Biological Sciences (BISC)

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

Degrees Conferred:  
M.S., Ph.D. in Biology (BIOL)

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, ecolobiology, 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 600V 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/graduatetcatalog/degerequiments/#mastersdegreeext).

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/graduatedcatalog/degerequirements/#phdandedddegreestext).

Graduate Faculty

Alrubaye, Adnan Ali Khalaf, Ph.D., M.Ed. (University of Arkansas), M.S., B.V.M. (University of Baghdad, Iraq), Clinical Assistant Professor, 2013.

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

Barabote, Ravi Damodar, Ph.D. (Texas Tech University), M.S. (Madurai Kamaraj University, Madurai, India), B.S. (Osmania University, Hyderabad, India), Assistant Professor, 2012.

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

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

Catanaro, 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, 2012.

Coleman, James S., Ph.D., M.S., M.Phil (Yale University), B.S. (University of Maine), Professor, 2017.

Douglas, Michael Edward, Ph.D. (University of Georgia), M.S., B.S. (University of Louisville), Professor, 2011.

Douglas, Marlis R., Ph.D., M.S., B.S. (University of Zurich), Professor, 2012.

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

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

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

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

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

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

Goforth, Robyn, Ph.D., B.S. (University of Arkansas), Research Assistant Professor, 2001.

Henry, Ralph Leroy, Ph.D., M.S. (University of Florida), B.S.E. (University of Kansas), Distinguished Professor, 1996.

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

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.

Lehmann, Michael Herbert, Ph.D., Diploma in Biology (Philips University of Marburg, Germany), Associate Professor, 2002.

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

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

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

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

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

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

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

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

Siepleski, Adam M., Ph.D. (University of Wyoming-Laramie), M.S. (New Mexico State University), B.S. (Pennsylvania State University-University Park), Assistant Professor, 2015.

Smith, Kimberly G., Ph.D. (Utah State University), M.S. (University of Arkansas), B.S. (Tufts University), Distinguished Professor, 1981.

Spiegel, Frederick W., Ph.D. (University of North Carolina at Chapel Hill), B.A. (Drew University), Distinguished Professor, 1982.

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.

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), Assistant Professor, 2012.

Courses

BIOL 4013. 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. Lecture 2 hours, laboratory/discussion 2 hours per week. Corequisite: Lab component. This course is cross-listed with ENTO 4013.

BIOL 4024. Insect Diversity and Taxonomy. 4 Hours.
Principles and practices of insect classification and identification with emphasis on adult insects. Corequisite: Lab component. Prerequisite: ENTO 3013. This course is cross-listed with ENTO 4024.

BIOL 4053. Insect Ecology. 3 Hours.
To develop understanding of important ecological concepts through study of dynamic relationships among insects and their environment. To become familiar with the literature of insect ecology, and interpretation and critique of ecological research. Previous knowledge of basic entomology and/or ecology will be assumed. Corequisite: Lab component. This course is cross-listed with ENTO 4053.

BIOL 4104. Taxonomy of Flowering Plants. 4 Hours.
Identifying, naming, and classifying of wildflowers, weeds, trees, and other flowering plants. Emphasis is on the practical aspects of plant identification. Lecture 3 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: BIOL 1613 and BIOL 1611L and BIOL 2323 and BIOL 3023.

BIOL 4114. Dendrology. 4 Hours.
Morphology, classification, geographic distribution, and ecology of woody plants. Lecture 3 hours, laboratory 3 hours per week, and fieldtrips. Prerequisite: BIOL 3863.
BIOL 412. Food Microbiology. 2 Hours.
The study of food microbiology including classification/taxonomy, contamination, preservation and spoilage of different kinds of foods, pathogenic microorganisms, food poisoning, sanitation, control and inspection and beneficial uses of microorganisms. Prerequisite: BIOL 2013 and BIOL 2011L or BIOL 2533. This course is cross-listed with FDSC 4122.

BIOL 4163. 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. Prerequisite: MATH 2554. This course is cross-listed with MATH 4163.

BIOL 4234. 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. Corequisite: Lab component. Prerequisite: BIOL 2533 and CHEM 3613 and (CHEM 3611L or CHEM 3612M).

BIOL 4333. Biotechnology in Agriculture. 3 Hours.
Discussion of the techniques, applications, and issues of biotechnology as it is being used in modern agriculture. Coverage includes the basics of molecular biology, production of transgenic plants and animals, and new applications in the agricultural, food, and medical marketplace. Lecture and discussion, 3 hours per week. This course is cross-listed with PLPA 4333.

BIOL 4613. Primate Adaptation and Evolution. 3 Hours.
Introduction to the biology of the order Primates. This course considers the comparative anatomy, behavioral ecology and paleontology of our nearest living relatives. Prerequisite: BIOL 3023 or ANTH 1013. This course is cross-listed with ANTH 4613.

BIOL 4693. Forest Ecology. 3 Hours.
Introduction to the various biological, ecological and historical aspects of forest communities, with particular emphasis on the forests of the central and southeastern United States. Prerequisite: BIOL 3863.

BIOL 4711L. Basic Immunology Laboratory. 1 Hour.
Basic immunology laboratory. Corequisite: BIOL 4713.

BIOL 4734. 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. Corequisite: Lab component. Prerequisite: BIOL 3863.

BIOL 4774. 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. Corequisite: Lab component. Prerequisite: STAT 2023 or equivalent, BIOL 3863.

BIOL 4793. Introduction to Neurobiology. 3 Hours.
Exploration of the neurological underpinnings of perception, action, and experience including: how sense receptors convert information in the world into electricity, how information flows through the nervous systems, how neural wiring makes vision possible, how the nervous system changes with experience, and how the system develops. Prerequisite: BIOL 2533.

BIOL 480V. 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. May be repeated for degree credit.

BIOL 485V. Field Ecology. 1-3 Hour.
Project oriented approach employing current field and laboratory techniques, experimental design, and data analysis. Field trip is required.

BIOL 4863. Analysis of Animal Populations. 3 Hours.
Basic principles of design and analysis for population studies of fish and wildlife species. Students will be instructed in the use of the latest software for estimating population parameters. Focus will be on both concepts and applications. Management applications of estimated parameters will be emphasized. Lecture 2 hours, laboratory 3 hours per week. Corequisite: BIOL 3863.

BIOL 496V. Culture and Environment: Field Studies. 1-6 Hour.
May be taken by students participating in overseas study programs or other domestic field study programs approved by the department. May be repeated for up to 12 hours of degree credit.

BIOL 5001. Seminar in Biology. 1 Hour.
Discussion of selected topics and review of current literature in any area of the biological sciences. May be repeated for up to 2 hours of degree credit. This course is cross-listed with CEMB 5911.

BIOL 5003L. Laboratory in Prokaryote Biology. 3 Hours.
Laboratory techniques in prokaryote culture, identification, physiology, metabolism, and genetics. Laboratory 6 hours per week. Prerequisite: BIOL 3123.

BIOL 5133. Insect Molecular Genetics. 3 Hours.
A hands on course in insect molecular genetic techniques including molecular diagnostics and population genetics. Students will learn how to apply advanced molecular genetic methodologies and Internet database resources to insects that they are using for their graduate research. This course is cross-listed with ENTO 5133.

BIOL 5143. Advanced Methods in Microscopy. 3 Hours.
Stand alone course on laboratory methods emphasizing techniques in modern microscopy. Individual research project required. Prerequisite: Graduate standing. May be repeated for up to 6 hours of degree credit.

BIOL 5153. 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 Perl, a popular scripting language for biological applications. Most examples focus on the analysis of genomic data.

BIOL 5174. Conservation Genetics. 4 Hours.
Covers concepts of biodiversity identification and illustrates how genetic data are generated and analyzed to conserve and restore biological diversity. Prerequisite: BIOL 3023, BIOL 3863 and STAT 2023 (or equivalent) and graduate standing.

BIOL 5213. 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.

BIOL 5233. Genomics and Bioinformatics. 3 Hours.
Principles of molecular and computational analyses of genomes. Prerequisite: BIOL 2533 or BIOL 2323.

BIOL 5263. 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 2323, BIOL 2533, BIOL 2531L, CHEM 3813, and PHYS 2033.

BIOL 5273. 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.
BIOL 5303. Plant Physiology. 3 Hours.
Introductory course in plant physiology focusing on cellular processes that support the metabolic, developmental, and reproductive needs of plants. Prerequisite: 3 hours of cell biology or biochemistry.

BIOL 5313. Molecular Cell Biology. 3 Hours.
In-depth molecular coverage of transcription, cell cycle, translation, and protein processing in eukaryotes and prokaryotes. Prerequisite: BIOL 2533 and BIOL 2323 and CHEM 3603 and CHEM 3601L and CHEM 3613 and CHEM 3611L.

BIOL 5323. 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.

BIOL 5343. 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. This course is cross-listed with POSC 5343.

BIOL 5352L. 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: BIOL 3543 or BIOL 5343. This course is cross-listed with POSC 5352L.

BIOL 5353. 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 2323 and BIOL 2321L, BIOL 3023 and MATH 2554 and STAT 2023 or equivalents.

BIOL 5404. 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: BIOL 3023 and MATH 3013; Laboratory 2 hours per week. Corequisite: BIOL 3023 and MATH 3013. This course is cross-listed with SPAC 5404.

BIOL 5414. Mycology. 4 Hours.
Form and function of the fungi. Lecture 2 hours, laboratory 4 hours per week.Corequisite: Laboratory component. Prerequisite: Graduate standing.

BIOL 5423. Human Evolutionary Anatomy, 3 Hours.
Paleobiologists reconstruct past lifeways and systematic relationships of our ancestors using comparative studies of bony morphology and associated soft tissues. This course surveys methods and theories used to infer function and phylogeny, and details relevant aspects of the anatomy of humans, living great apes, and fossil human ancestors. Prerequisite: ANTH 1013 and BIOL 1543. This course is cross-listed with ANTH 5423.

BIOL 5433. Principles of Evolution. 3 Hours.
Advanced survey of the mechanisms of evolutionary change with special emphasis on advances since the Modern Synthesis. Historical, theoretical, and population genetics approaches are discussed. Recommended: BIOL 3023 and BIOL 3021L and BIOL 3861L. Prerequisite: BIOL 2323 and BIOL 3863.

BIOL 5463. Physiological Ecology. 3 Hours.
Interactions between environment, physiology, and properties of individuals and populations on both evolutionary and ecological scales. Prerequisite: BIOL 3863 and BIOL 4234.

BIOL 5511L. Population Ecology Laboratory. 1 Hour.
Demonstration of the models and concepts from BIOL 5513. Pre- or Corequisite: BIOL 5513.

BIOL 5513. 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 5511L. Prerequisite: BIOL 3863.

BIOL 5523. Plant Ecology. 3 Hours.
To develop understanding of important ecological concepts through study of dynamics relationships among plants and their environment. To become familiar with the literature of plant ecology, and interpretation and critique of ecological research. Prerequisite: BIOL 3863.

BIOL 5524. 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 5543 Developmental Biology and BIOL 5524 Developmental Biology with Laboratory. Corequisite: Lab component.

BIOL 5534. Biochemical Genetics. 4 Hours.
Lectures and laboratories based on modern molecular genetic techniques for analyses of eukaryotes and manipulation of prokaryotes. A hands-on course in recombinant DNA techniques: laboratory practices in gene identification, cloning, and characterization. Lecture 2 hours, laboratory 6 hours per week. Corequisite: BIOL 2323 or BIOL 3543 and CHEM 3613 (or equivalent).

BIOL 5543. Developmental Biology. 3 Hours.
An analysis of the principles and mechanisms of development emphasizing the embryonic and postembryonic development of animals. Degree credit will not be allowed for both BIOL 5543 and BIOL 5524.

BIOL 5553. 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. This course is cross-listed with SPAC 5553.

BIOL 5563. Cancer Biology. 3 Hours.
An introduction to the fundamentals of cancer biology. Prerequisite: BIOL 2323. May be repeated for up to 6 hours of degree credit.

BIOL 5634. Wetlands Ecology and Management. 4 Hours.
To familiarize students with the ecology and management of wetlands. Students will be exposed to the characteristics of wetlands, the environmental factors that produce wetland types, and the management techniques used to meet desired wetland goals. Primary lecture topics will include: wetland definition, wetlands of the world, wetland status, trends, laws, wetland hydrology, wetland soils, wetland plants, wetland plant adaptations, wetland ecosystem development, and wetland management. Lecture 2 hours, Laboratory 3 hours per week. Prerequisite: BIOL 3863.

BIOL 5643. Eukaryote Phylogeny. 3 Hours.
Molecular analysis of the eukaryotic tree of life, phylogenetic tree reconstruction, and eukaryote diversity and evolutionary relationships.

BIOL 5703. 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.

BIOL 5713. 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.

BIOL 5723. 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.
BIOL 5734. Protistology. 4 Hours.
The biology of eukaryotes other than animals, land plants, and fungi with emphasis on morphology and modern approaches to phylogenetic systematics. Three hours lecture, four hours lab/week. Involves writing term papers. Corequisite: Lab component.

BIOL 5743. Herpetology. 3 Hours.
Morphology, classification and ecology of amphibians and reptiles. Lecture 2 hours, laboratory 1 hour per week. Corequisite: Lab component.

BIOL 5753. General Virology. 3 Hours.
An introduction to viral life-cycles, structure, and host cell interactions. Emphasis placed on molecular and biochemical aspects of virology. Two hour lecture and one hour discussion. Prerequisite: BIOL 2533 and BIOL 2323.

BIOL 5763. 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.

BIOL 5783. Mammalogy. 3 Hours.
Lectures and laboratory dealing with classification, morphology, distribution, ecology, behavior, and physiology of mammals. Two hours lecture, 4 hours laboratory. Corequisite: Lab component.

BIOL 580V. 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. May be repeated for up to 6 hours of degree credit.

BIOL 5814. Limnology. 4 Hours.
Physical, chemical and biological conditions of inland waters. Lecture 3 hours per week, laboratory arranged. Corequisite: Lab component. Prerequisite: (CHEM 1123 and CHEM 1121L) or equivalent and 12 hours of biological sciences.

BIOL 5833. Animal Behavior. 3 Hours.
Organization, regulation, and phylogeny of animal behavior, emphasizing vertebrates. Lecture, laboratory, and field work. Corequisite: Lab component.

BIOL 5843. 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 3863.

BIOL 5844. 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 3863.

BIOL 585V. Field Ecology. 1-3 Hour.
Project-oriented approach employing current field and laboratory techniques, experimental design and data analysis. Field trip is required. May be repeated for degree credit.

BIOL 5873. Microbial Molecular Genetics and Informatics. 3 Hours.
Fundamentals of microbial genomics and bioinformatics. Course covers microbial genetics, genetic structure, genome organization, proteome organization, approaches for the analysis of DNA, RNA, and proteins, cellular metabolic pathways, genetic regulation, small RNA molecules, functional genomics, metagenomics, and bioinformatics approaches for analysis of microbial genomes. Prerequisite: Graduate status.

BIOL 5914. 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.

BIOL 5933. 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.

BIOL 600V. Master's Thesis. 1-6 Hour.
Master's Thesis. Prerequisite: Graduate standing. May be repeated for degree credit.

BIOL 6113. Insect Physiology. 3 Hours.
General and comparative physiology of insects. Previous knowledge of basic entomology is helpful, but not required. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. This course is cross-listed with ENTO 6113.

BIOL 700V. Doctoral Dissertation. 1-18 Hour.
Doctoral Dissertation. Prerequisite: Graduate standing. May be repeated for degree credit.