit(s): 3 Credits  
Attributes: Natural Science Req (A&S)  

BIOL 1980 - Independent Study  
Credit(s): 1-3 Credits (Repeatable for credit)  
Attributes: Natural Science Req (A&S)  

BIOL 2165 - Genetics and Social Science  
Credit(s): 3 Credits  
Attributes: Prof. Studies Students Only
BIOL 2560 - Evolution & Christian Theology  
**Credit(s): 3 Credits**  
A student successfully completing this course will be able to articulate, in speaking and writing, why biological evolution and Christian theology are not mutually opposed to each other, but may benefit from dialog with one another. The student will be able to support his/her position with knowledge gained in biblical scholarship, basic biology, complexity hypothesis, critical-analytical reading of creationism-based refutations of evolution, and modern theology. Credit not given for both BIOL-2560 and THEO-2820.  
**Attributes:** Natural Science Req (A&S)  

BIOL 2600 - Human Physiology  
**Credit(s): 3 Credits**  
**Restrictions:** Enrollment is limited to students with a program in Biomedical Engineering.  
**Attributes:** Natural Science Req (A&S)  

BIOL 2800 - Biology for Education Majors  
**Credit(s): 4 Credits**  
This course is offered for elementary education majors. A variety of teaching methods will be used so that students with different learning styles may master the material. Curiosity and creativity are encouraged.  
**Attributes:** Natural Science Req (A&S)  

BIOL 2930 - Special Topics  
**Credit(s): 3 Credits (Repeatable for credit)**  
**Attributes:** Natural Science Req (A&S)  

BIOL 2980 - Independent Study  
**Credit(s): 1-3 Credits (Repeatable for credit)**  
**Attributes:** Natural Science Req (A&S)  

BIOL 3010 - Evolutionary Biology  
**Credit(s): 3 Credits**  
This course explores the principles of evolutionary biology through a discussion/lecture format. Topics covered include the theory of evolution, origin of new species, genetics of populations, relative roles of selection, drift, mutation, and migration in the evolutionary process, evolutionary rates, and pre-biotic evolution.  
**Prerequisite(s):** CHEM 1120; (BIOL 1060 or (BIOL 1260 and BIOL 1265))  
**Attributes:** Natural Science Req (A&S)  

BIOL 3020 - Biochemistry and Molecular Biology  
**Credit(s): 3 Credits**  
This course on cellular/molecular biochemistry includes the synthetic flow of genetic information from DNA to RNA to protein (replication, transcription and translation), RNA and protein structure and function, enzymology, and energy flow (metabolism). It is designed as a foundation course for subsequent upper division cellular/molecular biology courses, including Molecular Cell Biology II (BIOL 3040) and Genetics (BIOL 3030).  
**Prerequisite(s):** (BIOL 1240 and BIOL 1260); (CHEM 1110 or CHEM 1130); (CHEM 1120 or CHEM 1140))  
**Attributes:** Natural Science Req (A&S)  

BIOL 3030 - Principles of Genetics  
**Credit(s): 3 Credits**  
This course covers the basic principles of genetics, including transmission genetics, molecular genetics, gene regulation, recombinant DNA technology and genomics. Throughout the course, there is an emphasis on the application of genetics to experimental and problem-solving situations.  
**Prerequisite(s):** (BIOL 3020 or CHEM 4620)  
**Attributes:** Chemical Biology Elective, Natural Science Req (A&S)  

BIOL 3040 - Cell Structure & Function  
**Credit(s): 3 Credits**  
Building on the principles introduced in BIOL-3020, this course explores how specific proteins, lipids, sugars and nucleic acids contribute to cellular processes and structure. The material covered here provides a good foundation for upper-level courses in Development, Physiology, Microbiology and Immunology.  
**Prerequisite(s):** (BIOL 3020)  
**Concurrent enrollment allowed.**  
**Attributes:** Chemical Biology Elective, Natural Science Req (A&S)  

BIOL 3060 - Cell Structure & Function Laboratory  
**Credit(s): 1 Credit**  
Basic concepts in cell biology stressed in a laboratory setting. Protein and lipid components of biological membranes, DNA comparison of prokaryotic and eukaryotic organisms, principles of protein synthesis, establishment of primary cell cultures, analysis of the cytoskeleton and the extracellular matrix. Techniques stressed will include microscopy (light/fluorescent), SDS-PAGE and protein determination, thin layer chromatography, receptor analysis and the application of sterile culture to the study of cells.  
**Prerequisite(s):** BIOL 3040; (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
**Concurrent enrollment allowed.**  
**Restrictions:** Enrollment is limited to students with a major in Biology.  
**Attributes:** Cellular/Molecular Lab, Natural Science Req (A&S)  

BIOL 3100 - Experiments in Genetics Lab  
**Credit(s): 1 Credit**  
Advanced experiments in classical and molecular genetics will be conducted by the students. Data will be collected, analyzed, and reported.  
**Prerequisite(s):** BIOL 3030  
**Concurrent enrollment allowed.**  
**Restrictions:** Enrollment is limited to students with a major in Biology.  
**Attributes:** Cellular/Molecular Lab, Natural Science Req (A&S)  

BIOL 3220 - Biology of Invertebrates  
**Credit(s): 4 Credits**  
his course surveys the invertebrate phyla with emphases on evolution, comparative morphology, life cycles, physiology, and ecology.  
**Prerequisite(s):** (BIOL 1060 or (BIOL 1260 and BIOL 1265)); BIOL 1640  
**Restrictions:** Enrollment is limited to students with a major in Biology.  
**Attributes:** Natural Science Req (A&S), Systematic/Organismal Lab, Systematic/Organismal Biol  

BIOL 3260 - Biology of Plants & Fungi  
**Credit(s): 4 Credits**  
An introduction to algae, fungi, and true plants comparing life cycles (alternation of generations) and functional anatomy/morphology. Half of the course emphasizes the four developmental stages in the life of seed plants: germination, establishment, maturation, and reproduction.  
**Prerequisite(s):** (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
**Restrictions:** Enrollment is limited to students with a major in Biology.  
**Attributes:** Morph/Phys/Dev Lab, Natural Science Req (A&S), Morph/Physiology/Dev. Biol, Plant Science
BIOL 3280 - Ethnobotany
Credit(s): 3 Credits
A modern synthesis of plant biology and the principles of cultural anthropology to compare the use of domesticated and wild plants. A comparison of tropical and temperate zone 'cases' requires field trips to the Missouri Botanical Garden.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120

BIOL 3305 - The Biology of Plants and Animals
Credit(s): 3 Credits
This course explores the concepts of plant and animal biological interactions in the context of conservation and biodiversity. In addition to learning about plant and animal biology, students will learn how to read, analyze and interpret scientific research and data. They will also design ecological experiments and make predictions about how scientific research affects conservation efforts. The knowledge and analytic skills gained in this course can be applied to future academic course work as well as in professional settings.
Prerequisite(s): 1 Course from BIOL 1000-1999
Restrictions:
Enrollment limited to students in the Schl for Professional Studies college.
Attributes: Prof. Studies Students Only

BIOL 3400 - Introduction to Neuroscience I: Cellular, Molecular and Systemic
Credit(s): 3 Credits
This course teaches the fundamental anatomy and physiology of the nervous system. Clinical cases and neuroscience technologies will be discussed. The course covers cellular, molecular and organ-systemic aspects of the nervous system and relevant neuronal disorders.
Prerequisite(s): BIOL 3040*
* Concurrent enrollment allowed.
Attributes: Natural Science Req (A&S)

BIOL 3410 - Concepts in Ecology
Credit(s): 3 Credits
This course will explore the fundamental concepts in ecology including organisms, populations, and ecosystems, adaptation and natural selection, changing environmental conditions, and the interactions among the myriad inhabitants of Earth. This course will strive to provide scientific insight into a variety of current issues and everyday decisions about ecological problems. The course will include discussions of the destruction of habitats by fire, pest outbreaks and control, habitat fragmentation, conservation, and global warming.
Prerequisite(s): BIOL 1000
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 3415 - Concepts in Ecology
Credit(s): 3 Credits
This course will explore the fundamental concepts in ecology including organisms, populations, and ecosystems, adaptation and natural selection, changing environmental conditions, and the interactions among the myriad inhabitants of Earth. This course will strive to provide scientific insight into a variety of current issues and everyday decisions about ecological problems. The course will include discussions of the destruction of habitats by fire, pest outbreaks and control, habitat fragmentation, conservation, and global warming.
Prerequisite(s): 1 Course from BIOL 1000-1999
Attributes: Prof. Studies Students Only

BIOL 3420 - Comparative Anatomy of the Vertebrates
Credit(s): 5 Credits
Evolution of chordate morphology. Laboratory consists of the study of the structures of each major group of chordates with emphases on the dogfish shark and cat.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Morph/Phys/Dev Lab, Natural Science Req (A&S), Morph/Physiology/Dev. Biol

BIOL 3440 - Embryology
Credit(s): 5 Credits
Development of the vertebrate embryo from a single cell into a multicellular organism. Topics include: fertilization, changes in shape and form, increase in complexity and diversity, organ formation, processes by which cells with the same genetic endowment become different from one another.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Students with a classification of Freshman may not enroll.
Enrollment is limited to students with a major in Biology.
Attributes: Morph/Phys/Dev Lab, Natural Science Req (A&S), Morph/Physiology/Dev. Biol

BIOL 3450 - Economic Botany
Credit(s): 3 Credits
Overview of plant form and function, followed by investigations into economic and social aspects of plants, including origin of important crops and health impacts. Learn how foods and spices drove world exploration, and develop your ability to critically assess modern agricultural practices, including ethics of bioprospecting and genetically modified foods. Satisfies upper-division plant biology requirement.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265))
Attributes: Natural Science Req (A&S)
BIOL 3470 - General Physiology Laboratory
Credit(s): 1 Credit
This stand-alone laboratory course is designated to supplement and reinforce material presented in the BIOL 4540, but also covers topics beyond the scope of that syllabus, largely through computer-based interactive physiology programs, and the acquisition and analysis of cardiovascular, neuromuscular, and respiratory systems data using the PowerLab human physiology teaching system. Problems involving inquiry-based learning are also assigned.
Prerequisite(s): BIOL 4540
* Concurrent enrollment allowed.
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Morph/Phys/Dev Lab, Natural Science Req (A&S)

BIOL 3480 - Exercise Physiology
Credit(s): 3 Credits
Using exercise biochemistry as a foundation, this course will examine the responses and adaptations to physical exercise and/or inactivity, with special emphases on health, energy metabolism, and endocrinology.
Prerequisite(s): (BIOL 1040 or (BIOL 1240 and BIOL 1245)); (BIOL 1060 or (BIOL 1260 and BIOL 1265))
Attributes: Natural Science Req (A&S)

BIOL 3490 - Plant Physiology
Credit(s): 3 Credits
Principles of plant physiology: growth, phytomolecules, flowering, photosynthesis, water relations, mineral nutrition, translocation in higher plants.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Attributes: Chemical Biology Elective, Natural Science Req (A&S), Morph/Physiology/Dev. Biol, Plant Science

BIOL 3500 - Biodiversity of Africa I
Credit(s): 0 Credits
An introduction to the biodiversity of the tropical rainforest of equatorial Africa and the role this biodiversity plays in the culture of the native peoples of Gabon and Cameroon.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 3510 - Biodiversity of Africa II: Field Trip
Credit(s): 3 Credits
A field trip to study the biodiversity of the tropical rainforest and the role this biodiversity plays in the culture of the native peoples of Gabon and Cameroon.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Population/Evolutionary Lab

BIOL 3550 - Neuroscience Laboratory
Credit(s): 1 Credit
This course introduces to students basic neuroanatomy, as well as cellular and molecular neuroscience through hands-on laboratory exercises using a variety of techniques such as electrophysiology, computational neuroscience, immunohistochemistry, pharmacology, and cell culture. Students will design and conduct their own group projects.
Prerequisite(s): (NEUR 3400 or BIOL 3400)
* Concurrent enrollment allowed.
Attributes: Natural Science Req (A&S)

BIOL 3590 - Internship
Credit(s): 1-6 Credits (Repeatable for credit)

BIOL 3930 - Special Topics
Credit(s): 1-3 Credits (Repeatable for credit)
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 3980 - Independent Study
Credit(s): 1-3 Credits (Repeatable for credit)
Attributes: Natural Science Req (A&S)

BIOL 4010 - Sex, Evolution, and Behavior
Credit(s): 3 Credits
This course is an in-depth examination of evolutionary theories concerning the sexual reproduction, parthenogenesis, mate choice, sexual selection, life history strategies, and sex allocation. Specialized topics such as pheromone communication will also be covered.
Prerequisite(s): BIOL 3010
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio

BIOL 4020 - Vertebrate Reproductive Physiology
Credit(s): 3 Credits
This course is an in-depth examination of reproduction in the vertebrates. Topics include the development of the sex organs, gametogenesis, hormone function, and regulation of gonadal function, pregnancy, and parturition.
Prerequisite(s): BIOL 3040
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Morphology/Dev. Biol

BIOL 4030 - Introduction to Genomics
Credit(s): 3 Credits
This course introduces core concepts, techniques and analytical methods of genomics. The topics of this course include: genome projects; structure, components and evolutionary dynamics of genomes; sequencing, mapping and assembly techniques; online resources, databases and analytical methods for genomic studies.
Prerequisite(s): BIOL 3020; BIOL 3030
Attributes: Natural Science Req (A&S)
BIOL 4040 - Pollination Biology
Credit(s): 3 Credits
The function and evolution of the reproductive organs of seed plants based on their morphology, biochemistry, breeding system, genetics, and ecological relationships between flowers and such pollinators as insects, vertebrates, and air currents. Includes field trips to the Missouri Botanical Garden.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Plant Science, Population/Evolutionary Bio

BIOL 4050 - Molecular Technique Lab
Credit(s): 2 Credits
This course will provide students with experience in the theory and practice of molecular biology techniques. Topics to be covered include DNA isolation, cloning, PRC, DNA sequencing, and bioinformatics.
Prerequisite(s): BIOL 3020
* Concurrent enrollment allowed.
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 4060 - Structure and Function of Ecosystems
Credit(s): 3 Credits
Principles of ecology developed through an understanding of the nature and properties of ecosystems.
Prerequisite(s): BIOL 4750
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio

BIOL 4070 - Advanced Biological Chemistry
Credit(s): 3 Credits
This course is designed to increase students’ understanding of biochemical principles, current research questions, and biochemical strategies to answer these questions. Topics covered will include protein structure and function, enzymology, protein engineering, experimental design and interpretation of results.
Prerequisite(s): BIOL 3020; BIOL 3040
Restrictions:
Enrollment is limited to students with a classification of Senior.
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 4080 - Advanced Cell Biology
Credit(s): 3 Credits
This course is designed to deepen students’ understanding of cell biology principles, experimental strategies, and current research questions. Topics covered will include how different categories of molecules regulate cellular activity and literature, experimental design and interpretation of results.
Prerequisite(s): BIOL 3040
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 4090 - Plant Ecology
Credit(s): 3 Credits
Principles of plant autecology and synecology. The nature and properties of plant communities - structure, development, and distribution. The interaction of the individual plant with its environment.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Plant Science, Population/Evolutionary Bio

BIOL 4100 - Natural History of Vertebrates
Credit(s): 4 Credits
This field-based course introduces students to the diversity of plant communities in the Ozark Mountain region of Missouri and to the tools scientists use to quantify that diversity. Class and laboratory activities will be conducted at Reis Biological Field Station and at nearby parks and natural areas.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
 Attributes: Natural Science Req (A&S), Population/Evolutionary Lab, Population/Evolutionary Bio

BIOL 4110 - Natural History
Credit(s): 1 Credit
An extended field trip to study the ecology of vertebrates, and the ecological features of fishes, amphibians, reptiles, birds, and mammals. Week-end field trips are required. This course does not fulfill a B.Sc. area requirement.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Population/Evolutionary Lab, Population/Evolutionary Bio

BIOL 4120 - Field Botany
Credit(s): 5 Credits
This field-based course introduces students to the diversity of plant communities in the Ozark Mountain region of Missouri and to the tools scientists use to quantify that diversity. Class and laboratory activities will be conducted at Reis Biological Field Station and at nearby parks and natural areas.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265))
Corequisite(s): BIOL 4130,BIOL 4140,BIOL 4980
Attributes: Natural Science Req (A&S)

BIOL 4130 - Field Mammalogy
Credit(s): 5 Credits
This course examines the evolution, physiology, ecology and behavior of mammals. Emphasis on field identification and field methods used to study the behavior and ecology of mammals. The course is taught at the Reis Biological Field Station. Students cannot receive credit for this course and Biology of Mammals (BIOL-4380).
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265))
Corequisite(s): BIOL 4120,BIOL 4140,BIOL 4980
Attributes: Natural Science Req (A&S)
BIOL 4140 - Field Ornithology  
**Credit(s):** 5 Credits  
This course examines the evolution, physiology, ecology and behavior of birds. Emphasis on field identification and field methods used to study bird behavior and ecology. The course is taught at the Reis Biological Field station. Students cannot receive credit for this course and Biology of Birds (BIOL-4310).  
**Prerequisite(s):** (BIOL 1060 or (BIOL 1260 and BIOL 1265))  
**Corequisite(s):** BIOL 4120, BIOL 4130, BIOL 4980  
**Attributes:** Natural Science Req (A&S)  

BIOL 4150 - Nerve Cell Mechanisms in Behavior  
**Credit(s):** 3 Credits  
A comprehensive introductory neuroscience course which covers electrophysiology of action potentials and synapses, channels, neurotransmitters, sensory and motor systems, development, neuroanatomy, and integrative brain function.  
**Prerequisite(s):** (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
**Restrictions:**  
Enrollment is limited to students with a major in Biology.  
**Attributes:** Cellular/Molecular Biol, Natural Science Req (A&S)  

BIOL 4160 - Microbial Ecology and Molecular Evolution  
**Credit(s):** 4 Credits  
This course will actively engage students in the creative process of scientific inquiry, provide skills necessary for success in the modern research laboratory, and foster excitement about the discovery process central to research in microbial ecology and molecular evolution. Discussions will include critical evaluation of primary literature in the field.  
**Prerequisite(s):** BIOL 3020  
**Attributes:** Natural Science Req (A&S)  

BIOL 4170 - Introduction to GIS  
**Credit(s):** 3 Credits  
This class introduces concepts, science and theory of GIS with hands-on experiences. After successful completion of the course, students will be able to demonstrate fundamental techniques of geospatial analysis and mapping.  
**Restrictions:**  
Enrollment is limited to students with a major in Biology.  
**Attributes:** Natural Science Req (A&S)  

BIOL 4180 - Intermediate Geographic Information Systems  
**Credit(s):** 1 or 3 Credits  
This course covers intermediate and advanced topics in GIS including remote sensing for GIS, geospatial statistics and GIS in biogeography. Each part is instructed by a professor specialized in the particular area. Students may only apply credits towards their graduation requirements from one of the following courses: EAS-4180, BIOL-4180, or SOC-4660.  
**Prerequisite(s):** (EAS 4170, BIOL 4170, or SOC 4650)  
**Restrictions:**  
Enrollment is limited to students with a major in Biology.  
**Attributes:** Natural Science Req (A&S)  

BIOL 4190 - GIS in Biology  
**Credit(s):** 3 Credits  
This course provides an introduction to the application of Geographic Information System (GIS) techniques to research in organismal biology. The goal of this course is to provide training in the spatial analysis of biodiversity using GIS software. The course will involve an integration of lectures, group discussions, and computer exercises.  
**Restrictions:**  
Enrollment is limited to students with a major in Biology.  
**Attributes:** Natural Science Req (A&S)  

BIOL 4200 - Aquatic Ecology  
**Credit(s):** 4 Credits  
An exploration of freshwater ecosystems in Missouri including springs, rivers, and lakes. The course will explore the diversity of living organisms, both animals and plants, found in these ecosystems. A major goal will be to understand how the physical and chemical properties of water affect the abundance and diversity of aquatic organisms. Week-end field trips are required. This course is also taught during the summer at the Reis Field Station.  
**Prerequisite(s):** (BIOL 1060 or (BIOL 1260 and BIOL 1265))  
**Restrictions:**  
Enrollment is limited to students with a major in Biology.  
**Attributes:** Natural Science Req (A&S), Plant Science, Systematic/Organismal Biol  

BIOL 4210 - Biology and Classification of Orchids  
**Credit(s):** 3 Credits  
An introduction to the evolution, classification, and distribution of the Orchidaceae (the largest family of flowering plants). The course will cover how their functional anatomy/morphology encourages their unique interactions with trees, fungi, and a range of insects. Includes one field trip to the Missouri Botanical Garden.  
**Prerequisite(s):** (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
**Restrictions:**  
Enrollment is limited to students with a major in Biology.  
**Attributes:** Natural Science Req (A&S), Plant Science, Systematic/Organismal Biol  

BIOL 4220 - Aquatic Biology Field Trip  
**Credit(s):** 3 Credits  
A companion course to BIOL 4200. Explores the diversity of lakes of Western North America through a one-month field trip. Ten lakes from California to the Northwest Territories, Canada will be compared in terms of physical and chemical properties, water chemistry and biotic diversity.  
**Prerequisite(s):** (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
**Restrictions:**  
Enrollment is limited to students with a major in Biology.  
**Attributes:** Natural Science Req (A&S)  

BIOL 4240 - General and Medical Entomology  
**Credit(s):** 4 Credits  
This course is a survey of the natural history, classification, and phylogeny of insects, with an emphasis on common insects. Field trips during laboratory hours.  
**Restrictions:**  
Enrollment is limited to students with a major in Biology.  
**Attributes:** Natural Science Req (A&S), Systematic/Organismal Lab, Systematic/Organismal Biol
BIOL 4250 - Neurobiology of Disease
Credit(s): 3 Credits
This course takes a problem-based learning approach to study fundamental aspects of diseases affecting the nervous system. Students will gain an understanding of basic cellular and molecular concepts related to neurobiological disorders and the experimental approaches used to investigate them.
Prerequisite(s): BIOL 3040
Attributes: Natural Science Req (A&S)

BIOL 4260 - Biology of Amphibians and Reptiles
Credit(s): 4 Credits
Lecture three hours, laboratory four hours per week. This course is a survey of the diversity, natural history, evolution, and biology of amphibians and reptiles. Week-end field trips are required.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions: Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Systematic/Organismal Lab, Systematic/Organismal Biol

BIOL 4270 - Field Studies with Amphibians and Reptiles
Credit(s): 1 Credit
An extended field trip to study the ecology of amphibians and reptiles. This course does not fulfill a B. Sc. area requirement.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions: Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 4280 - Biology of Fishes
Credit(s): 4 Credits
Introduction of the study of fishes: systematics, ecology, behavior, evolution, and the economic importance of freshwater and marine fishes. Laboratory acquaints students with 80 of the 400 fish families. Week-end field trips are required to study the Missouri fish fauna.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Attributes: Natural Science Req (A&S), Systematic/Organismal Lab, Systematic/Organismal Biol

BIOL 4290 - Biology of Fishes: Field Trip
Credit(s): 1 Credit
An exploration of the freshwater fishes of Florida. Offered as a 10-day Field trip during Spring Break. This course does not fulfill a B. Sc. area requirement.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions: Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 4310 - Biology of Birds
Credit(s): 0-4 Credits
Introduction to the study of birds including discussion of ecology, structure and function, evolution, behavior, and systematics. Laboratory includes field trips to the St. Louis Zoo, Missouri Botanical Garden, and other birding areas. Also, taught occasionally at the Reis Field Station. Students cannot receive credit for this course and Field Ornithology (BIOL-4140).
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions: Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Systematic/Organismal Lab, Systematic/Organismal Biol

BIOL 4320 - Cave Biology
Credit(s): 4 Credits
An introduction to the study of caves. Emphasis will be placed on the systematics of cave organisms and on the adaptations that cave organisms possess to exist in an energy poor environment. Field work will involve studying cave systems in the Ozarks of Missouri. This course is taught during the summer at the Reis Field Station.
Prerequisite(s): (BIOL 1060 and CHEM 1120)
Restrictions: Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Population/Evolutionary Lab, Population/Evolutionary Bio

BIOL 4330 - Spring Flora of the Ozarks
Credit(s): 4 Credits
A field-based course designed to acquaint students with the spring flora of the Ozarks. Students will learn to recognize common Missouri plant families and to identify plant species using taxonomic keys. Includes discussion of the major phytogeographic areas of Missouri and the biotic and abiotic factors that define them. Course is offered in May and is based at the Reis Field Station, but also includes off-site trips to state parks and conservation areas.
Prerequisite(s): ((BIOL 1060 or (BIOL 1260 and BIOL 1265))); CHEM 1120
Attributes: Natural Science Req (A&S), Plant Science, Systematic/Organismal Lab, Systematic/Organismal Biol

BIOL 4340 - Systematic Biology
Credit(s): 3 Credits
This course is a general survey of the principles of systematics and taxonomy. Topics to be covered include a history of taxonomic and systematic methods; classification, species and speciation; population variation and its analysis; taxonomic publications; and rules of zoological nomenclature.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions: Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio
BIOL 4350 - Biology of Parasitic Organisms  
Credit(s): 4 Credits  
Discussion of symbiotic relationships between animal and plant parasites and their hosts, evolution of parasitism, and current approaches to chemotherapy. In the laboratory, parasite form and function will be studied.  
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Natural Science Req (A&S), Systematic/Organismal Lab,  
Systematic/Organismal Biol

BIOL 4360 - Animal Behavior  
Credit(s): 3 Credits  
This course surveys the vast diversity of behaviors among all taxa of animals, including humans. Topics covered: the mechanisms that produce and modify behavior at the genetic, endocrine, and neural levels; and how the environment interacts with the biology of species in order to modify behaviors that lead to optimized evolutionary fitness.  
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265))  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio

BIOL 4370 - Animal Behavior Lab  
Credit(s): 1 Credit  
This laboratory course will introduce hypothesis testing, techniques, designing protocols, and statistical analyses used in the study of animal behavior in the laboratory and in the field.  
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265))  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Natural Science Req (A&S), Population/Evolutionary Lab

BIOL 4380 - Biology of Mammals  
Credit(s): 4 Credits  
This course surveys the evolution, morphological characteristics, physiology, ecology and behavior of mammals. Students cannot receive credit for this course and Field Mammalogy (BIOL 4130).  
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Natural Science Req (A&S)

BIOL 4390 - Systematic Biology Lab  
Credit(s): 1 Credit  
This laboratory course provides a series of 'hands-on' experiences applying the principles of taxonomy and systematics to biological diversity. Topics include homology and formulation of data matrices; species boundaries and modes of speciation; population taxonomy, variation and analysis; taxonomic publications; rules of nomenclature; and applications of systematic results.  
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265))  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Natural Science Req (A&S)

BIOL 4400 - Applied Ecology  
Credit(s): 3 Credits  
This course will concentrate on the identification and possible solutions of ecological problems faced by managers today. Introduction to general methods of ecological risk assessment. Special emphasis on sustainable use of land, marine, and aquatic resources.  
Prerequisite(s): BIOL 4750  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio

BIOL 4410 - Comparative Animal Physiology  
Credit(s): 3 Credits  
Functional adaptations of vertebrates and invertebrates to their environment (e.g. desert, arctic, high altitude, etc.).  
Prerequisite(s): BIOL 3020  
Attributes: Natural Science Req (A&S), Morph/Physiology/Dev. Biol

BIOL 4430 - Principles of Virology  
Credit(s): 3 Credits  
This class will explore the principles of: viral replication, viral spread within a host, viral maintenance within populations, viral pathogenesis, viral control by the immune system, and viral evolution. Students will learn the experimental and model systems that have been used to study viruses.  
Prerequisite(s): BIOL 3040  
Attributes: Natural Science Req (A&S)

BIOL 4440 - Vertebrate Histology: Structure and Function of Tissues  
Credit(s): 4 Credits  
Function and microscopic morphology of vertebrate tissues.  
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Morph/Phys/Dev Lab, Natural Science Req (A&S), Morph/Physiology/Dev. Biol

BIOL 4450 - Ecological Risk Assessment  
Credit(s): 3 Credits  
This course will review the federal laws pertaining to environmental protection, including NEPA, RCRA, CERCLA, and the Clean Water and Clean Air Acts. The course will also examine the sources of risk for ecological entities and discuss how to determine and manage those risks. The main focus will be on risk determination and management of wild populations, ecosystems, and landscapes.  
Prerequisite(s): BIOL 4750  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio

BIOL 4470 - Electron Microscopy  
Credit(s): 3 Credits  
A techniques-based course in the fundamentals of transmission and scanning electron microscopy. The theory of electron microscopy and related techniques will be covered in lectures and the labs will provide the practical skills required for tissue preparation, sectioning, microscope operation and photography.  
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120  
Restrictions:  
Enrollment is limited to students with a major in Biology.  
Attributes: Morph/Phys/Dev Lab, Natural Science Req (A&S), Morph/Physiology/Dev. Biol
BIOL 4480 - Conservation Biology
Credit(s): 3 Credits
Fundamental principles of biodiversity maintenance through the management of ecosystems and populations. This course will examine conservation at the level of species, population, and ecosystems.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265))
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio

BIOL 4500 - Introductory Endocrinology
Credit(s): 3 Credits
General principles of vertebrate endocrinology, including biochemistry, metabolism, cellular activity, and organismal and behavioral effect of systemic hormones and neurotransmitters.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Morph/Physiology/Dev. Biol

BIOL 4510 - Behavioral Endocrinology
Credit(s): 3 Credits
The effects of hormones and neurotransmitters on reproductive, parental, aggressive, and social behavior; as well as on homeostasis, biological rhythms, learning, and mood. Introductory Endocrinology and Animal Behavior recommended but not required.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Morph/Physiology/Dev. Biol

BIOL 4520 - Biochemical Pharmacology
Credit(s): 3 Credits
This course is designed to give students a good understanding of fundamental principles of pharmacology. Specifically, the course will focus on how drugs interact with various targets in the body and how body affects these compounds. The course begins with basic principles of pharmacology, pharmacokinetics and pharmacodynamics such as sites of drug action, agonists and antagonists, receptor theories and dose response relationships, drug absorption, distribution, metabolism, and elimination. It also covers GPCR, cell excitation, nitric oxide, eicosanoid mediators and related drugs, intermediate metabolism and related drugs, chemotherapy of infectious diseases and tumor, RNA as new drug targets, and pharmacogenomics. (Offered every Spring)
Prerequisite(s): BIOL 3040
Attributes: Natural Science Req (A&S)

BIOL 4540 - Human Systemic Physiology
Credit(s): 3 Credits
This course examines the mechanisms of organ system function in humans, including the general principles of homeostasis as they relate to basic endocrine, neural, muscle, cardiovascular, pulmonary and renal physiology.
Prerequisite(s): BIOL 3020
* Concurrent enrollment allowed.
Attributes: Natural Science Req (A&S)

BIOL 4550 - Biology of Aging
Credit(s): 3 Credits
A review and discussion of the theories associated with aging with a survey of the mechanisms of aging and a discussion of age-related changes in animals and humans.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Morph/Physiology/Dev. Biol

BIOL 4580 - Applied Population Genetics
Credit(s): 3 Credits
Population genetics is the study of the origin, amount, and distribution of genetic variation in populations, and the fate of this variation over time and across space. This course integrates population genetic theory, empirical studies derived from contemporary literature, and hands-on experience with software applications.
Prerequisite(s): BIOL 3010; BIOL 3030
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 4600 - Developmental Biology
Credit(s): 3 Credits
This course investigates cellular and molecular mechanisms responsible for building multicellular organisms. Topics include fertilization, cleavage, gastrulation, axis specification, and organogenesis, with particular attention devoted to the experimental basis for current models. The connections between developmental biology and medical and environmental issues will also be considered. Textbook reading assignments will be supplemented by selected articles from the scientific literature.
Prerequisite(s): BIOL 3020; BIOL 3040
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Cellular/Molecular Biol, Natural Science Req (A&S), Morph/Physiology/Dev. Biol

BIOL 4610 - Developmental Biology Lab
Credit(s): 2 Credits
This laboratory course is designed to supplement and reinforce material presented in BIOL-4600 through observation and experimental manipulation of developing organisms. Living invertebrate and vertebrate model organisms will be used. Approximately two hours for observations will be required outside of scheduled lab times to be arranged at the mutual convenience of each student and the instructor.
Prerequisite(s): BIOL 4600
* Concurrent enrollment allowed.
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)
BIOL 4620 - Biochemistry I
Credit(s): 3 Credits
This course focuses on biomolecules. Topics to be covered include biological buffers, thermodynamics, amino acids, proteins, carbohydrates, lipids, membranes, nucleic acids, recombinant DNA, enzymes, and molecular motors.
Prerequisite(s): CHEM 2200; (0 Course from CHEM 346-2435 or 0 Course from CHEM 343-2425)
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S)

BIOL 4630 - Foundations of Immunobiology
Credit(s): 3 Credits
The cellular and molecular basis of immune function. Topics include receptors on T, B, and antigen presenting cells, cytokine networking, complement, function of the major histocompatibility complex, hypersensitivity of the immune system, and infection by HIV.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Attributes: Chemical Biology Elective, Cellular/Molecular Biol, Natural Science Req (A&S)

BIOL 4640 - General Microbiology
Credit(s): 3 Credits
General introduction to the diversity, bioenergetics, growth, genetics, and ecology of microorganisms. Special emphasis will be placed on molecular and genomic methods used in the characterization of microorganisms.
Prerequisite(s): BIOL 3020; BIOL 3040
Attributes: Chemical Biology Elective, Cellular/Molecular Biol, Natural Science Req (A&S)

BIOL 4650 - General Microbiology Laboratory
Credit(s): 2 Credits
Basic techniques in handling bacteria, identifying microorganisms and investigating microbial growth and metabolism.
Prerequisite(s): BIOL 3020; BIOL 3040; BIOL 4640* Concurrent enrollment allowed.
Attributes: Cellular/Molecular Lab, Natural Science Req (A&S)

BIOL 4660 - Biological Conflicts
Credit(s): 3 Credits
The course is designed to introduce genetic, biochemical and evolutionary aspects of biological conflicts. We discuss the complex interactions between organisms, cells, and genomes, including self-defense, predation, kin-selection, symbiotic mutualism, parasitism, reproductive/genetic conflicts, and diseases/disorders developed during conflicts. (Offered every Spring)
Prerequisite(s): BIOL 3030
Attributes: Natural Science Req (A&S)

BIOL 4670 - Population Biology
Credit(s): 3 Credits
This course covers theoretical and empirical investigations at the population level. Major topics include population and growth dynamics, population regulation, the evolution of life, histones, ecological interactions between populations, and the evolutionary ecology of populations.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio

BIOL 4680 - Landscape Ecology
Credit(s): 3 Credits
This course will concentrate on the ecology and management of landscapes. Topics will include formation of spatial patterns, flux of materials and organisms across space, and natural and human-mediated disturbance; as well as the relevance of scale in identifying patterns and how it relates to management decisions. Case studies with relevance to state and federal lands will be covered.
Prerequisite(s): BIOL 4750
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio
BIOL 4790 - Biometry
Credit(s): 4 Credits
This course is intended for students pursuing a biology major or minor. College-level algebra and general biology are required. The course will cover biological distributions and probabilities; the application of hypothesis testing; the relationship between biological and statistical hypothesis; the nature of biological data and sampling regimes, and how these fit within the scientific method.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Restrictions:
Enrollment is limited to students with a major in Biology.
Attributes: Chemical Biology Elective, Natural Science Req (A&S)

BIOL 4890 - Senior Inquiry: Comprehensive Examination
Credit(s): 1 Credit
Permission of department chairperson required.
Prerequisite(s): (BIOL 1060 and CHEM 1120)
Attributes: Natural Science Req (A&S)

BIOL 4910 - Internship in Conservation
Credit(s): 1-6 Credits (Repeatable for credit)
Students will work with professional conservation/environmental biologists to get practical experience. Students may work with conservation biologists associated with the EPA, Missouri Conservation Department, Corps of Engineers, or private environmental consulting firms. Environmental problems treated within the framework of fundamental ecological principles.
Prerequisite(s): BIOL 4480
Attributes: Natural Science Req (A&S), Population/Evolutionary Bio

BIOL 4911 - Integrated Bioinformatics Internship
Credit(s): 1-3 Credits
Students will work with laboratories conduction molecular biology/ bioinformatics research to gain practical experience. Internships will include research and development laboratories of local biotechnology companies, and in the departments of Biology, Chemistry, Mathematics, Statistics or Computer Science.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Attributes: Natural Science Req (A&S)

BIOL 4912 - Internship in Plant Science
Credit(s): 1-3 Credits (Repeatable for credit)
Students work with professional plant scientists to gain practical experience. Students may work with scientists at botanical gardens or arboreta, the EPA, Missouri Department of Conservation, the Donald Danforth Plant Sciences Center, Monsanto, or other biotech firms.
Prerequisite(s): (BIOL 1060 or (BIOL 1260 and BIOL 1265)); CHEM 1120
Attributes: Natural Science Req (A&S)

BIOL 4930 - Special Topics
Credit(s): 1-4 Credits (Repeatable for credit)
Prerequisite(s): BIOL 302; BIOL 303; BIOL 304
Attributes: Natural Science Req (A&S)

BIOL 4960 - Independent Research
Credit(s): 1-3 Credits (Repeatable for credit)
This course provides an opportunity for first and second year students to carry out independent study and research. Permission of the Instructor required. Course goals, content and meeting times to be determined by the instructor.
Attributes: Natural Science Req (A&S)

BIOL 4970 - Library Project
Credit(s): 1-3 Credits (Repeatable for credit)
Permission of Instructor required.
Attributes: Natural Science Req (A&S)

BIOL 4975 - Advanced Independent Research
Credit(s): 1-4 Credits (Repeatable for credit)
Attributes: Natural Science Req (A&S)

BIOL 4980 - Advanced Independent Study
Credit(s): 1-4 Credits (Repeatable for credit)
Individual study and research.
Prerequisite(s): (6.000 Credits from BIOL3000-4999)
Attributes: Natural Science Req (A&S)

BIOL 5000 - Problems in Vertebrate Morphology
Credit(s): 2-5 Credits
Studies of the gross and microscope anatomy of the organs and organ systems of vertebrates. Gross dissection and histological preparation of selected structures in typical vertebrates of different classes.

BIOL 5010 - Ecology of Vertebrate Reproduction
Credit(s): 3 Credits
A study of life history traits that lead to the evolution of sexual selection, parthenogenesis, viviparity, sex ratios, and environmental and genetic sex determination.

BIOL 5020 - Comparative Vertebrate Reproduction
Credit(s): 3 Credits
Advanced study of reproductive anatomy and physiology of the vertebrates.

BIOL 5030 - Genomics
Credit(s): 3 Credits
This course introduces core concepts, techniques and analytical methods of genomics. The topics of this course include: genome projects; structure, components and evolutionary dynamics of genomes; sequencing, mapping and assembly techniques; online resources, databases and analytical methods for genomic studies.
Prerequisite(s): BIOL 3030

BIOL 5040 - Problems in Experimental Embryology
Credit(s): 2-4 Credits
Laboratory work conducted on an individual basis in selected areas of experimental embryology.

BIOL 5050 - Molecular Techniques Lab
Credit(s): 2 Credits
Students will learn principles of molecular biology and recombinant DNA technology, and will gain hands-on experience with nucleic acid isolation, cloning, sequencing, and analysis.

BIOL 5060 - Advanced Topics in Molecular Biology
Credit(s): 1 or 4 Credits
This course encompasses the central roles of DNA and RNA in molecular biology and the technologies used to analyze and manipulate nucleic acids in biomedical research. Topics to be covered are the structure, topology, and arrangement of nucleic acids in genomes, recombinant DNA technology, bioinformatics, and current research in molecular biology.

BIOL 5070 - Advanced Biological Chemistry
Credit(s): 3 Credits
An in-depth analysis of selected topics in biological chemistry. Topics may include for example, protein structure and function, and nucleotides and nucleic acids.
BIOL 5080 - Advanced Cell Biology  
Credit(s): 3 Credits  
This course is designed to deepen students' understanding of cell biology principles, experimental strategies, and current research questions. Topics covered will include how different categories of molecules regulate cellular activity and literature, experimental design and interpretation of results.

BIOL 5090 - Biometry  
Credit(s): 4 Credits  
This course is intended for graduate students in biology. The course will cover the description of biological distributions and probabilities; the application of hypothesis testing, including the relationship between biological and statistical hypothesis; the nature of biological data, samples and sampling regimes, and how these fit within the scientific method. Central to the course is the use of biological models and experiments.

BIOL 5100 - Cellular and Molecular Genetic  
Credit(s): 3 Credits  
The cellular and molecular basis of genetically controlled biological phenomena from microorganisms to complex, multicellular organisms. Topics considered are transcriptional regulation in prokaryotes and eukaryotes, chromatin structure and function, sporation, yeast mating types, pattern formation in Drosophila, sex determination, and genetic control of development in C. elegans. Experimental methods used to study these events will be stressed.

BIOL 5120 - Signal Transduction  
Credit(s): 3 Credits  
Mechanisms by which cells receive and respond to external signals; properties of the cell membrane; receptor structure and function; G protein-regulated transmembrane signaling; intercellular communication; first and second messengers. Experimental methods used to study these phenomena will be emphasized.

BIOL 5170 - Intro to GIS  
Credit(s): 3 Credits  
This class introduces concepts, science and theory of GIS with hands-on experiences. After successful completion of the course, students will be able to demonstrate fundamental techniques of geospatial analysis and mapping. Students may only apply credits towards their graduation requirements from one of the following courses: IAS 517, BIOL 517, or SOC 565.

BIOL 5180 - Intermediate GIS  
Credit(s): 3 Credits  
This course covers intermediate and advanced topics in GIS including remote sensing for GIS, geospatial statistics and GIS biography. Each part is instructed by a professor specialized in the particular area. Students may only apply credits towards their graduation requirements from one of the following courses: IAS 518, BIOL 518, or SOC 566.  
Prerequisite(s): BIOL 5170

BIOL 5190 - Geographic Information Systems in Biology  
Credit(s): 3 Credits

BIOL 5300 - Problems in Vertebrate Physiology  
Credit(s): 2-4 Credits  
Laboratory research on current problems in organ system physiology.

BIOL 5330 - Systematic Biology  
Credit(s): 3 Credits  
General survey of the principles of systematics and taxonomy. Topics covered include a history of taxonomic and systematic methods, classification, species and speciation, population variation and its analysis, taxonomic publications, and rules of zoological nomenclature.

BIOL 5340 - Problems in Cell Biology  
Credit(s): 1-2 Credits  
Laboratory experimentation to answer specific questions concerning DNA replication and cell division. Students design and carry out experiments to test a specific hypothesis.

BIOL 5350 - Current Topics in Cell Biology  
Credit(s): 2 Credits (Repeatable for credit)  
Prerequisite(s): BIOL 5080

BIOL 5400 - Problems in Genetics  
Credit(s): 1-4 Credits  
Advanced experimental work in selected areas of genetics.

BIOL 5410 - Ecological Genetics  
Credit(s): 3 Credits  
Lectures and discussion on the genetic factors determining the abundance and distribution of protista, animals and plants, including the Hardy-Weinberg Equilibrium, community interactions and genetic polymorphisms.

BIOL 5420 - Problems in Evolutionary Biology  
Credit(s): 1-4 Credits  
Laboratory and field research on contemporary problems in evolutionary Biology.

BIOL 5430 - Advanced Principles of Virology  
Credit(s): 3 Credits  
This course is intended as an introduction to virology for the graduate biology student & other scientists who want to know more about viruses. This class will explore the basic principles of: viral replication, viral spread within a host, viral maintenance within populations, viral pathogenesis, viral control by the immune system, and viral evolution. We will examine the experimental and model systems that have been used to study viruses. The lectures will include videos, in-class activities relating to experimental design and analysis, and case study discussions. Students will also present primary journal articles in the field of virology.

BIOL 5450 - Biogeography  
Credit(s): 3 Credits  
A discussion of the major distribution patterns of plants and animals and the mechanisms responsible for these patterns.

BIOL 5460 - Exercise Physiology  
Credit(s): 3 Credits  
Using exercise biochemistry as a foundation, this course will examine the responses and adaptations to physical exercise and/or inactivity, with special emphasis on nutrition, energy metabolism, and endocrinology; and their relations to health.

BIOL 5480 - Conservation Biology  
Credit(s): 3 Credits  
Fundamental principles of biodiversity maintenance through the management of ecosystems and populations are explored. Begins with the philosophical underpinnings of the conservation movement as developed in the writings of Leopold and moves on to extensive treatment of modern conservation practices directed toward preservation of imperiled systems.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 5500</td>
<td>Problems in Ecology</td>
<td>2-4</td>
<td>Independent laboratory or field study on a specific problem in ecology.</td>
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<tr>
<td>BIOL 5510</td>
<td>Plant Ecophysiology</td>
<td>3</td>
<td>A treatment of environmental effects on the physiology of vascular plants with reference to the whole organism and ecological interactions.</td>
</tr>
<tr>
<td>BIOL 5520</td>
<td>Biochemical Pharmacology</td>
<td>3</td>
<td>This course is designed to give students a good understanding of fundamental principles of pharmacology. Specifically, the course will focus on how drugs interact with various targets in the body and how body affects these compounds. The course begins with basic principles of pharmacology, pharmacokinetics and pharmacodynamics such as sites of drug action, agonists and antagonists, receptor theories and dose response relationships, drug absorption, distribution, metabolism, and elimination. It also covers GPCR, cell excitation, nitric oxide, eicosanoid mediators and related drugs, intermediate metabolism and related drugs, chemotherapy of infectious diseases and tumor, RNA as new drug targets, and pharmacogenomics.</td>
</tr>
<tr>
<td>BIOL 5550</td>
<td>Advanced Ecology</td>
<td>3</td>
<td>An in-depth treatment of the relationships between organisms and their environment via lecture, discussion and seminar formats plus occasional laboratory and field exercises.</td>
</tr>
<tr>
<td>BIOL 5560</td>
<td>Advanced Evolution</td>
<td>3</td>
<td>This course explores aspects of natural selection, adaptation, gene flow, speciation, and evolutionary hypothesis testing at a level consistent with a modern graduate education containing a component of evolutionary theory. The format of the course includes both lecture and discussion of the topics outlined in the topical syllabus. Each week will include a set of readings from both historical/semital writings in an area as well as current papers that treat the topics.</td>
</tr>
<tr>
<td>BIOL 5570</td>
<td>Advanced Behavioral Ecology</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>BIOL 5580</td>
<td>Applied Population Genetics</td>
<td>3</td>
<td>Population genetics is the study of origin, amount, and distribution of genetic variation in populations, and the fate of this variation over time and across space (Templeton, 2006). This course examines the primary concepts of population genetics through an integrated approach involving basic theory, empirical studies derived from primary contemporary literature, and hands-on experience with software application.</td>
</tr>
<tr>
<td>BIOL 5600</td>
<td>Developmental Genetics</td>
<td>3</td>
<td>Exploration of genetic mechanisms by which genomically equivalent cells generated from the fertilized egg become different during development. The role of cytoplasmically located determinants and progressive cell interactions on differential gene expression. The genetic basis of pattern formation in the vertebrate limb and nervous system, particularly during Drosophila development emphasizing the role of maternal effect, segmentation, and homeotic selector gene expression.</td>
</tr>
<tr>
<td>BIOL 5610</td>
<td>Principles of Develop Biology</td>
<td>3</td>
<td>This course investigates cellular and molecular mechanisms responsible for building multicellular organisms. Topics include fertilization, cleavage, gastrulation, axis specification, and organogenesis, with particular attention devoted to the experimental basis for current models. The connections between developmental biology and medical and environmental issues will also be considered.</td>
</tr>
<tr>
<td>BIOL 5630</td>
<td>Concepts of Immunobiology</td>
<td>3</td>
<td>Cellular and molecular basis of immune function. Topics include receptors on T, B and antigen presenting cells, cytokine networking, complement, function of the major histocompatibility complex, hypersensitivity of the immune system, and infection by HIV.</td>
</tr>
<tr>
<td>BIOL 5640</td>
<td>Advanced Microbiology</td>
<td>3</td>
<td>The course reviews the diversity, bioenergetics, growth, genetics and ecology of microorganisms. Special emphasis will be placed on contemporary issues and techniques used in the field of microbiology.</td>
</tr>
<tr>
<td>BIOL 5660</td>
<td>Biological Conflicts</td>
<td>3</td>
<td>The course is designed to introduce genetic, biochemical and evolutionary aspects of biological conflicts. We will discuss the complex interactions between organisms, cells, and genomes, including self-defense, predation, kin-selection, symbiotic mutualism, parasitism, reproductive/genetic conflicts, and diseases/disorders developed during conflicts.</td>
</tr>
<tr>
<td>BIOL 5670</td>
<td>Advanced Population Biology</td>
<td>3</td>
<td>This course covers the theoretical and empirical investigations of population ecology and genetics. Major topics will include population growth and dynamics, population regulation, evolution of life histories, ecological interactions between populations, and evolutionary ecology of populations.</td>
</tr>
<tr>
<td>BIOL 5700</td>
<td>Advanced Molecular Biology</td>
<td>3</td>
<td>Current problems in plant morphology and systematics. Library/laboratory phase stressed.</td>
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<tr>
<td>BIOL 5760</td>
<td>Problems in Botany</td>
<td>3</td>
<td>Offered Occasionally.</td>
</tr>
<tr>
<td>BIOL 5770</td>
<td>Coevolution</td>
<td>3</td>
<td>This seminar course focuses on reading and discussion of primary literature related to coevolution. Students will gain improved understanding of interspecific interactions (e.g. predation, parasitism, competition, pollination, mimicry) that led to interdependent evolution of species. Study and discussion of these interactions will demonstrate the essential link between ecology and evolution.</td>
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</table>
BIOL 5780 - Molecular Phylogenetic Analysis
Credit(s): 3 Credits
This course is designed to give students the knowledge and technical competence necessary for working with molecular phylogenetic data. Students will learn how to edit and align sequence data, and will explore how alternative alignments affect phylogenetic reconstructions. They will learn how to access and download data from online databases such as Genbank and Tree Base. Differing analytical approaches will be presented and discussed, including current and ongoing controversies in the primary literature. Students will gain experience using numerous software packages for analyzing data, testing constraints, choosing likelihood models, assessing support and exploring character evolution.

BIOL 5800 - Research Colloquium
Credit(s): 0-1 Credits (Repeatable for credit)
The course is designed to provide practice with oral communication of scientific studies. The format involves the design and execution of an oral presentation and students will be assessed by the instructor and classmates. Presentations on student research projects and proposals will be open to all members of the department.

BIOL 5810 - Department Seminar
Credit(s): 0-1 Credits (Repeatable for credit)
Selected topics in Biology. Attendance and participation required for all M.S. and M.S.(R) students in Biology.

BIOL 5820 - Graduate Seminar in Cell and Molecular Regulation
Credit(s): 1-2 Credits (Repeatable for credit)
In depth analysis of one or two topics of current importance to cellular and molecular biology and the regulation of biological processes will be developed each semester. Students will present a lecture building on some aspect of the topic being analyzed. The focus is on skills of literature analysis, lecture organization, and oral presentation as well as on learning about a specific discipline related topic.

BIOL 5840 - Graduate Seminar in Ecology, Evolution and Systematics
Credit(s): 2 Credits (Repeatable for credit)
Readings and discussions of current literature in areas related to ecology, evolution, and systematics. Students are encouraged to present research plans and report on research progress. Each semester several topics will be examined in depth.

BIOL 5850 - Floristic Taxonomy
Credit(s): 1 Credit
This weekly seminar provides an overview of Vascular Plants. The seminar will cover several crown orders of the monocots, including grasses and relatives, and begin the Eudicots. Weekly presentations include a summary of all relevant information (molecular, chemical, anatomical, embryological, morphological, ecological, geographical, historical/paleontological, etc.) about the plant group under consideration, review of the classification/phylogeny of the group, examination of fresh and/or preserved specimens, and discussion of relationships, human uses, and other relevant aspects of the biology of that group.

BIOL 5860 - Scientific Communication Practicum
Credit(s): 1 Credit
The course is designed to provide practice with written communication of scientific studies. The course includes assignments of documents that are commonly used in scientific discourse. The objectives of each assignment will be discussed in group meetings, and students will meet with the instructor individually to review the documents.

BIOL 5870 - Advanced Biometry
Credit(s): 3 Credits
Graduate level course that will cover major aspects of the design and analysis of research studies in the life sciences. The purpose of the course is to provide the student with sufficient knowledge as to be able to design and analyze experiments that will most properly answer relevant questions in their fields. Topics will include, but not limited to, historical, philosophical, and ethical issues, statistical techniques, and computer applications. Students enrolling in this course must have at least one semester of calculus and one semester or statistics or probability and are familiar with analysis of variance techniques.

BIOL 5930 - Special Topics
Credit(s): 1-4 Credits (Repeatable for credit)

BIOL 5970 - Research Topics
Credit(s): 1-3 Credits (Repeatable for credit)
Prior permission of guiding professor and department/program chairperson required.

BIOL 5980 - Graduate Reading Course
Credit(s): 1-3 Credits (Repeatable for credit)
Prior permission of guiding professor and department/program chairperson required.

BIOL 5990 - Thesis Research
Credit(s): 0-6 Credits (Repeatable for credit)

BIOL 6040 - Current Topics in Developmental Biology
Credit(s): 3 Credits
Topics to be discussed include molecular biology and genetic analysis of channels, electrophysiology of synapses and transmitter amines, second messenger systems, molecular genetics of color vision, color blindness, sensory transduction, and development of neural circuitry.

BIOL 6150 - Neural Basis of Behavior
Credit(s): 3 Credits
Conferences and library or laboratory problems dealing with specific functions of animals from the comparative viewpoint.

BIOL 6300 - Special Studies: Comparative Physiology
Credit(s): 1-4 Credits
Conferences and library or laboratory problems dealing with specific functions of animals from the comparative viewpoint.

BIOL 6310 - Comparative Immunobiology
Credit(s): 3 Credits
Discussion of defense reactions of invertebrates and non-mammalian vertebrates from textbooks and current literature.

BIOL 6320 - Comparative Endocrinology
Credit(s): 3 Credits
Survey of endocrine functions in invertebrates and vertebrates. Discussion of current models of mechanisms of action of hormones.

BIOL 6330 - Special Studies: Insect Physiology
Credit(s): 1-4 Credits
Library of laboratory study on a specific question.

BIOL 6460 - Exercise Biology
Credit(s): 3 Credits
Course will examine the responses and adaptations to physical exercise and/or inactivity with special emphasis on nutrition, energy metabolism, and endocrinology, and their reaction to health.
BIOL 6510 - Plant-Water Relationships  
Credit(s): 3 Credits  
An in-depth treatment of the water relationships of vascular plants via lecture, discussion and seminar formats.

BIOL 6810 - Departmental Seminar  
Credit(s): 0-1 Credits (Repeatable for credit)  
Selected topics in biology. Attendance and participation required for all Ph.D. students in Biology.

BIOL 6900 - Scientific Communication Practicum  
Credit(s): 1 Credit (Repeatability up to 12 credits)

BIOL 6930 - Special Topics  
Credit(s): 1-3 Credits (Repeatable for credit)

BIOL 6970 - Research Topics  
Credit(s): 1-3 Credits (Repeatable for credit)  
Prior permission of guiding professor and department/program chair required. Offered every semester.

BIOL 6980 - Graduate Reading Course  
Credit(s): 1-3 Credits (Repeatable for credit)  
Prior permission of guiding professor and department/program chair required.

BIOL 6990 - Dissertation Research  
Credit(s): 0-6 Credits (Repeatable for credit)