

# Biology

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## General Information

### Degrees and Areas of Concentration

The Department of Biology provides academic programs leading to the B.A. or B.S. in Biology. In cooperation with the College of Education, the department offers the B.S. Ed. in Secondary Education with Emphasis in Biology and the B.A. or B.S. in Biology with Master's Level Coursework for Secondary Teacher Certification. It also offers graduate work leading to the Master of Science and the Doctor of Philosophy degrees in Biology. Biology faculty members are engaged in teaching and research in areas ranging from cell and molecular biology to population and community studies.

### Minor in Biology

Students majoring in another discipline may earn a minor in biology by completing a prescribed course of study. Unique programs can be developed to coordinate with special career objectives.

### Graduate Studies

The Department of Biology offers graduate work leading to the M.S. and Ph.D. degrees in biology. Graduate students will normally work toward an M.S. or Ph.D. degree in two broad areas of biology: a) cellular, molecular, and developmental biology, or b) ecology, evolution, and systematics. Students in the M.S. and Ph.D. programs also have the opportunity to do their graduate work in collaboration with scientists at the Missouri Botanical Garden, the Donald Danforth Plant Science Center, or the Saint Louis Zoo through cooperative graduate programs.

### Facilities

Department facilities include research and teaching laboratories, environmental chambers, greenhouses, and a large array of supporting modern research instrumentation. Graduate research can be pursued using facilities of the Missouri Botanical Garden, the Donald Danforth Plant Science Center, or the Saint Louis Zoo. Several sites within an hour of campus are suitable for regional field studies, including state parks, wildlife conservation areas, the Shaw Nature Reserve, and Washington University's Tyson Research Center. UMSL is a member of the St. Louis University Research Station Consortium that operates Lay and Reis Field Stations in Missouri and is also a member of the Organization for Tropical Studies, which operates three field stations in Costa Rica. Student researchers work independently at research stations throughout the world.

### Cooperative Programs

The department participates in a cooperative consortium program in biology with Washington University, Saint Louis University, Southern Illinois University-Edwardsville, the St. Louis Zoo, the Donald Danforth Plant Science Center, and the Missouri Botanical Garden.

### Program Objectives and Career Prospects

The degree program at the baccalaureate level is designed to prepare the student for further professional training in areas such as medicine, dentistry, veterinary medicine, optometry, plant science, conservation, and related areas or for further graduate training in research in biology.

The Master of Science program is an extension of the undergraduate program and provides the research-oriented training and education

necessary for students to enter doctoral programs in biology and develops professional biologists qualified to function in responsible technical positions. It also trains students to become effective secondary school and junior college biology teachers.

The Ph.D. program prepares students to be research biologists in academics or other professional fields in ecology, evolution and systematic and cellular and molecular biology. Employment opportunities are available in college or university research and teaching, in government and public institutions such as museums, botanical gardens and conservation organizations, and in industry.

### Degrees

Biology BA

Biology BS

Biology MS

- Cell and Molecular Biology Emphasis
- Ecology Evolution and Systematics Emphasis
- Professional Science in Cellular and Molecular Biology Emphasis

Biology MS Accelerated Master's Degree

Biology PhD

- Cell and Molecular Biology Emphasis
- Ecology, Evolution and Behavior Emphasis
- Integrative Biology Emphasis

### Minors

Biology Minor

Environmental Studies Minor

### Certificates

Biotechnology Graduate Certificate

Global Biodiversity Conservation and Leadership Graduate Certificate

### Courses

#### ***BIOL 1010 Introduction to Student Research: 1-3 semester hours***

Prerequisites: Minimum of four semesters of high school science and math courses and consent of the instructor. This course provides high school students an opportunity to develop individual research projects under faculty mentorship. It includes interdisciplinary lectures, demonstrations, seminars, and project guidance. Evaluation will be based on written and oral presentation of the research project and student portfolio.

#### ***BIOL 1012 General Biology: The Science of Life (MOTR BIOL 100): 3 semester hours***

This non-majors biology course is designed for students who want to know more about themselves and the living things surrounding them. The course emphasizes the fundamental principles and processes of biology. Course topics may include the scientific method, organization of living things, cell and molecular biology, genetics, evolution, human body systems, and ecology. Credit for BIOL 1012 can be applied towards fulfillment of the general education requirement in science. Biology majors, Biochemistry and Biotechnology (BCBT) majors, or any students who plan to pursue a career in medicine or one of the medical-oriented professions should enroll in BIOL 1831 rather than BIOL 1012.

**BIOL 1013 General Biology Laboratory: The Science of Life: 1 semester hour**

Prerequisites: BIOL 1012 (may be taken concurrently). This non-majors biology laboratory course is designed to complement the non-majors general biology lecture course BIOL 1012. The activities students undertake and the thought processes they develop are similar to those used by scientists. Students become actively involved in learning about science by doing it. Specific course topics may include the scientific method, organization of living things, cell and molecular biology, genetics, evolution, ecology, and human anatomy and physiology. Credit for BIOL 1013 can be applied towards fulfillment of the general education requirement in a laboratory science.

**BIOL 1102 Human Biology (MOTR LIFS 150): 3 semester hours**

Lectures and readings concerned with the reproduction, development, genetics, functional anatomy, behavior, ecology, and evolution of the human species. Three hours lecture per week.

**BIOL 1110 Nutrition in Health: 3 semester hours**

This course studies dietary nutrients essential for health, proper selection of foods to provide them and current issues affecting them.

**BIOL 1131 Human Physiology and Anatomy I: 4 semester hours**

Prerequisites: BIOL 1012 or equivalent or consent of instructor. This course covers the basic aspects of the structure of the healthy human body and how it functions. Special emphasis is on how the human body adapts itself to its environment and how changes affect physiological activities. Three hours lecture and two hours laboratory per week.

**BIOL 1131A Human Physiology and Anatomy I Lecture Only: 3 semester hours**

Prerequisites: BIOL 1012. This course covers the basic aspects of the structure of the healthy human body and how it functions. Special emphasis is on how the human body adapts itself to its environment and how changes affect physiological activities. Three hours lecture per week.

**BIOL 1131L Human Anatomy and Physiology I Lab Only: 1 semester hour**

Prerequisites: BIOL 1131A, BIOL 1012, and consent of instructor. This laboratory course covers the basic aspects of the structure of the healthy human body and how it functions. Special emphasis is on how the human body adapts itself to its environment and how changes affect physiological activities. It involves two hours of laboratory per week.

**BIOL 1141 Human Physiology and Anatomy II: 4 semester hours**

Prerequisite: BIOL 1131. A continuation of BIOL 1131. A study of the basic aspects of human physiology and anatomy. Three hours lecture and two hours laboratory per week.

**BIOL 1141A Human Anatomy and Physiology II Lecture Only: 3 semester hours**

Prerequisites: BIOL 1131 and consent of instructor. This course is a continuation of BIOL 1131 and includes a study of the basic aspects of human physiology and anatomy. This course is the lecture portion only of BIOL 1141.

**BIOL 1141L Human Anatomy and Physiology II Lab Only: 1 semester hour**

Prerequisites: BIOL 1131 and consent of instructor. This laboratory course is a continuation of BIOL 1131 and includes a study of the basic aspects of human physiology and anatomy. It involves two hours of laboratory per week.

**BIOL 1150 Concepts in Health and Wellness: 3 semester hours**

This course introduces students to the concepts and issues related to multiple dimensions of health and wellness through topics such as nutrition, exercise, mental health, sexual health, and environmental health.

**BIOL 1162 General Microbiology: 3 semester hours**

Prerequisite: BIOL 1012 or its equivalent. A survey of microbiology structure, genetics, and physiology. Special emphasis will be placed on the transmission and control of such organisms as it relates to the maintenance of human health. Three hours of lecture per week.

**BIOL 1202 Environmental Biology: 3 semester hours**

An examination of the biological basis of current environmental problems, with emphasis upon resources, energy, pollution and conservation. Three hours lecture per week.

**BIOL 1800 Introduction to the Biology Major: 1 semester hour**

Prerequisites: Biology major or consent of the instructor. This course is an orientation to the field of biology for majors and for students who are considering declaring the major. This course introduces students to concepts, skills, and practices that are essential for success as a Biology major and must be completed by all freshman and transfer Biology majors during their first semester of study at UMSL.

**BIOL 1821 Introductory Biology: Organisms and the Environment (MOTR BIOL 150LEC): 5 semester hours**

Prerequisites: A minimum of high school chemistry, ENGL 1100 or equivalent (may be taken concurrently), and placement into college algebra or higher. This course presents an introduction to some of the principles of biology and scientific methodology applied to the organism and supraorganism levels of biology. Topics to be covered may include ecology, evolution, diversity, and population biology. Three hours of lecture, three our hours of lab, and one hour of discussion per week. This course is required for students intending to major in biology or take specified biology courses at the 2000 level or above.

**BIOL 1831 Introductory Biology: From Molecules to Organisms (MOTR BIOL 150L): 5 semester hours**

Prerequisites: A minimum of high school chemistry and MATH 1030; ENGL 1100 or equivalent (may be taken concurrently). Required for students intending to major in biology or take specified biology courses at the 2000 level or above. This course presents an introduction to some of the principles of biology and scientific methodology applied to the molecular/ cellular through organ system levels of organization. Topics include: cell structure, metabolism, reproduction, heredity and major physiological processes regulated by organ systems. Three hours of lecture, three and one half hours of lab, and one hour of discussion per week.

**BIOL 1920 Introductory Topics in Biology: 1-5 semester hours**

Prerequisites: Consent of instructor. The topics will vary each semester. See online course schedule for topics. Credit arranged. May be taken more than once for credit if topics are different. The applicability toward a Biology degree is dependent on the topic.

**BIOL 2010 Introduction to Inquiry Approaches to STEM Education (STEP I): 1 semester hour**

Same as CHEM 2010, PHYSICS 2010, MATH 2010, and SEC ED 2010. Prerequisites: Concurrent enrollment BIOL 1821, BIOL 1831, CHEM 1111, CHEM 1121, PHYSICS 2111, PHYSICS 2112, MATH 1800, or MATH 1900 or have a declared STEM major. Students who want to explore teaching careers become familiar with lesson plan development by writing, teaching and observing lessons in a local school class. Students build and practice inquiry-based lesson design skills and become familiar with and practice classroom management in the school setting. As a result of the STEP I experiences students should be able to decide whether to continue to explore teaching as a career and ultimately finishing the remainder of the WE TEACH MO curriculum leading to teacher certification. The classroom observations and teaching represent a major field component and requires at least one two hour block of free time during the school day once a week.

**BIOL 2011 Designing Inquiry-Based STEM Experiences (STEP II): 1 semester hour**

Same as CHEM 2011, PHYSICS 2011, MATH 2011, and SEC ED 2011. Prerequisites: BIOL 2010, CHEM 2010, PHYSICS 2010, MATH 2010, or SEC ED 2010. Students explore teaching careers, become familiar with STEM school setting through observing and discussing the school environment and by developing and teaching inquiry-based lessons.

**BIOL 2012 Genetics: 3 semester hours**

Prerequisites: BIOL 1831, MATH 1030, and CHEM 1111. This course covers the fundamental principles of inheritance, including classical genetic theory as well as recent advances in the molecular basis of heredity. It is three (3) hours of lecture per week.

**BIOL 2013 Genetics Laboratory: 2 semester hours**

Prerequisites: Concurrent registration in BIOL 2012, or consent of instructor. Laboratory to accompany BIOL 2012. Three and one-half hours of organized laboratory time per week. Students may need to return to the laboratory at unscheduled times to complete some exercises.

**BIOL 2102 Ecology: 3 semester hours**

Prerequisites: BIOL 1821 and BIOL 1831. This course examines the relationships between living organisms and their environment.

**BIOL 2103 Ecology Laboratory: 2 semester hours**

Prerequisites: BIOL 2102 (may be taken concurrently); a general statistics course is strongly recommended. This laboratory course analyzes environmental factors influencing the abundance and distribution of living organisms. Some classes will be held at field sites in and around St. Louis.

**BIOL 2402 Vertebrate Anatomy: 3 semester hours**

Prerequisites: BIOL 1821 and BIOL 1831. Development, structure, function, interrelationships, and zoogeography of vertebrate animals with particular attention to phylogenetic aspects. Three hours of lecture per week.

**BIOL 2403 Vertebrate Anatomy Laboratory: 2 semester hours**

Prerequisite: BIOL 2402 (may be taken concurrently). Laboratory to accompany BIOL 2402. Morphological analysis and systematic survey of major vertebrate groups. Overview of the vertebrate life forms and their adaptations to habitats and resources. Three and one-half hours of laboratory per week.

**BIOL 2482 Microbiology: 3 semester hours**

Prerequisites: BIOL 1831 (majors must also take BIOL 1821), MATH 1030, and CHEM 1111. Study of microorganisms, their metabolism, genetics, and their interaction with other forms of life. Three hours of lecture per week.

**BIOL 2483 Microbiology Laboratory: 2 semester hours**

Prerequisite: BIOL 2482 (may be taken concurrently). Experimental studies and procedures of microbiological techniques. Three and one-half hours of organized laboratory time per week. Students will need to return to the laboratory at unscheduled times to complete some exercises.

**BIOL 2920 Contemporary Topics in Biology: 1-5 semester hours**

Prerequisites: Consent of instructor. The topics will vary each semester. See course schedule online for topics. Credit arranged. May be taken more than once for credit if topics are different.

**BIOL 3001 Experiential Practicum in Biosciences: 1 semester hour**

Prerequisites: Consent of Biology Curriculum Committee. Credit for off-campus bioscience projects providing extraordinary student experience and service to a community in need.

**BIOL 3102 Animal Behavior: 3 semester hours**

Prerequisites: BIOL 1821 and BIOL 1831. The study of invertebrate and vertebrate behavior, including neurophysiological, hormonal, developmental, genetic, ecological and evolutionary aspects of behavior; behavior interactions within and between populations. Three hours of lecture per week.

**BIOL 3103 Animal Behavior Laboratory: 2 semester hours**

Prerequisites: BIOL 3102 (may be taken concurrently). Observational and experimental studies of animal behavior in the field and laboratory. Three and one-half hours of formal laboratory time per week, but additional time may be required for independent projects. Some activities involve field trips or trips to the St. Louis Zoo.

**BIOL 3202 Conservation Biology: 3 semester hours**

Prerequisites: BIOL 1821 and BIOL 1831. This course is an introduction to the principles and theories of conservation biology, and field interviews with governmental and nongovernmental agencies. Course topics may include biodiversity, extinctions, population modeling, habitat fragmentation, conservation area management, restoration ecology, and social science elements of conservation strategies. Class sessions will include lectures and discussions. Three hours of lecture per week.

**BIOL 3203 Conservation Biology Laboratory: 2 semester hours**

Prerequisite: BIOL 3202 (recommended to be taken concurrently). This is the laboratory to accompany BIOL 3202. This laboratory class will include several field trips to local conservation projects, and field interviews with governmental and nongovernmental agencies. Three and one-half hours of laboratory per week.

**BIOL 3302 Evolution: 3 semester hours**

Prerequisites: BIOL 1821, BIOL 1831, BIOL 2012, and MATH 1030. This course covers the theory, events, and processes of organic evolution.

**BIOL 3622 Cell Biology: 3 semester hours**

Prerequisites: BIOL 1831, BIOL 2012, CHEM 1121, and MATH 1030. This course examines the organization and basic processes of cells including tissues, organelles, glycolysis, respiration, photosynthesis, trafficking, cytoskeleton, signal transduction, and cell division.

**BIOL 3699 Undergraduate Internship in Biotechnology: 1-4 semester hours**

Prerequisites: BIOL 1821, BIOL 1831, and CHEM 1111 and CHEM 1121 and consent of instructor. Concurrent enrollment in CHEM 2612 or higher is strongly encouraged. A 2.5 GPA and enrollment in the undergraduate Biotechnology Certificate Program is required. Internship will consist of a period of observation, experimentation and on-the-job training in a biotechnology laboratory. The laboratory may be industrial or academic. Credit will be determined by the number of hours a student works each week and in consultation between the intern's supervisor and instructor. Internship assignments will be commensurate with the education and experience of the student. Two credits may be used to fulfill the lab requirement.

**BIOL 3802 Vertebrate Physiology: 3 semester hours**

Prerequisites: BIOL 1821 and BIOL 1831 and CHEM 1111. This course covers the basic functional aspects of organ systems in relation to the physiochemical properties of protoplasm. It is three hours of lecture per week.

**BIOL 3803 Vertebrate Physiology Lab: 2 semester hours**

Prerequisite: BIOL 3802 (may be taken concurrently). Instrumental and experimental studies in physiology. Three and one-half hours laboratory per week.

**BIOL 3920 Special Topics in Biology: 1-5 semester hours**

Prerequisites: Consent of instructor. The topics will vary each semester. See course schedule online for topics. Credit arranged. May be taken more than once for credit if topics are different.

**BIOL 4102 Behavioral Ecology: 3 semester hours**

Prerequisite: BIOL 3102 (BIOL 3302 recommended). The evolution and ecology of animal behavior. Topics include the theoretical framework for making predictions, foraging, decision making, sensory ecology, sexual selection, mating systems, sociality and groups, cooperation, signal use and communication. Three hours of lecture per week. Students may not receive credit for both BIOL 4102 and BIOL 6102.

**BIOL 4122 Biostatistics: 3 semester hours**

Prerequisites: MATH 1030 and a minimum of 15 hours in biology. This course covers basic theory and mathematics behind statistical testing in biology. It includes components on experimental design, a historical perspective on statistics, and the description of a range of parametric and non-parametric statistical tests. This course also includes a practical component, where students apply their statistical knowledge using the R statistical computing environment. The course fulfills the statistics requirement for the BA or BS degree in biology.

**BIOL 4182 Population Biology: 3 semester hours**

Prerequisite: BIOL 2102 and BIOL 2012 (BIOL 3302 recommended). Introduces concepts and mathematical models of population ecology and population genetics. By integrating the ecology and genetics of populations, the course goal is to understand the processes that contribute to microevolution of populations. Topics include: demography, metapopulation biology, natural selection, migration, gene flow, and genetic drift. Three hours of lecture per week. Students may not receive credit for both BIOL 4182 and BIOL 6182.

**BIOL 4270 Global Climate Change: 3 semester hours**

Prerequisites: BIOL 3302 or consent of instructor. Topics included are fundamental physical, meteorological, and biological circumstances of global climate change, as well as predictions of its future effects on biological diversity, including humans, and how those estimates are made. In addition, basic environmental economics and politics of climate change at local and global levels will be included. The course will be taught as a series of lectures and discussions led by guest experts in each of the subdisciplines covered. Students may not receive credit for both BIOL 4270 and BIOL 6270.

**BIOL 4299 Practicum in Conservation: 2 semester hours**

Prerequisites: BIOL 3202 and consent of instructor. This course is generally restricted to students officially enrolled in the Certificate Program in Conservation Biology. The course provides practical experience with conservation or environmental agencies. Specific placement will be selected according to student's interests and career goals as well as availability of agency openings. Course requirements include practical experience and final report on practicum experience.

**BIOL 4402 Ornithology: 3 semester hours**

Prerequisites: BIOL 2102 and junior standing. Introduction to avian biology and ecology. Material to be covered will include basic adaptations of anatomy, physiology, and behavior of birds. There will be a strong emphasis on avian ecology and conservation. Specific topics will include flight, reproductive behavior, migration, foraging behavior, community structure, and current conservation concerns. The diversity of birds will be emphasized through comparisons between temperate and tropical regions. Three hours of lecture per week.

**BIOL 4403 Ornithology Laboratory: 2 semester hours**

Prerequisites: BIOL 4402 (may be taken concurrently), or consent of instructor. This course will introduce students to methods of identifying and studying birds. Labs will almost entirely be comprised of field trips to local areas and will emphasize diversity of birds, adaptations shown by different groups, and means of identification, particularly of birds found in Missouri. Field projects will focus on techniques for censusing birds, sampling foraging behavior, and studying habitat selection. Indoor periods will cover internal and external anatomy of birds. Slides and field trips to the St Louis Zoo will be used to survey the diversity of birds worldwide. Three and one-half hours of laboratory per week. Longer (e.g., Saturday) field trips will be made when appropriate.

**BIOL 4412 Principles of Ichthyology: 3 semester hours**

Prerequisites: BIOL 1821 and BIOL 2102. This course provides an introduction to the diversity of fishes, with a particular emphasis on systematics as well as the form and function of different species in the context of their natural history. Students will learn how to identify common fish species in Missouri and other portions of the United States. The course includes hands-on work with specimens and excursions to learn about fish in their natural habitats.

**BIOL 4422 Entomology: 3 semester hours**

Prerequisites: BIOL 1821, BIOL 1831, 9 additional hours of biology and upper-division standing. Development, structure, function, behavior and ecology of insects, including a systematic survey of the orders of Insecta. Three hours of lecture per week.

**BIOL 4423 Entomology Laboratory: 2 semester hours**

Prerequisites: BIOL 4422 (may be taken concurrently). Laboratory to accompany BIOL 4422. Studies of the morphology, physiology, and behavior of insects to give a sampling of biological studies of the class Insecta. Formation of a collection of insects, comprising a systematic survey of orders and principal families, will be an integral part of the course and will require additional time beyond the official lab hours. Three and one-half hours of lab per week.

**BIOL 4436 Applied Bioinformatics: 3 semester hours**

Prerequisites: BIOL 2012 and one of the following: BIOL 3302, BIOL 3622, BIOL 4182, BIOL 4602, or BIOL 4732. This course will provide exposure to using various computational approaches to solve biological problems. Specific attention will focus on methods for using and interpreting information from biological databases, analyzing biological sequence information, and making functional and structural predictions. Students may not receive credit for both BIOL 4436 and BIOL 5436.

**BIOL 4442 Developmental Biology: 3 semester hours**

Prerequisites: BIOL 2012 and BIOL 3622. A study of the basic principles that shape the embryonic and post-embryonic development of animals with an emphasis on the underlying cellular and molecular mechanisms. Specific topics include fertilization, determination of cell fate and differentiation, cell migration, establishment of the body plan, formation of selected organs and organ systems, stem cells, and limb regeneration. Environmental influences on development and the impact of developmental biology on modern medicine are also discussed. Three hours of lecture/discussion per week. Students may not receive credit for both BIOL 4442 and BIOL 6442.

**BIOL 4502 Evolution of Cognition: 3 semester hours**

Prerequisites: BIOL 3102 or consent of instructor; BIOL 3302 and PSYCH 2211 are strongly recommended. The evolutionary ecology of animal cognitive abilities. Topics include learning, memory, perception, navigation, and communication from an evolutionary perspective. The focus is on cognitive abilities as adaptations, which have evolved to solve specific environmental problems. Topics include empirical methods for assessing cognitive ability, experimental design, theoretical approaches for generating predictions, and the parsimonious interpretation of data. Two hours of lecture and one hour of discussion per week.

**BIOL 4550 Bacterial Pathogenesis: 3 semester hours**

Prerequisites: BIOL 2012 and BIOL 2482. Examination of the strategies bacterial pathogens use to infect animals. Topics include host immune responses to infection, bacterial virulence factors, regulation of bacterial virulence, and the cellular and molecular approaches used to study host/parasite interactions. Three hours of lecture per week. Students may not receive credit for both BIOL 4550 and BIOL 6550.

**BIOL 4602 Molecular Biology: 3 semester hours**

Prerequisites: BIOL 2012 and CHEM 2612. This course is a survey of the principles of molecular biology, with emphasis on understanding the genetic regulation of DNA, RNA, and protein synthesis and function in eukaryotic cells.

**BIOL 4608 Synthetic Biology: 3 semester hours**

Prerequisites: BIOL 2012, BIOL 2482. A study of the molecular biology of microbial cells, in the context of synthetic biological systems. Topics include DNA replication, transcription, translation, gene regulation and protein structure as well as aspects of genetic engineering as they apply to the construction of novel biological systems. Following an introduction to the design of biological parts used in synthetic biology, students read, discuss and present recent journal articles in order to learn about current advances and applications of synthetic biology. Three hours of lecture per week. Students may not receive credit for BIOL 4608 and BIOL 6608.

**BIOL 4614 Biotechnology Laboratory I: 4 semester hours**

Prerequisites: BIOL 2012 or consent of instructor. An introduction to the fundamental concepts that underlie the field of biotechnology. Both the basic principles of molecular biology and hand-on experience with the techniques of the field will be addressed through lectures, discussions, and a series of laboratory exercises. Two hours of lecture and four hours of laboratory per week. Fulfills a laboratory requirement only; may not be used to fulfill the higher level (4000-5000) lecture course requirement for the B.A. or B.S. degree in biology. Students may not receive credit for BIOL 4614 and a comparable biotechnology course from another institution.

**BIOL 4615 Biotechnology Laboratory II: 4 semester hours**

Prerequisites: BIOL 4614 and either BIOL 4602 or BIOL 4732 or CHEM 4712, or consent of instructor. This course is an in-depth look at theory and practice of biotechnology. Lectures and discussion will examine the underlying principles, and laboratory exercises will present hands-on experience with current techniques. The course entails one hour of lecture and six hours of laboratory per week. It fulfills a laboratory requirement only and may not be used to fulfill the higher level (4000-5000) lecture course requirement for the B.A. or B.S. degree in Biology. Students may not receive credit for BIOL 4615 and BIOL 6615.

**BIOL 4622 Cellular Basis of Disease: 3 semester hours**

Prerequisites: BIOL 3622. A study of the structural organization and processes of eukaryotic cells, focusing on how defects in cellular function lead to genetic diseases and cancer. Topics of discussion may include membrane dynamics, intracellular trafficking, signal transduction, and the cell cycle. Three hours of lecture per week. Students may not receive credit for both BIOL 4622 and BIOL 6622.

**BIOL 4632 Nucleic Acid Structure and Function: 3 semester hours**

Prerequisites: BIOL 2012 and BIOL 4732 or equivalent, or consent of instructor. A comprehensive view of the structural properties of DNA and RNA that promote molecular interactions and biological function. Topics will include the physical properties of nucleic acids, the formation and biological importance of higher order structures, RNA enzymatic activities, nucleic acid-protein interactions, and RNA metabolism. Three hours of lecture per week. Students may not receive credit for both BIOL 4632 and BIOL 6632.

**BIOL 4642 Plant Molecular Biology and Biotechnology: 3 semester hours**

Prerequisites: BIOL 2012, BIOL 3622. This course will introduce molecular biology principles that govern plant growth, development, and responses to stress. This course integrates the experimental approaches of genetics, molecular biology, and biochemistry, with a specific focus on biotechnology techniques and applications. Students may not receive credit for both BIOL 4642 and BIOL 6642.

**BIOL 4652 Virology: 3 semester hours**

Prerequisite: BIOL 2012 and BIOL 3622. This first half of the course entails a comparative study of the structure, replication, and molecular biology of viruses. The second half of the course focuses on the pathogenesis, control, and evolution of animal viruses. Three hours of lecture per week. Students may not receive credit for both BIOL 4652 and BIOL 6652.

**BIOL 4713 Techniques in Biochemistry: 2 semester hours**

Prerequisites: BIOL 4732 or CHEM 4712 (may be taken concurrently). Laboratory activities introducing fundamental qualitative and quantitative biochemical techniques. Student evaluation will be based on laboratory participation, student laboratory reports, and written examinations. Three and one-half hours of organized laboratory time per week. Students may need to return to the laboratory at unscheduled times to complete some experiments.

**BIOL 4732 Principles of Biochemistry: 3 semester hours**

Prerequisites: CHEM 2612 and BIOL 1831. This course explores the structure, function, and chemistry of biological molecules including enzymology, bioenergetics, and cellular metabolism. Biochemistry and Biotechnology majors should take CHEM 4712. Students may not receive credit for both BIOL 4732 and CHEM 4712.

**BIOL 4743 Principles of Pharmacology: 3 semester hours**

Prerequisites: BIOL 2012 and BIOL 3622 or consent of instructor. This course covers the foundational principles of drug delivery, distribution and loss within the body (pharmacokinetics), and the molecular mechanisms of drug effects in the body (pharmacodynamics). To illuminate these principles, selected classes of drugs will be discussed in regard to delivery, distribution with the body, mechanism of action, metabolism and elimination at both the qualitative and quantitative level. Students may not receive credit for both BIOL 4743 and BIOL 6743.

**BIOL 4797 Biochemistry and Biotechnology Seminar: 1 semester hour**

Same as CHEM 4797. Prerequisites: Senior standing in the Biochemistry and Biotechnology program and consent of faculty advisor. This course will focus on selected publications related to biochemistry and biotechnology from both refereed journals and news sources. Students are expected to participate in discussions and to prepare oral and written presentations. Completion of the Major Field Achievement Test in Biochemistry & Biotechnology is a course requirement. May not be taken for graduate credit.

**BIOL 4822 Introduction to Neuroscience: 3 semester hours**

Prerequisite: BIOL 3802 or consent of instructor. The study of nervous systems, featuring the cellular bases of initiation and conduction to the impulse, synaptic transmission, and the network integrative function of invertebrate and vertebrate nervous systems. This course emphasizes the multidisciplinary nature of the neurosciences, including anatomical, physiological and molecular approaches to understanding neural function. Three hours of lecture per week.

**BIOL 4842 Immunobiology: 3 semester hours**

Prerequisite: BIOL 3622 and CHEM 2612. The fundamental principles and concepts of immunology and immunochemistry. Emphasis on the relation of immunological phenomena to biological phenomena and biological problems. Three hours lecture per week.

**BIOL 4889 Senior Seminar: 2 semester hours**

Prerequisites: BIOL 1821, BIOL 1831, BIOL 2012, BIOL 3302, BIOL 3622, and the consent of your assigned Biology Advisor. This course involves oral and written presentations by students of selected scientific research papers. Students will also participate in discussions of scientific research. The course may not be taken for graduate credit. This course is intended to be taken during the last semester prior to graduation.

**BIOL 4905 Research: 1-3 semester hours**

Prerequisites: Consent of faculty research advisor. Research in an area selected by the student in consultation with and under the direct supervision of an UMSL biology faculty research adviser. Research opportunities are subject to availability and must be approved in advance of beginning research. The project may include the reading of pertinent literature, laboratory or field experience, including keeping of a logbook, and a summary paper and a presentation, all based on an average 8 hours per week per credit during a 15 week semester at the discretion of the instructor. Credit arranged. Course may be repeated for a total of up to 5 credit hours. A maximum of one lab requirement may be satisfied using any two BIOL 4905 credits. Additional credits may be applied toward the total biology hours required for the biology BA or BS. May not be taken for graduate credit.

**BIOL 4910 Applied Community Health: 3 semester hours**

Prerequisites: Consent of instructor; enrollment limited to community health certificate students. This course provides an advanced practical work experience emphasizing community health concepts. Experiences may include a practicum or internship in an outside agency, research, or an independent study with a community health focus. Students will collaborate with the program director to identify and define the project parameters based on student's experience and goals; all projects must be approved by the course instructor prior to enrollment.

**BIOL 4915 Biology Internship: 1-3 semester hours**

Prerequisites: Consent of faculty research advisor; generally restricted to junior and senior standing. Research in an area selected by the student to be conducted off-campus in a lab of a professional researcher or faculty person (the internship mentor) other than those in UMSL Biology. Research opportunities are subject to availability and must be approved in advance of beginning research by an UMSL biology faculty liaison and the internship mentor. The project normally includes the reading of pertinent literature, laboratory or field experience, including keeping of a logbook, and a summary paper and a presentation, all based on an average 8 hours per week per credit during a 15 week semester. Credit arranged. This course and BIOL 4905 may be repeated in any combination for a total of up to 5 credit hours. A maximum of one lab requirement may be satisfied using any two BIOL 4905 and/or BIOL 4915 credits. Additional credits may be applied toward the total biology hours required for the biology BA or BS.

**BIOL 4920 Selected Topics in Biology: 3 semester hours**

Prerequisites: Junior standing and consent of instructor. The topic for this course will vary each semester. Topics offered for the following semester will be posted in the departmental office. This course may be repeated once if the topic is different.

**BIOL 5012 Advanced Genetics: 3 semester hours**

Prerequisites: BIOL 2012 or consent of instructor. This course explores advanced topics in the study of genetics, including advanced principles of inheritance, classical genetic theory, advances in understanding the nature of genetic material, and the molecular basis of heredity. Variation between individuals and populations will be considered to emphasize the effects of genetics on both medical and evolutionary questions. A particular focus will be placed on identifying, analyzing, and communicating findings from recent primary literature.

**BIOL 5059 Topics in Ecology, Evolution, and Systematics: 1 semester hour**

Prerequisites: Graduate standing. Presentation and discussion of faculty and student current research projects in behavior, ecology, evolution, and systematics. May be repeated.

**BIOL 5069 Topics in Cellular and Molecular Biology: 1 semester hour**

Prerequisites: Graduate standing or consent of instructor. Presentation and discussion of student and faculty research projects and/or current research articles in molecular, cellular and developmental biology. May be repeated. Course graded on a satisfactory/unsatisfactory basis.

**BIOL 5079 Topics in Floristic Taxonomy: 1 semester hour**

Prerequisites: Graduate standing. This is a seminar course in systematics of higher plants, arranged in the Cronquist sequence of families, covering morphology, anatomy, palynology, biogeography, chemosystematics, cytology, and other aspects of plant classification and phylogenetics. It is given at the Missouri Botanical Garden. It is one hour per week.

**BIOL 5089 Topics in Animal Behavior: 1 semester hour**

Prerequisites: Graduate standing. Presentation and discussion of current research articles and/or student and faculty research projects in animal behavior, including ecology, evolution, genetics, and mechanisms of behavior. May be repeated.

**BIOL 5099 Biology Colloquium: 1 semester hour**

Prerequisites: Graduate standing. Attendance is required for the Biology weekly seminar series, consisting of research presentations by department faculty and invited speakers. Class sessions will include discussion of scientific research and presentation practices.

**BIOL 5177 Graduate Research Writing Workshop in Biology: 1 semester hour**

Prerequisites: Graduate standing. This hands-on course is designed to give Biology graduate students practical assistance and advice on writing, including grant proposal content and organization, writing succinctly but clearly, and editing. The course format will include both informational lectures with discussions and working sessions focused on writing and critiquing drafts. Students are recommended to begin the class ready to write at least one aim of a grant or thesis proposal. Course is graded on a satisfactory/unsatisfactory basis.

**BIOL 5178 Introduction to Graduate Research in Biology: 1 semester hour**

Prerequisites: Graduate standing or consent of instructor. A discussion-based class to introduce new PhD and thesis MS students to the Biology department, graduate school, and best research practices.

**BIOL 5179 Ethical Issues in Biology: 1 semester hour**

Prerequisites: Graduate standing. Using readings and discussions, students will explore ethical issues in Biology in both professional and social realms. Professional topics include authorship, grants accounting, and academic misconduct; social topics include ethical foundations of basic and applied science, government regulation of science, environmental and individual protection, and current issues. Course graded on a satisfactory/unsatisfactory basis.

**BIOL 5192 Community Ecology: 3 semester hours**

Prerequisites: Graduate standing and either BIOL 2102 and BIOL 4182 or an equivalent course. Studies of structure and organization of natural communities stressing the abundance and distribution of species, the regulation of species diversity, and the evolution of demographic parameters in populations.

**BIOL 5302 Advanced Evolution: 3 semester hours**

Prerequisites: BIOL 3302 or graduate standing. Explores advanced topics in the study of adaptation and the origin of species. Covers phenomena both within populations (e.g. natural selection, sexual selection, and molecular evolution) and between populations (e.g. speciation, coevolution, competition, gene flow, biogeography, and comparative phylogenetics), with a particular focus on recent primary literature.

**BIOL 5312 Theory of Systematics: 3 semester hours**

Prerequisites: BIOL 1821, BIOL 1831 and at least one course beyond the introductory level dealing with animal, plant, or microbial diversity (BIOL 2482, BIOL 2402, BIOL 3102, BIOL 4501, BIOL 4402, or BIOL 4422) or consent of instructor. This course investigates the theory of classification, phylogenetic analysis, systematic biology, and their relation to systematic practice. The course covers goals and schools of systematics, characters and homology, analysis of molecular and morphological data and underlying assumptions, species concepts, classification, naming, and the connections between evolutionary biology and systematics. The course is appropriate for upper level undergraduates & graduate students in all disciplines (animal, plant, and microbial) as an introduction to systematic methods. Three hours of lecture per week.

**BIOL 5436 Advanced Applied Bioinformatics: 3 semester hours**

Prerequisites: BIOL 4732 or BIOL 4602 or consent of instructor. This course provides an advanced foundation in using various computational approaches to solve biological problems. Specific attention focuses on methods for using and interpreting information from biological databases, analyzing biological sequence information, and making functional and structural predictions. Students may not receive credit for both BIOL 4436 and BIOL 5436.

**BIOL 5798 Practicum in Science in Business: 1-2 semester hours**

Same as CHEM 5798. Prerequisites: Graduate standing and enrollment in a Professional Science emphasis in Chemistry, Biochemistry & Biotechnology, or Biology. Students will integrate and apply their scientific expertise to a practical, business-related problem. The course will emphasize interdisciplinary team-work as well as both written and oral communication skills.

**BIOL 5799 Internship in Sciences in Business: 1-2 semester hours**

Same as CHEM 5799. Prerequisites: Graduate standing and enrollment in a Professional Science emphasis area in Chemistry, Biochemistry & Biotechnology, or Biology. The internship will consist of a period of on-the-job training at a local company. Credit hours will be determined by the number of hours the student works each week and in consultation between the intern's supervisor and the course instructor. Internship assignments will be commensurate with the education and experience of the student, with an emphasis on work at the interface between the scientific and business components of the company. A written report describing the internship project is required.

**BIOL 6102 Advanced Topics in Behavioral Ecology: 3 semester hours**

Prerequisite: BIOL 3102 (BIOL 3302 is recommended). The evolution and ecology of animal behavior. Topics include the theoretical framework for making predictions, foraging, decision making, sensory ecology, sexual selection, mating systems, sociality and groups, cooperation, and signal use and communication. Three hours of lecture per week. Assignments will include a heavy emphasis on theory and modelling approaches to behavioral ecology. Students may not receive credit for both BIOL 4102 and BIOL 6102.

**BIOL 6182 Advanced Population Biology: 3 semester hours**

Prerequisites: BIOL 2012 (BIOL 3302 recommended). Introduces concepts and mathematical models of population ecology and population genetics. By integrating the ecology and genetics of population, the course goal is to understand the processes that contribute to microevolution of populations. Topics include: demography, metapopulation biology, natural selection, migration, gene flow, and genetic drift. A discussion section will focus on mathematical elements of population biology models. Three hours of discussion per week. Students may not receive credit for both BIOL 4182 and BIOL 6182.

**BIOL 6250 Public Policy of Conservation and Sustainable Development: 3 semester hours**

Same as POL SCI 6452. Prerequisites: Graduate standing in Political Science or Biology. This course introduced concepts and techniques for formulating, implementing, and analyzing public policy with an emphasis on environmental concerns, conservation, and sustainable development. The course will be team-taught by faculty representing the departments of political science and biology. Course materials will include case studies that demonstrate the special problems of environmental policymaking in developing and developed economies.

**BIOL 6270 Advanced Global Climate Change: 3 semester hours**

Prerequisites: Graduate standing or permission of the instructor. We will cover the fundamental physical, meteorological, and biological circumstances of global climate change, as well as predictions of its future effects on biological diversity, including humans, and how those estimates are made. We will also cover basic environmental economics and politics of climate change at local and global levels. The course will be taught as a series of lectures and discussions led by guest experts in each of the subdisciplines covered. Students may not receive credit for both BIOL 4270 and BIOL 6270.

**BIOL 6299 Internship in Conservation Biology: 1-4 semester hours**

Prerequisites: BIOL 6250. This internship-based course consists of a period of study, observation and on-the-job training at a conservation or environmental agency. Specific placements will be selected according to student's interests and career goals. Internships may vary from 2 weeks to 4 months in duration.

**BIOL 6412 Advanced Principles of Ichthyology: 3 semester hours**

Prerequisites: Graduate standing. This course is an advanced, comprehensive study of the diversity of fishes, with a particular emphasis on systematics as well as the form and function of different species in the context of their natural history. Students will learn to identify common fish species in Missouri and other regions of the United States. The course includes hands-on work with specimens and excursions to study fish in their natural habitats. Students may not receive credit for both BIOL 4412 and BIOL 6412.

**BIOL 6442 Advanced Developmental Biology: 3 semester hours**

Prerequisites: BIOL 2012 and BIOL 3622. A study of the basic principles that shape the embryonic and post-embryonic development of animals with an emphasis on the underlying cellular and molecular mechanisms. Specific topics include fertilization, determination of cell fate and differentiation, cell migration, establishment of the body plan, formation of selected organs and organ systems, stem cells, and limb regeneration. Environmental influences on development and the impact of developmental biology on modern medicine are also discussed. Three hours of lecture/discussion per week. Students may not receive credit for both BIOL 4442 and BIOL 6442.

**BIOL 6502 Advanced Evolution of Cognition: 3 semester hours**

Prerequisites: BIOL 3102 and BIOL 3302, or consent of instructor; PSYCH 2211 strongly recommended. The evolutionary ecology of animal cognitive abilities. Topics include learning, memory, perception, navigation, and communication from an evolutionary perspective. The focus is on cognitive abilities as adaptations, which have evolved to solve specific environmental problems. Topics include empirical methods for assessing cognitive ability, experimental design, theoretical approaches for generating predictions, and the parsimonious interpretation of data. Two hours of lecture and one hour of discussion per week. Students may not receive credit for both BIOL 4502 and BIOL 6502.

**BIOL 6550 Advanced Bacterial Pathogenesis: 3 semester hours**

Prerequisites: BIOL 2012 and BIOL 2482. Examination of the strategies bacterial pathogens use to infect animals. Topics include host immune responses to infection, bacterial virulence factors, regulation of bacterial virulence, and the cellular and molecular approaches used to study host-parasite interactions. Students may not receive credit for both BIOL 6550 and BIOL 4550. Students will be required to give an oral presentation and/or write an extra paper on a topic relevant to the course. Three hours of lecture per week.

**BIOL 6602 Advanced Molecular Biology: 3 semester hours**

Prerequisites: BIOL 2012 and CHEM 2612, or consent of instructor. This course covers advanced principles of molecular biology, with an emphasis on primary literature. Students may be required to give an oral presentation and/or write papers on a topic relevant to the course. Students may not receive graduate credit for both BIOL 4602 and BIOL 6602.

**BIOL 6608 Advanced Synthetic Biology: 3 semester hours**

Prerequisites: BIOL 2012, BIOL 2482. A study of the molecular biology of microbial cells, in the context of synthetic biological systems. Topics include DNA replication, transcription, translation, gene regulation and protein structure as well as aspects of genetic engineering as they apply to the construction of novel biological systems. Following an introduction to the design of biological parts used in synthetic biology, students read, discuss and present recent journal articles in order to learn about current advances and applications of synthetic biology. Three hours of lecture per week. Students may not receive credit for both BIOL 4608 and BIOL 6608.

**BIOL 6615 Advanced Biotechnology Laboratory II: 4 semester hours**

Prerequisites: BIOL 4602 or BIOL 4732 or CHEM 4712, or consent of instructor. This course is an advanced analysis of the theory and practice of biotechnology. Lectures and discussion will examine the underlying principles, and laboratory exercises will present hands-on experience with current techniques. It entails one hour of lecture and six hours of laboratory per week. Students may not receive credit for both BIOL 6615 and BIOL 4615.

**BIOL 6618 Practical Next-Generation Sequencing: 3 semester hours**

Prerequisites: Consent of instructor. This is a laboratory course in practical next-generation sequencing. Roughly one-half of the course will focus on bench-top methods for generating sequencing libraries from total RNA as well as the use of next-generation sequencing instruments. The second half of the course will focus on computational methods for analyzing sequencing data, including data visualization and coding.

**BIOL 6622 Advanced Cellular Basis of Disease: 3 semester hours**

Prerequisites: BIOL 3622, or consent of instructor. A study of the structural organization and processes of eukaryotic cells, focusing on how defects in cellular function lead to genetic diseases and cancer. Topics of discussion may include membrane dynamics, intracellular trafficking, signal transduction, and the cell cycle. Three hours of lecture per week. Students may not receive credit for both BIOL 6622 and BIOL 4622.

**BIOL 6632 Advanced Nucleic Acid Structure and Function: 3 semester hours**

Prerequisites: BIOL 2012 and BIOL 4732 or equivalent, or consent of instructor. A comprehensive view of the structural properties of DNA and RNA that promote molecular interactions & biological function. Topics will include the physical properties of nucleic acids, the formation and biological importance of higher order structures, RNA enzymatic activities, nucleic acid-protein interactions, and RNA metabolism. Three hours of lecture and one hour of discussion per week. Students may not receive credit for both BIOL 4632 and BIOL 6632.

**BIOL 6642 Advanced Plant Biology and Biotechnology: 3 semester hours**

Prerequisites: Graduate standing. This course will introduce molecular biology principles that govern plant growth, development, and responses to stress. This course integrates the experimental approaches of genetics, molecular biology, and biochemistry, with a specific focus on biotechnology techniques and applications. Student may not receive credit for both BIOL 4642 and BIOL 6642.

**BIOL 6652 Advanced Virology: 3 semester hours**

Prerequisites: BIOL 2012, BIOL 3622, and graduate standing. This first half of the course entails a comparative study of the structure, replication, and molecular biology of viruses. The second half of the course focuses on the pathogenesis, control, and evolution of animal viruses. Three hours of lecture, one hour of discussion or seminar per week. Students may not receive credit for both BIOL 4652 and BIOL 6652.

**BIOL 6699 Graduate Internship in Biotechnology: 1-4 semester hours**

Prerequisites: Graduate standing and enrollment in graduate Biotechnology Certificate Program. 6 credit hours maximum (maximum of 8 combined credit hours of BIOL 6905 and internship) Internship will consist of period of observation, experimentation and on-the-job training in biotechnology laboratory. The laboratory may be industrial or academic. Credit will be determined by the number of hours the student works each week and in consultation between the intern's supervisor and the instructor. Internship assignments will be commensurate with the education and experience of the student.

**BIOL 6743 Advanced Pharmacology: 3 semester hours**

Prerequisites: Graduate standing. This course covers the foundational principles of drug delivery, distribution, and loss within the body (pharmacokinetics) and the molecular mechanisms of drug effects in the body (pharmacodynamics). To illuminate these principles, selected classes of drugs will be discussed regarding delivery, distribution within the body, mechanism of action, metabolism, and elimination at both the qualitative and quantitative levels. Students will advance their understanding of the topics through oral presentations and/or written papers. Students may not receive credit for both BIOL 4743 and BIOL 6743.

**BIOL 6889 Graduate Seminar: 2 semester hours**

Presentation and discussion of various research problems in biology. Graduate student exposure to the seminar process.

**BIOL 6905 Graduate Research in Biology: 1-10 semester hours**

Research in area selected by student in consultation with faculty members.

**BIOL 6915 Graduate Research Practicum: 1-2 semester hours**

Prerequisite: Consent of instructor. This course is designed for graduate students wishing to pursue research experience in an area outside their dissertation topic. The project can be techniques-oriented or focused on a specific research question. The credit hours will depend on the time commitment to the project as decided by the supervisory faculty member.

**BIOL 6920 Advanced Topics in Biology: 1-5 semester hours**

Prerequisites: Graduate standing. In-depth studies of selected topics in contemporary biology. May be repeated.