BIOLOGICAL SCIENCES

The department of biological sciences offers a thesis and a non-thesis M.S. degree track for students who want to pursue graduate education. A graduate degree in biological sciences allows students to enhance their career marketability and further their education. As part of a science and technology university, our program has the unique advantage of being part of a rich history of scientific application that includes patent development, deep connections with the leading scientific and technological industries, and innovative solutions to challenging global problems.

Graduate students in the department work closely with faculty advisors and other students to design, execute, and interpret experiments that answer basic and applied scientific questions. We encourage interdisciplinary and transdisciplinary collaborations, external partnerships, and participation in regional and national conferences. Competitively awarded graduate teaching assistantships are available for excellent applicants with an identified faculty mentor.

Equipment and Facilities

In the department of biological sciences, we have access to and utilize an array of cutting-edge technologies for microscopy, genetic analyses, cytology, molecular biology, and microbiology. Our environmental and ecological students utilize the outdoor laboratory at the Missouri S&T Ozark Research Field Station, abundant local natural resources, and our connections with federal and state land management agencies to answer questions related to environmental physiology, hydrological flow, evolutionary origins, and ecological function. The 1,780 square foot Missouri S&T Animal Research Facility houses research animals, colony rooms, and a surgical theater for experimental research in physiology, anatomy, behavior, and medical applications. Departmental offices and laboratories are housed in Schrenk Hall.

Course Study

Degree Requirements M.S. - with thesis

BIO SCI 6202	Problems In Applied And Environmental Biology
BIO SCI 5010	Graduate Seminar
or BIO SCI 5020	Data Analysis and Presentation
BIO SCI 5099	Graduate Research
BIO SCI 6223	Research Proposal Writing

Degree Requirements M.S. - without thesis

BIO SCI 6202	Problems In Applied And Environmental Biology
BIO SCI 5010	Graduate Seminar

Elective courses are chosen with guidance from the advisor and advisory committee. A minimum of 30 credit hours is required for a M.S. degree. Up to 6 credit hours may be taken at the 3000-level in courses offered by other departments. Candidates for the M.S. degree with thesis conduct original research that is defended in a final oral examination. Non-thesis M.S. degree candidates take a comprehensive written final examination.

A student holding a B.S. degree and pursuing a Ph.D. in biological sciences will complete a total of 72 credit hours including a minimum of 30 credit hours in graduate course work and a minimum of 30 hours of research credit. There are three alternative tracks for doctoral students: 1) Bioinnovation, 2) Biomedicine, and 3) Environmental Biology. Students will begin the program by enrolling in one of three topical introductory courses, Advanced Principles of Biodesign (BIO SCI 6603), Current Topics in Biomedical Sciences (BIO SCI 6613), or Current Topics in Environmental Biology (BIO SCI 6623). Required courses include Problems in Applied and Environmental Biology (BIO SCI 6202) and Research Proposal Writing (BIO SCI 6223). Ph.D. students are required to enroll in Data Analysis and Presentation (BIO SCI 5020) for two semesters during their program of study. At least 6 credit hours of mathematics, statistics or computer science course work is required. The remaining 14 credit hours may include any additional graduate courses offered in BIO SCI or any additional graduate courses in other programs (e.g. CHEM, CHEM ENG, BIO ENG, IS&T, STAT, MSE, COMP SCI) with approval from the student's advisory committee. Students are encouraged to pursue graduate certificates in other programs that are relevant to their program of study. Note that no course below the 5000-level may be applied to the degree requirements.

A student entering with an M.S. degree will complete a total of 42 credit hours including a minimum of 12 credit hours in graduate course work after meeting all degree requirements through transfer course credit, and a minimum of 30 credit hours of research.

A qualifying exam based upon a research proposal written and defended by the student will be successfully completed no later than the end of the fifth semester of enrollment, and a plan of study will be approved by a student's advisory committee by the end of the semester in which the qualifying exam is passed. A comprehensive exam will be completed after the student has completed their coursework. Upon conclusion of research, the student will complete a written dissertation and successfully defend the dissertation in their final exam (defense).

David Duvernell, Professor
PHD Virginia Tech
Population genetics, evolutionary ecology.

Chen Hou, Associate Professor
PHD University of Missouri-Columbia
Metabolic basis of aging, energetic basis of animal growth and reproduction.

Yue-Wern Huang, Professor
PHD University of Wisconsin Madison
Toxicology, nanobiotechnology, biomedical science.

Melanie R Mormile, Professor
PHD University of Oklahoma, Norman
Environmental microbiology.

Dev K. Niyogi, Professor
PHD University of Colorado Boulder
Ecology, limnology.

Andrea Scharf, Assistant Professor
PHD Heinrich Heine University Düsseldorf

Julie A Semon, Associate Professor
PHD Tulane University
Adult stem cells, tissue engineering.

Katie B Shannon, Teaching Professor
PHD Harvard Medical School
Cell biology, mitosis, cytokinesis, cell cycle regulation.

Katherine Sharp, Assistant Professor
PHD University of Kentucky

Matthew Scott Thimgan, Associate Professor
PHD The University of North Carolina at Chapel Hill
Biochemistry, genetics and anatomy of the sleep-loss response, sleep biomarkers.

Robin Verble, Associate Professor
PHD University of Arkansas-Little Rock
Fire ecology, entomology, fire adapted ecosystems and organisms.

David J Westenberg, Curators Teaching Professor
PHD University of California-Los Angeles
Molecular microbiology, microbial diversity, microbial physiology.

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

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

BIO SCI 5010 Graduate Seminar (RSD 1.0)
Presentation and discussion of current topics in Biology.

BIO SCI 5020 Data Analysis and Presentation (LEC 1.0)
This class will evaluate effective oral communication methodologies by introducing students to ways to communicate visual and auditory information. Student will lead an audience through a series of scientific findings. Moreover, students will use primary literature to evaluate conclusions. The class will assist in developing professional networks.

BIO SCI 5040 Oral Examination (IND 0.0)
(Variable) After completion of all other program requirements, oral examinations for on-campus M.S./PH.D students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

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

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

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

BIO SCI 5313 Pathogenic Microbiology (LEC 3.0)
A study of medically important microorganisms. Students will learn about the properties that enable organisms to cause disease as well as the disease process within the host. Special emphasis will be placed on recent advances in the molecular genetics of host pathogen interaction. Prerequisite: Bio Sci 3313 or Civ Eng 2601.

BIO SCI 5323 Bioinformatics (LEC 3.0)
The course will familiarize students with the application of computational methods to biology, as viewed from both perspectives. It will introduce problems in molecular, structural, morphological, and biodiversity informatics, and will discuss principles, algorithms, and software to address them. Prerequisites: A grade of "C" or better in both one of Bio Sci 1113 or Bio Sci 1213 and one of Comp Sci 1570 and Comp Sci 1580 or Comp Sci 1971 and Comp Sci 1981. (Co-listed with COMP SCI 5700).

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

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

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

BIO SCI 5443 Population and Conservation Genetics (LEC 3.0)
An overview of population genetics theory with a focus on evolutionary processes (mutation, natural selection, genetic drift, inbreeding, recombination and gene flow), and a review of molecular data collection and analysis methods. Emphasis will be placed on application to conservation genetics with a review of examples from current literature. Prerequisites: Bio Sci 2223 and Bio Sci 3233.

BIO SCI 5453 Forest Insect Diversity & Ecology (LAB 2.0)
In this course, you will learn key insect characteristics, common forest insects, insect life history and ecology, and entomological collection techniques. This course will be taught at the Ozark Research Field Station and will consist of several field trips to collecting sites and laboratory identification of insects. Prerequisites: Bio Sci 2263.

BIO SCI 5493 General Virology (LEC 3.0)
An overview of the field of virology, including plant, animal, and bacterial viruses. Discussions will include morphology, classification, virus-host interactions, genetics, clinical and industrial aspects of viruses, and viruses as model systems for basic biological studies. Prerequisites: Bio Sci 1113 or Bio Sci 1213; Bio Sci 2213 or Bio Sci 3313, Chem 1310, Chem 1320, Chem 2210.

BIO SCI 5523 Ichthyology (LAB 1.0 and LEC 3.0)
An introduction to evolutionary relationships, ecology, morphology, physiology and behavior of fishes. Includes a lab that focuses on anatomy, taxonomy, and identification with an emphasis on regional fauna. The lab includes some required field trips. Prerequisites: Bio Sci 1113 or Bio Sci 1213; and Bio Sci 1219, and Bio Sci 1223, and Bio Sci 1229.

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

BIO SCI 6001 Special Topics (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

BIO SCI 6040 Oral Examination (IND 0.0)
After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/ comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

BIO SCI 6050 Continuous Registration (IND 1.0)
Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

BIO SCI 6099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

BIO SCI 6202 Problems In Applied And Environmental Biology (LEC 0.0-3.0)
Overview of major areas of research in applied biology and environmental science with a focus on interdisciplinary approaches used on S&T campus in ongoing research. Prerequisite: Acceptance to Graduate Program.

BIO SCI 6210 Biomaterials II (LEC 3.0)
This course will introduce graduate students to a broad array of topics in biomaterials, including ceramic, metallic, and polymeric biomaterials for in vivo use, basic concepts related to cells and tissues, host reactions to biomaterials, biomaterials-tissue compatibility, and degradation of biomaterials. A term paper and oral presentation are required. Prerequisite: Graduate Standing. (Co-listed with CHEM ENG 6300, MS&E 6310).

BIO SCI 6223 Research Proposal Writing (LEC 3.0)
Students will learn best practices of grant proposal writing. Students will conduct background research, prepare an annotated bibliography, brainstorm specific aims, and critique each other's writing. The course will conclude with a presentation by the student of their finished proposal. Prerequisites: Graduate standing.

BIO SCI 6240 Advanced Tissue Engineering (LEC 3.0)
The course will introduce graduate students to the principles and clinical applications of tissue engineering including the use biomaterials, scaffolds, cells, and external factors to develop implantable parts for the restoration, maintenance, or replacement of tissues and organs. A related topic term paper and oral presentation are expected. Prerequisite: Graduate standing. Prerequisite: Graduate standing. (Co-listed with MS&E 6210).

BIO SCI 6273 Techniques In Applied And Environmental Biology (LEC 3.0)
Students will have the opportunity for hands on experience with the various techniques used in the modern biology laboratory. Techniques will include gene cloning, DNA sequencing, protein purification, growth and development of various model organisms, data acquisition. Prerequisite: Graduate standing.

BIO SCI 6313 Environmental Microbiology (LEC 3.0)
Topics to be explored in this course will include but are not limited to microbial growth and metabolic kinetics, life in extreme conditions, biogeochemical cycling, bioremediation of contaminants, waterborne pathogens and environmental biotechnology. Prerequisite: Must be a graduate student.

BIO SCI 6343 Advanced Geomicrobiology (LEC 3.0)
Microorganisms have profound effects on the environment around them and have influenced biochemical and mineralogical processes throughout time. This course will explore the impact microorganisms have on geological processes. Students will prepare a NSF-style report and defend it.

BIO SCI 6353 Advanced Cancer Cell Biology (LEC 3.0)
Graduate level biology course examining cellular processes that go awry during tumorigenesis. We will discuss cell cycle controls, signal transduction pathways, DNA repair, telomerase, apoptosis, cell migration and adhesion that are altered in cancer cells. In addition to lecture, will include a weekly section to examine primary cancer literature. Prerequisite: Bio Sci 2213.

BIO SCI 6363 Advanced Freshwater Ecology (LEC 3.0)
The ecology of streams, lakes, and wetlands. The course will cover the physical and chemical characteristics of freshwater environments, the diversity of life in freshwaters, biogeochemical processes, and threats to freshwater systems. Research proposal and additional readings required for graduate credit. Prerequisite: Graduate student standing.

BIO SCI 6373 Advanced Stem Cell Biology (LEC 3.0)
This course will cover the fast-moving field of stem cell biology. Topics include: development and organogenesis, regeneration and repair, stem cell types and sources, pluripotency and reprogramming, stem cells and cancer, therapeutics, and ethics. Research proposal and additional readings required for graduate credit.

BIO SCI 6383 Advanced Toxicology (LEC 3.0)
We will discuss the toxicity and mechanisms of action of natural and man-made toxicants. The impact of toxicants on both human health and the environment will be considered. Students will be assigned to independent literature search and write a report. Prerequisites: Bio Sci 2213.

BIO SCI 6423 Astrobiology (LEC 3.0)
The origins of life on early earth and the possibility of life on extraterrestrial bodies will be explored in this course through lectures and journal article discussions. In addition, the means to study extraterrestrial environments will be considered. Prerequisite: Graduate standing.

BIO SCI 6433 Advanced Genomics (LEC 3.0)
An overview of the field of genomics. Topics covered include genome sequencing and annotation, transcriptomics, proteomics, metabolomics, genomic variation, and human, and several animal, plant, and microbial genome projects. Students will complete an independent genomics project that incorporates concepts and bioinformatics tools learned. Prerequisites: Students may not receive credit for both Bio Sci 4433 and Bio Sci 6433.

BIO SCI 6463 Bioremediation (LEC 3.0)
'During this course, the use of microorganisms and other living organisms for the remediation of contaminated environments will be explored along with the techniques necessary for monitoring their activities. Prerequisite: Graduate standing.

BIO SCI 6513 Advanced Microbial Metabolism (LEC 3.0)
A survey of the diverse metabolic properties of microorganisms. Course material will emphasize major metabolic pathways and how they relate to microbial diversity and microbial ecology. Prerequisite: Bio Sci 3313 or an equivalent course.

BIO SCI 6523 Advanced Biomolecules (LEC 3.0)
Demonstration of the principles of modern biochemistry as they relate to the structure and function of the major macromolecules of the cell. An emphasis will be placed on reading and interpreting scientific literature and scientific writing. Prerequisite: Bio Sci 2213 or Chem 4610 or an equivalent course.

BIO SCI 6533 Advanced Neurobiology (LEC 3.0)
A course in cellular neurobiology. Emphasis will be placed on the unique properties of neurons and other excitable cells. Topics include the structure and biophysical properties of neurons, synaptic transmission, neurochemistry, signal transduction, neuropharmacology and neurodevelopment. Students will give a 30 min class presentation on a relevant subject. Prerequisites: Students may not receive credit for both Bio Sci 4533 and Bio Sci 6533.

BIO SCI 6563 Advanced Global Ecology (LEC 3.0)
This class covers ecological topics at large scales, emphasizing global scales. Topics include global energy balance, biogeochemical cycles of water, carbon, nitrogen, and other biologically important elements, and global biodiversity. Students will focus on primary literature related to global ecology. Research proposal and additional readings required. Prerequisites: Students may not receive credit for both Bio Sci 4563 and Bio Sci 6563.

BIO SCI 6603 Advanced Principles of Biodesign (LEC 3.0)
Students identify significant problems in biological/biomedical sciences, and then design and implement innovative solutions using advanced techniques. Students present and defend proposals and results.

BIO SCI 6613 Current Topics in Biomedical Sciences (LEC 3.0)
A review of current topics in biomedical sciences such as obesity, cancer, neurological diseases, cardiovascular disease and microbial infections. An emphasis on recent research gains in these areas.

BIO SCI 6623 Current Topics in Environmental Biology (LEC 3.0)
A review of current topics in environmental biology such as climate change, fire ecology, urban ecology, bioremediation, pollution, conservation biology, and environmental justice. An emphasis on recent research gains in these areas.

BIO SCI 6666 Advanced Nanotechnology in Biomedicine (LEC 3.0)
Applications of nanotechnology in life science is termed nanobiotechnology. This course describes recent development of nanotechnology in basic biological research as well as biomedical applications. In addition to attending regular lectures, graduate students will be assigned to an independent research project and present the information in the class. Prerequisites: Bio Sci 2213 and Bio Sci 2223 and graduate standing.
