

Biology

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.

Departmental Honors

The Department of Biology offers an Honors Program to train students in conducting research in areas of biological research currently under study in the Department.

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. CEIBA Biological Centre in Guyana has hosted several UMSL courses and student researchers. Student researchers work independently at research stations throughout the tropics.

Cooperative Programs

The department participates in a cooperative consortium program in biology with Washington University, Saint Louis University, Southern Illinois University-Edwardsville, 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 Undergraduate Certificates in Biotechnology and Conservation Biology are for majors interested in careers in biotechnology and associated areas and in conservation, respectively.

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 Graduate Certificates in Biotechnology and in Tropical Biology and Conservation provides professional training in the areas of biotechnology and conservation.

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 (<http://bulletin.umsl.edu/programs/biology-ba/>)

Biology BS (<http://bulletin.umsl.edu/programs/biology-bs/>)

Biology BS/MS Dual Degree Program (<http://bulletin.umsl.edu/programs/biology-bs-and-ms/>)

Biology MS (<http://bulletin.umsl.edu/programs/biology-ms/>)

- Cell and Molecular Biology Emphasis (<http://bulletin.umsl.edu/programs/biology-ms-cell-and-molecular-biology-emphasis/>)
- Ecology Evolution and Systematics Emphasis (<http://bulletin.umsl.edu/programs/biology-ms-ecology-evolution-and-systematics-emphasis/>)
- Professional Science in Cellular and Molecular Biology Emphasis (<http://bulletin.umsl.edu/programs/biology-ms-professional-science-in-cellular-and-molecular-biology-emphasis/>)

Biology PhD

- Cell and Molecular Biology Emphasis (<http://bulletin.umsl.edu/programs/biology-phd-cell-and-molecular-biology-emphasis/>)
- Ecology, Evolution and Systematics Emphasis (<http://bulletin.umsl.edu/programs/biology-phd-ecology-evolution-and-systematics-emphasis/>)

Minors

Biology Minor (<http://bulletin.umsl.edu/programs/biology-minor/>)

Environmental Studies Minor (<http://bulletin.umsl.edu/programs/environmental-studies-minor/>)

Certificates

Biotechnology Graduate Certificate (<http://bulletin.umsl.edu/programs/biotechnology-graduate-certificate/>)

Global Biodiversity Conservation and Leadership Graduate Certificate (<http://bulletin.umsl.edu/programs/global-biodiversity-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 (MOTR BIOL 100): 3 semester hours

Emphasis on fundamental principles of biology. BIOL 1012 can be applied toward fulfillment of the general education requirement in science. BIOL 1012 does not satisfy the prerequisite requirements in other courses in biology at the 2000 level or above. 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: 1 semester hour

Prerequisite: BIOL 1012 (may be taken concurrently). This Laboratory course accompanies BIOL 1012. BIOL 1013 can be used to fulfill the general education requirements in a laboratory science. BIOL 1013 does not meet the prerequisite requirements for other courses in biology. Two and one-half hours of laboratory per week.

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. Fulfills Science/Math requirement.

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 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 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. Fulfills Science/Math requirement.

BIOL 1212 Applied Environmental Sciences: 4 semester hours

In a combined lecture/laboratory setting, students will get hands-on experience collecting and testing environmental samples for abiotic factors such as contaminants, and experimentally assessing the impact of those contaminants on the biological communities contained within the samples. Important approaches include global positioning and information technologies, microscopy, microbiological techniques, genomics, and quantitative analytical measures for assessing the physical, biological and chemical properties of collected samples.

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 150L): 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. 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 organism and supraorganism levels of biology. Topics to be covered include: ecology, evolution, diversity, and population biology. Three hours of lecture and one hour of discussion per week.

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 and 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 1999 Evolution for Everyone: 3 semester hours

Evolution for Everyone explores the development of our current understanding by examining modern and ancient controversies, and by studying major processes by which change occurs. Lectures will present overviews and many examples on topics in history, mechanisms, and outcome of evolutionary change, and students will participate in classroom and online discussions based on readings, computer exercises, and data collection and analysis. Course may not be applied towards major in Biology. Not eligible for credit with BIOL 3302 (Introduction to Evolution) required for Biology majors.

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 (majors must also take BIOL 1821) MATH 1030, and CHEM 1111 or (CHEM 1081 plus CHEM 1091). Fundamental principles of inheritance, including classical genetic theory as well as recent advances in the molecular basis of heredity. Three hours of lecture per week. Fulfills Science/Math requirement.

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. Fulfills Science/Math requirement.

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 2501 Biology of Plants: 5 semester hours

Prerequisites: BIOL 1821 and BIOL 1831. A general discussion of the plant groups from algae through angiosperms. Plant morphology, physiology, reproduction and ecology will be discussed in lecture (three hours per week). The laboratory (three and one half hours per week) involves examination of representatives of the plant kingdom and experimentation in plant physiology and genetics. Fulfills both a lecture and laboratory requirement.

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. Introduction to the principles and theories of conservation biology. Course topics include biodiversity, extinctions, population modeling, habitat fragmentation, conservation area management, restoration ecology, and social science elements of conservation strategies. Class sessions will include lectures, discussions, and simulation exercises. Three hours of lecture per week.

BIOL 3203 Conservation Biology Laboratory: 2 semester hours

Prerequisite: BIOL 3202 (recommended to be taken concurrently). Laboratory to accompany BIOL 3202. Laboratory will include computer simulations of conservation problems using existing software, 2-3 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 3631 Histology and Microtechniques: 5 semester hours

Prerequisites: BIOL 1831 (majors must also take BIOL 1821), BIOL 3622 recommended. The basic principles of histology. A survey of basic tissues and organ systems. Techniques associated with preparation of animal tissues for light microscopic studies. Three hours of lecture and 3 1/2 hours of laboratory per week. (Additional lab hours arranged). Fulfills both a lecture and a laboratory requirement.

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 or CHEM 1081 plus CHEM 1091. Basic functional aspects of organ systems in relation to the physiochemical properties of protoplasm. Three hours lecture per week. Fulfills Science/Math requirement.

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 Biometry: 3 semester hours

Prerequisites: MATH 1030 and a minimum of 15 hours in biology. Reviews descriptive, analytical, and experimental methods useful for the statistical study of biological phenomena. Students will develop the skills needed to better appreciate and evaluate the published literature, as well as the ability to design their own research programs. Topics include: the collection and summarization of biological observations; development, design, and testing of hypothesis; analysis and presentation of data. Three hours of lecture per week. Fulfills the statistics requirement for the B.A. or B.S. 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 4192 Applications of Geographic Information Systems: 5 semester hours

Prerequisites: BIOL 2102, BIOL 4122 or equivalent, and consent of instructor. Geographic Information Systems (GIS) are sophisticated computer-based systems for analysis, capture, presentation, and maintenance of geographically referenced data. This course provides a foundation in using GIS for spatial analysis. Although biological examples are primarily used, examples from a range of disciplines are employed to emphasize the use of GIS as a tool to support analysis and decision-making. Students will have hands-on use of GIS software during each session. An independent research project applying the spatial analysis tools learned in GIS to biological research will be required. Five hours of combined lecture and computer operations, plus 2-3 hours of open lab per week. Fulfills both a lecture and a laboratory requirement. Students may not receive credit for both BIOL 4192 and BIOL 6192.

BIOL 4222 Tropical Ecology and Conservation: 3 semester hours

Prerequisite: BIOL 2102, BIOL 4182, BIOL 5192, or equivalent. This course will cover research areas in tropical population, community and ecosystem ecology, with emphasis on inter-species and environment-organism interactions, population control factors, and genetic structure of populations. Topics include the current status and causes of tropical habitat destruction, ongoing attempts to manage those habitats, and development of strategies leading to sustained use of non-renewable resources. Three hours of lecture per week. Students may not receive credit for both BIOL 4222 and BIOL 6222.

BIOL 4245 Field Biology: 3 semester hours

Prerequisite: Three biology courses and consent of instructor. Intensive study of the flora and fauna of selected natural areas of North America, including an extended field trip. Details of the field trip and course schedule will be posted in the Biology department preceding registration for the term in which the course will be offered. Students will be required to pay costs of travel and of the field trip. This is a laboratory course appropriate for advanced undergraduates and non-thesis Master of Science students.

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 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 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 4501 Flowering Plant Families: Phylogeny and Diversification: 5 semester hours

Prerequisites: BIOL 1821, BIOL 1831 and junior standing or consent of instructor. Focusing on the flowering plant families of North America, the aim of the course is to give an understanding of their phylogeny and diversification. Student will also gain an understanding of plant morphology and anatomy, a basis for further developing their knowledge of plants. Three hours of lecture and three to four hours of laboratory per week. Students may need to return to the laboratory at unscheduled times.

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 4612, or consent of instructor. 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. One hour of lecture and six 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 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 4712 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 4662 Human Pathology: 3 semester hours

Prerequisites: BIOL 3622 or consent of the instructor. A study of disease processes as they affect the human body. The course will examine both the proximate causes and underlying mechanisms of disease. Specific conditions will be used to illustrate application of clinical approaches in determining the origin, development, and effects of a disease.

BIOL 4712 Biochemistry: 3 semester hours

Same as: CHEM 4712. Prerequisites: CHEM 2612 and either BIOL 1831 or CHEM 2622. Examines the chemistry and function of cell constituents, and the interaction and conversions of intracellular substances. Students may not receive credit for both BIOL 4712 and CHEM 4712.

BIOL 4713 Techniques in Biochemistry: 2 semester hours

Prerequisites: BIOL 4712 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 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 of 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, and BIOL 3302, with a total of at least 30 credits in Biology and the consent of your assigned Biology Advisor. Oral and written presentation by students of selected scientific papers or articles. Students are expected to participate in discussions of oral presentations by other students. May not be taken for graduate credit.

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 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

Prerequisite: 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

Prerequisite: BIOL 2501 or equivalent, and graduate standing. 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. Given at the Missouri Botanical Garden. 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 5123 Advanced Tropical Resource Ecology Field Studies: 2 semester hours

Prerequisites: BIOL 5122 (may be taken concurrently). The field component to the lecture and seminar course. Examines the patterns of use and exploitation of resources in the tropics by humans in the context of the theories of behavioral ecology. Two weeks of intensive field research and lectures in Guyana, South America during the second and third weeks of Summer Session I (trip costs to be borne by the student). Students may not receive credit for both BIOL 3123 and BIOL 5123. Offered in odd numbered years.

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 (such as BIOL 2482, BIOL 2501, BIOL 2402, BIOL 4482, BIOL 4501, BIOL 4402, BIOL 4422) or consent of instructor. Course investigates the theory of classification, phylogenetic analysis, systematic biology, and their relation to systematic practice. Will cover 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 Applied Bioinformatics: 3 semester hours

Prerequisites: BIOL 4712 or BIOL 4602 or consent of instructor. This course provides a survey of the various computational approaches that can be used to solve biological problems. Specific attention will be focused on biological databases and methods for using and interpreting database information, sequence alignments, functional genomics, structure prediction, high-throughput analyses, and proteomics. Three hours of lecture per week.

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 6192 Applications of Geographic Information Systems: 5 semester hours

Prerequisites: BIOL 2102, BIOL 4122 or equivalent, and consent of instructor. Geographic Information Systems (GIS) are sophisticated computer-based systems for analysis, capture, presentation, and maintenance of geographically referenced data. This course provides a foundation in using GIS for spatial analysis. Although biological examples are primarily used, examples from a range of disciplines are employed to emphasize the use of GIS as a tool to support analysis and decision-making. Students will have hands-on use of GIS software using Windows 2000/NT based workstations during each session. An independent research project applying the spatial analysis tools learned in GIS to biological research will be required. Five hours of combined lecture and computer operations, plus 2-3 hours of open lab per week.

BIOL 6222 Advanced Tropical Ecology and Conservation: 3 semester hours

Prerequisite: BIOL 2102, BIOL 4182, or BIOL 5192, or their equivalent. This course will cover research areas in tropical population, community and ecosystem ecology, with emphasis on inter-species and environment-organism interactions, population control factors, and genetic structure of populations. Topics include the current status and causes of tropical habitat destruction, ongoing attempts to manage those habitats, and development of strategies leading to sustained use of non-renewable resources. A research proposal designed to investigate a current topic in tropical ecology will be required. Students may not receive credit for BIOL 4222 and BIOL 6222. Three hours of lecture per week.

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

Same as POL SCI 6452. Prerequisite: Graduate standing in Biology or Political Science and consent of instructor. Prior course in ecology recommended. This course will introduce the student to 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 a political scientist and a biologist. 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

Prerequisite: BIOL 6250 or BIOL 6212 and consent of the director of graduate studies in biology. Internships will consist 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 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 4614 and either BIOL 4602 or BIOL 4612, or consent of instructor. An in-depth look at 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. One hour of lecture and six hours of laboratory per week. Students will be required to give an oral presentation and/or write an extra paper on a topic relevant to the course. Students may not receive credit for both BIOL 6615 and BIOL 4615 or any course previously called Techniques in Molecular Biology or Advanced Techniques in Molecular Biology.

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 4712 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 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.