

# Biological Sciences (BISC)

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Michelle Evans-White  
Department Chair  
601 Science-Engineering Building  
479-575-4706  
Email: [mevanswh@uark.edu](mailto:mevanswh@uark.edu)

J.D. Willson  
Graduate Coordinator  
479-575-2647  
Email: [jwillson@uark.edu](mailto:jwillson@uark.edu)

Department of Biological Sciences Website (<http://fulbright.uark.edu/departments/biology/>)

## Degrees Conferred:

M.S., Ph.D. in Biology (BIOLMS, BIOLPH)

**Program Description:** The graduate programs in Biological Sciences offer opportunity for advanced study and research to students who desire a comprehensive view of biological sciences. Accomplishment is judged by competence and a developing sense of responsibility for the advancement of knowledge rather than the fulfillment of routine requirements. The faculty requires of all candidates for advanced degrees a period of study in residence, advanced competence in the chosen area of expertise, satisfactory introduction to allied subjects, the ability to communicate at a scholarly level, and a satisfactory performance in examinations.

**Primary Areas of Faculty Research:** Cell and molecular biology (biotechnology, cellular physiology, functional genomics, gene regulation, immunology, developmental biology, molecular genetics, pathogenic microbiology); ecology and evolutionary biology (animal behavior, aquatic ecology, animal and plant physiology, conservation biology, community ecology, exobiology, fisheries biology, limnology, molecular systematics, mycology, physiological ecology, plant morphology, population and quantitative genetics, taxonomy, vertebrate biology — herpetology, ichthyology, mammalogy, ornithology — and wildlife management).

## M.S. in Biology

**Admission to Degree Program:** Applicants who wish to study for advanced degrees are expected to present a minimum of 18 hours of biological science. These normally will include training in the three areas of the Biology Subject test of the Graduate Record Examinations: a) cellular and molecular biology, b) organism biology, and c) ecology, evolution, and population biology. Applicants lacking experience in any of the above areas will be expected to broaden their biological training and may be assigned specific course work to fulfill this requirement. Students lacking a total of 18 hours of biological sciences may be admitted on a conditional basis and are not eligible for assistantships. All students applying for admission to the graduate program must provide scores on the verbal, quantitative, and analytical writing sections of the Graduate Record Examinations. Those scores, along with transcripts and three letters of recommendation, will be used in evaluating applications of students applying for assistantships.

All students must have a major professor to enter the graduate program in biological sciences. Ultimately each candidate will have a committee composed of members of the graduate faculty and the student's major

professor. Students must also fulfill the Graduate School's residency requirements, which are stated elsewhere in this catalog.

All students are required to earn credit in two graduate seminars. Additional seminar requirements may be specified by the major professor in conjunction with the graduate committee. Students are required to present a research seminar prior to the oral thesis or dissertation defense.

**Requirements for the Master's Degree:** The Master of Science degree requires 30 semester hours of graduate credit specified by the department to include at least 24 semester hours of course credit and thesis research. Any student who receives a grade of "D" or "F" in any graduate-level course will be subject to dismissal following review by the Graduate Studies Committee. Master of Science students are required to enroll in BIOL 6007V for 6 hours of credit and to submit a scholarly thesis based on field and/or laboratory research. A specific coursework program will be selected under the guidance of the student's major professor and graduate committee. An oral comprehensive examination is required of all candidates, including a defense of the thesis, which will follow their research seminar.

Students should also be aware of Graduate School requirements with regard to master's degrees (<http://catalog.uark.edu/graduatecatalog/degree requirements/#mastersdegree text>).

## Ph.D. in Biology

**Specific Requirements for the Doctor of Philosophy Degree:** There are no formal course requirements for doctoral students, except that all graduate students in biology are required to earn credit in two graduate seminars. However, students complete a minimum of 72 graduate semester hours if entering the Ph.D. program without a master's degree, or 42 graduate semester hours beyond the master's degree. A minimum of 18 hours must be taken in dissertation credit; these will count in the minimums mentioned in the previous sentence. Any student who receives a grade of "D" or "F" in any graduate-level course will be subject to dismissal following review by the Graduate Studies Committee. Any student receiving more than two grades of "C" in courses of two or more credit hours is no longer eligible for the Ph.D. degree, but may elect to complete an M.S. degree in the program. The Ph.D. is granted not only for fulfillment of technical requirements, but also for development and possession of a critical and creative ability in science and fruitful expression of imagination. Evidence of this is given in the dissertation that the candidate prepares, which constitutes an original research contribution to the fields of the biological sciences.

The Graduate School requires two examinations of all students pursuing the Doctor of Philosophy degree. These examinations are designed to assist students in developing the ability to communicate at a scholarly level and to show they have attained intellectual mastery of knowledge relating to the biological sciences. The first examination, the Candidacy Examination, contains questions related to the student's field of interest and such other areas as the doctoral committee may specify. This examination is given by the doctoral advisory committee in two parts, written and oral. The written and oral portions of the candidacy examination must be completed within the first three calendar years in the program. Satisfactory performance on this examination will be indicated by either pass or fail as determined by the doctoral committee. In the event of failure, the examination may be repeated at the discretion of the doctoral committee. In no case may the candidacy examination be taken more than twice. Notification to the Graduate School of failure to pass the Candidacy Examination means that the student is dismissed from the Ph.D. program, and the student is not eligible for readmission into the Biology program to pursue the Ph.D. degree. The second examination,

the oral Final Examination, preceded by a research seminar, is primarily concerned with the candidate's dissertation and is taken at the end of the candidate's program.

Students should also be aware of Graduate School requirements with regard to doctoral degrees (<http://catalog.uark.edu/graduatecatalog/degree requirements/#phdandedddgreestext>).

## Graduate Faculty

**Alrubaye, Adnan A.**, Ph.D., M.Ed. (University of Arkansas), M.Sc. (University of Baghdad), Assistant Professor, 2016, 2021.

**Alverson, Andrew James**, Ph.D. (University of Texas at Austin), M.S. (Iowa State University), B.S. (Grand Valley State University), Associate Professor, 2012, 2018.

**Bailey, Tameka A.**, Ph.D. (University of Arkansas), B.S. (University of Arkansas-Pine Bluff), Research Assistant Professor, 2017.

**Beaulieu, Jeremy M.**, Ph.D. (Yale University), M.S., B.S. (California Polytechnic State University), Associate Professor, 2016, 2021.

**Beaupre, Steven J.**, Ph.D. (University of Pennsylvania), M.S., B.S. (University of Wisconsin), Professor, 1995, 2006.

**Catanzaro, Donald G.**, Ph.D. (University of Arkansas), A.B. (University of California, Los Angeles), Research Assistant Professor, 2014.

**Ceballos, Ruben M.**, Ph.D. (University of Montana), M.A. (University of Alabama-Birmingham), B.S. (University of Alabama-Huntsville), Assistant Professor, 2016.

**Douglas, Marlis R.**, Ph.D., M.S., B.S. (University of Zurich), Professor, Bruker Life Sciences Chair, 2012.

**Douglas, Michael Edward**, Ph.D. (University of Georgia), M.S., B.S. (University of Louisville), Professor, 21st Century Chair in Global Change Biology, 2011.

**Du, Yuchun**, Ph.D. (Kagoshima University, Japan), B.S. (Shaanxi University of Technology, China), Associate Professor, 2007, 2013.

**DuRant, Sarah Elizabeth**, Ph.D. (Virginia Polytechnic Institute and State University), B.S. (University of South Carolina), Associate Professor, 2017, 2021.

**Duridik, Jeannine M.**, Ph.D. (Johns Hopkins University), B.S. (Purdue University), Professor, 1994, 2004.

**Etges, William J.**, Ph.D. (University of Rochester), M.S. (University of Georgia), B.S. (North Carolina State University), Professor, 1987, 2004.

**Evans, Timothy A.**, Ph.D. (Indiana University), B.S. (Slippery Rock University), Associate Professor, 2013, 2019.

**Evans-White, Michelle Allayne**, Ph.D. (University of Notre Dame), M.S., B.S. (Kansas State University), Professor, 2008, 2018.

**Forbes, Kristian M.**, Ph.D. (University of Jyväskylä), M.P.H. (Latrobe University), B.Sc. (Latrobe University), Assistant Professor, 2018.

**Henry, Ralph Leroy**, Ph.D., M.S. (Kansas State University), B.S.E. (University of Kansas), Distinguished Professor, W.M. Keck Endowed Professorship, 1996, 2012.

**Ivey, Mack**, Ph.D., B.S. (University of Georgia), Associate Professor, 1992, 1998.

**Iyer, Shilpa**, Ph.D. (University of Georgia), M.Sc., B.Sc. (University of Pune, India), Assistant Professor, 2016.

**Kral, Timothy Alan**, Ph.D. (University of Florida), B.S. (John Carroll University), Professor, 1981, 2008.

**Lehmann, Michael Herbert**, Ph.D., Diploma in Biology (Philipps University of Marburg, Germany), Professor, 2002, 2018.

**Lessner, Daniel J.**, Ph.D. (University of Iowa), B.S. (University of Wisconsin-Stevens Point), Professor, 2008, 2020.

**Lewis, Jeffrey A.**, Ph.D. (University of Wisconsin-Madison), B.S. (University of California-Santa Barbara), Associate Professor, 2013, 2020.

**Magoulick, Daniel D.**, Ph.D. (University of Pittsburgh), M.S. (Eastern Michigan University), B.S. (Michigan State University), Research Professor, 2000, 2010.

**McNabb, David S.**, Ph.D. (Louisiana State University Health Sciences Center), B.S. (University of Texas at Arlington), Associate Professor, 2000, 2006.

**Mortensen, Jennifer**, Ph.D. (Tufts University), M.S. (Villanova University), Teaching Assistant Professor, 2019.

**Naithani, Kusum**, Ph.D. (University of Wyoming), M.Sc. (G.B. Pant University of Agriculture and Technology-India), B.Sc. (University of Lucknow-India), Associate Professor, 2014, 2021.

**Nakanishi, Nagayasu**, Ph.D. (University of California, Los Angeles), B.S. (University of California, San Diego), Assistant Professor, 2017.

**Paré, Adam C.**, Ph.D. (University of California, San Diego), B.S. (Cornell University), Assistant Professor, 2019.

**Pinto, Ines**, Ph.D. (Louisiana State University Health Sciences Center), M.S., B.S. (University of Chile), Associate Professor, 2000, 2006.

**Rhoads, Douglas Duane**, Ph.D. (Kansas State University), M.A., B.A. (Wichita State University), University Professor, 1990, 2006.

**Siepielski, Adam M.**, Ph.D. (University of Wyoming-Laramie), M.S. (New Mexico State University), B.S. (Pennsylvania State University-University Park), Associate Professor, 2015, 2019.

**Stephenson, Steven Lee**, Ph.D., M.S. (Virginia Polytechnic Institute and State University), B.S. (Lynchburg College), Research Professor, 2003.

**Tipsmark, Christian K.**, Ph.D., M.S. (University of Southern Denmark), Associate Professor, 2010, 2016.

**Walker, James M.**, Ph.D. (University of Colorado-Boulder), M.S., B.S. (Louisiana Polytechnic Institute), Professor, 1965.

**Westerman, Erica L.**, Ph.D. (Yale University), M.Sc. (University of New Hampshire), B.S. (Yale University), Assistant Professor, 2016.

**Willson, John David**, Ph.D. (University of Georgia), B.S. (Davidson College), Associate Professor, 2012, 2018.

**Zhuang, Xuan**, Ph.D. (University of Illinois Urbana-Champaign), Assistant Professor, 2021.

## Courses

### BIOL 50071. Seminar in Biology. 1 Hour.

Discussion of selected topics and review of current literature in any area of the biological sciences. (Typically offered: Fall and Spring) May be repeated for degree credit.

### BIOL 50173. Laboratory in Prokaryote Biology. 3 Hours.

Laboratory techniques in prokaryote culture, identification, physiology, metabolism, and genetics. Laboratory 6 hours per week. Prerequisite: BIOL 40403. (Typically offered: Fall and Spring)

### BIOL 50274. Insect Diversity and Taxonomy. 4 Hours.

Principles and practices of insect classification and identification with emphasis on adult insects. 2.5 hours lecture, 4 hours lab. Previous knowledge of basic entomology is necessary. Graduate degree credit will not be given for both BIOL 40274 and BIOL 50274. Prerequisite: Instructor consent. Corequisite: Lab component. (Typically offered: Fall)  
This course is cross-listed with ENTO 50204.

### BIOL 50374. Wildlife Management Techniques. 4 Hours.

To familiarize students with techniques used in the management of wildlife populations. Students will be exposed to field methods, approaches to data analysis, experimental design, and how to write a scientific paper. Management applications will be emphasized. Lecture 3 hours, laboratory 3 hours per week. Graduate degree credit will not be given for both BIOL 47374 and BIOL 50374. Corequisite: Lab component. Prerequisite: BIOL 38773. (Typically offered: Irregular)

**BIOL 50403. Prokaryote Biology. 3 Hours.**

An in-depth coverage of prokaryote diversity, genetics, metabolism, growth, structures and functions. (Typically offered: Spring)

**BIOL 50573. Insect Ecology. 3 Hours.**

Teaches important ecological concepts through study of dynamic relationships among insects and their environment. Introduces literature of insect ecology, and interpretation and critique of ecological research. Previous knowledge of basic entomology and/or ecology will be assumed. 2 hours lecture/2 hours lab. Graduate degree credit will not be given for both BIOL 40573 and BIOL 50573. Prerequisite: Instructor consent. Corequisite: Lab component. (Typically offered: Fall Even Years) This course is cross-listed with ENTO 50503.

**BIOL 50703. Mitochondrial Biology and Medicine. 3 Hours.**

Overview of mitochondrial biology with a focus on the clinical spectrum of human diseases affected by dysfunctional mitochondria. Introduces basic mitochondrial biology, structure and function, genetics and bioenergetics. Highlights common and rare diseases influenced by mitochondrial malfunction. Prerequisite: Graduate Standing. (Typically offered: Fall)

**BIOL 51173. Insect Behavior and Chemical Ecology. 3 Hours.**

Basic concepts in insect senses and patterns of behavioral responses to various environmental stimuli. Previous knowledge of basic entomology is helpful, but not required. Prerequisite: Instructor consent. Corequisite: Lab component. (Typically offered: Spring Even Years)

This course is cross-listed with ENTO 51103.

**BIOL 51274. Dendrology. 4 Hours.**

Morphology, classification, geographic distribution, and ecology of woody plants. Lecture 3 hours, laboratory 3 hours per week, and fieldtrips. Graduate degree credit will not be given for both BIOL 41174 and BIOL 51274. Prerequisite: BIOL 38773. (Typically offered: Fall)

**BIOL 51573. Practical Programming for Biologists. 3 Hours.**

Hands-on instruction in the fundamentals of biological computing. Students learn how to set up a Unix work station, work from the command line, install software, build databases, and program in Python, a popular scripting language for biological applications. Most examples focus on the analysis of genomic data. (Typically offered: Spring)

**BIOL 51673. Dynamic Models in Biology. 3 Hours.**

Mathematical and computational techniques for developing, executing, and analyzing dynamic models arising in the biological sciences. Both discrete and continuous time models are studied. Applications include population dynamics, cellular dynamics, and the spread of infectious diseases. Graduate degree credit will not be given for both BIOL 41673 and BIOL 51673. Prerequisite: MATH 24004. (Typically offered: Irregular)

**BIOL 51774. Conservation Genetics. 4 Hours.**

Covers concepts of biodiversity identification and illustrates how genetic data are generated and analyzed to conserve and restore biological diversity. Corequisite: Lab component. Prerequisite: BIOL 30473, BIOL 38773 and STAT 28233 (or equivalent) and graduate standing. (Typically offered: Spring)

**BIOL 52173. Biological Regulation and Subcellular Communication. 3 Hours.**

Combines lectures, review of primary literature, student presentations, and small group discussions to explore a diversity of topics related to mechanisms of biological regulation and subcellular communication. Prerequisite: Graduate standing. (Typically offered: Irregular)

**BIOL 52461. Ichthyology Laboratory. 1 Hour.**

Practical application of fish identification based on anatomy, fish sampling methods, and curation of fish specimen. Laboratory component of BIOL 52463. Corequisite: BIOL 52463. (Typically offered: Spring Odd Years)

**BIOL 52463. Ichthyology. 3 Hours.**

Comprehensive overview of the diversity of fishes. Covers anatomy, physiology, evolution, taxonomy, ecology, behavior, zoogeography and conservation of marine and freshwater fishes. Lecture 3 hours per week. Corequisite: BIOL 52461. (Typically offered: Spring Odd Years)

**BIOL 52574. Comparative Physiology. 4 Hours.**

Comparison of fundamental physiological mechanisms in various animal groups. Adaptations to environmental factors at both the organismal and cellular levels are emphasized. Lecture 3 hours, laboratory 3 hours per week. Graduate degree credit will not be given for both BIOL 42384 and BIOL 52574. Prerequisite: BIOL 25473 and CHEM 36203 and (CHEM 36201 or CHEM 361H1). (Typically offered: Fall)

**BIOL 52673. Cell Physiology. 3 Hours.**

In-depth molecular coverage of cellular processes involved in growth, metabolism, transport, excitation, signaling and motility, with emphasis on function and regulation in eukaryotes, primarily animals. Prerequisite: BIOL 23373, BIOL 25473, BIOL 25471, CHEM 38103, and PHYS 20203. (Typically offered: Fall)

**BIOL 52773. Endocrinology. 3 Hours.**

In endocrinology we study hormonal integration of living processes at all levels from molecule to organism. We will work with the mechanisms of hormone action, the endocrine control axes and hormones physiological role. The course will include paper discussions and student presentations on topics of special interest. (Typically offered: Spring)

**BIOL 53173. Molecular Cell Biology. 3 Hours.**

In-depth molecular coverage of transcription, cell cycle, translation, and protein processing in eukaryotes and prokaryotes. Prerequisite: BIOL 25473 and BIOL 23373 and CHEM 36053 and CHEM 36051 and CHEM 36203 and CHEM 36201. (Typically offered: Spring)

**BIOL 53273. Comparative Neurobiology. 3 Hours.**

Exploration of modern research approaches to understanding the development and function of animal nervous systems, with emphasis on molecular and cellular approaches in non-human animal models commonly used in biomedical research. Format combines lectures, group discussions, and student presentations using examples from the primary neurobiology literature. Prerequisite: Graduate standing. (Typically offered: Irregular)

**BIOL 53473. Advanced Immunology. 3 Hours.**

Aspects of innate, cell-mediated, and humoral immunity in mammalian and avian species. Molecular mechanisms underlying the function of the immune system are emphasized. A course in Basic Immunology prior to enrollment in Advanced Immunology is recommended but not required. Lecture 3 hours per week. (Typically offered: Spring)

This course is cross-listed with POSC 53403.

**BIOL 53572. Immunology in the Laboratory. 2 Hours.**

Laboratory course on immune-diagnostic laboratory techniques and uses of antibodies as a research tool. Included are cell isolation and characterization procedures, immunochemistry, flow cytometry, ELISA and cell culture assay systems. Laboratory 6 hours per week. Prerequisite: POSC 53403 or BIOL 53473. (Typically offered: Spring)

This course is cross-listed with POSC 53502.

**BIOL 53583. Ecological Genetics/genomics. 3 Hours.**

Analysis of the genetics of natural and laboratory populations with emphasis on the ecological bases of evolutionary change. Prerequisite: BIOL 23373 and BIOL 23371, BIOL 30473 and MATH 24004 and STAT 28233 or equivalents. (Typically offered: Fall Odd Years)

**BIOL 54074. Comparative Botany. 4 Hours.**

A comparative approach to organisms classically considered to be plants with emphasis on morphology, life history, development, and phylogeny. Three hours lecture, 4 hours lab per week. Corequisite: Lab component. Prerequisite: Graduate standing. (Typically offered: Fall Odd Years)

**BIOL 54671. Population Ecology Laboratory. 1 Hour.**

Demonstration of the models and concepts from BIOL 55183. Pre- or Corequisite: BIOL 55183. (Typically offered: Fall Even Years)

**BIOL 54673. Physiological Ecology. 3 Hours.**

Interactions between environment, physiology, and properties of individuals and populations on both evolutionary and ecological scales. Prerequisite: BIOL 38773 and BIOL 42384. (Typically offered: Spring Odd Years)

**BIOL 55183. Population Ecology. 3 Hours.**

Survey of theoretical and applied aspects of populations processes stressing models of growth, interspecific interactions, and adaptation to physical and biotic environments. Corequisite: BIOL 54671. Prerequisite: BIOL 38773. (Typically offered: Fall Even Years)

**BIOL 55284. Developmental Biology with Laboratory. 4 Hours.**

An analysis of the concepts and mechanisms of development emphasizing the experimental approach. Students may not receive degree credit for both BIOL 55473 Developmental Biology and BIOL 55284 Developmental Biology with Laboratory. Corequisite: Lab component. (Typically offered: Fall)

**BIOL 55573. Astrobiology. 3 Hours.**

Discusses the scientific basis for the possible existence of extraterrestrial life. Includes the origin and evolution of life on Earth, possibility of life elsewhere in the solar system (including Mars), and the possibility of life on planets around other stars. Prerequisite: Instructor consent. (Typically offered: Irregular)  
This course is cross-listed with SPAC 55503.

**BIOL 55673. Cancer Biology. 3 Hours.**

An introduction to the fundamentals of cancer biology. Prerequisite: BIOL 25473. (Typically offered: Fall)

**BIOL 55703. Laboratory In Marine Invertebrate Development and Evolution. 3 Hours.**

Provides a hands-on introduction to investigation of problems in marine invertebrate development and evolution. Emphasizes comparative molecular genetic approaches using non-traditional model organisms. The topic of research may vary from year to year; examples include, but are not limited to, the mechanisms of life cycle transition. (Typically offered: Fall)

**BIOL 57073. Mechanisms of Pathogenesis. 3 Hours.**

A survey of events causing human disease at the molecular, cellular and genetic levels. Seeks to develop an appreciation that both the tricks pathogens use and the body's own defenses contribute to pathology. (Typically offered: Fall)

**BIOL 57183. Basic Immunology. 3 Hours.**

A general overview of Immunity with emphasis on the underlying cellular, molecular and genetic events controlling immune reactions. Reading of the primary literature on disease states involving the immune system. (Typically offered: Spring)

**BIOL 57273. Fish Biology. 3 Hours.**

Morphology, classification, life histories, population dynamics, and natural history of fishes and fish-like vertebrates. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: 12 hours of biological sciences. (Typically offered: Spring Odd Years)

**BIOL 57473. Herpetology. 3 Hours.**

Morphology, classification and ecology of amphibians and reptiles. Lecture 2 hours, laboratory 1 hour per week. Corequisite: Lab component. (Typically offered: Spring Even Years)

**BIOL 57673. Ornithology. 3 Hours.**

Taxonomy, morphology, physiology, behavior, and ecology of birds. Lecture, laboratory, and field work. Corequisite: Lab component. Prerequisite: 10 hours of biological sciences. (Typically offered: Spring Even Years)

**BIOL 57774. Biometry. 4 Hours.**

Students learn biological statistics and experimental design by actually designing experiments and analyzing data, as well as through lecture, discussion, reading, writing, and problem solving. Lecture 3 hours, laboratory 3 hours each week. Graduate degree credit will not be given for both BIOL 47774 and BIOL 57774. Corequisite: Lab component. Prerequisite: STAT 28233 or equivalent, BIOL 38773. (Typically offered: Spring Even Years)

**BIOL 5800V. Special Topics in Biological Sciences. 1-6 Hour.**

Consideration of new areas of biological sciences not yet treated adequately in other courses. Prerequisite: 8 hours of biological sciences. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

**BIOL 58273. Science Communication. 3 Hours.**

Covers the foundations of writing strategies, how to communicate with discipline-specific versus broad audiences, elements of an effective presentation, and the manuscript and proposal review process. (Typically offered: Fall)

**BIOL 58373. Animal Behavior. 3 Hours.**

Organization, regulation, and phylogeny of animal behavior, emphasizing diversity across animal taxa. Lecture, laboratory, and field work. Corequisite: Lab component. (Typically offered: Spring)

**BIOL 58464. Community Ecology. 4 Hours.**

Survey of theoretical and applied aspects of community processes stressing structure, trophic dynamics, community interactions, and major community types. Corequisite: Lab component. Prerequisite: BIOL 38773. (Typically offered: Fall Odd Years)

**BIOL 58473. Conservation Biology. 3 Hours.**

The study of direct and indirect factors by which biodiversity is impacted by human activity. It is a synthetic field of study that incorporates principles of ecology, biogeography, population genetics, economics, sociology, anthropology, philosophy, geology, and geography. Prerequisite: BIOL 38773. (Typically offered: Irregular)

**BIOL 59174. Stream Ecology. 4 Hours.**

Current concepts and research in lotic ecosystem dynamics. Lecture, laboratory, field work and individual research projects required. Corequisite: Lab component. Prerequisite: 3 hours of ecology-related coursework. (Typically offered: Fall Even Years)

**BIOL 59373. Global Biogeochemistry: Elemental Cycles and Environmental Change. 3 Hours.**

This course explores the chemical, biological, and geological processes occurring within ecosystems. An understanding of these processes is used to investigate how they form the global biogeochemical cycles that provide energy and nutrients necessary for life. Class discussions focus on global change and the effects of more recent anthropogenic influences. Prerequisite: 3 hours of chemistry or biochemistry and ecology. (Typically offered: Spring Odd Years)

**BIOL 6007V. Master's Thesis. 1-6 Hour.**

Master's Thesis. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

**BIOL 7007V. Doctoral Dissertation. 1-18 Hour.**

Doctoral Dissertation. Prerequisite: Graduate standing. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.