

# BIOLOGY

## Department of Biology

**Chairperson:** Patrick Farmer

**Graduate Program Director:** Joseph H. Taube

The Department of Biology offers advanced study leading to doctoral (Ph.D.) and master's (M.S., M.A.) degrees with emphases in ecology, evolution, and organismal biology (EEO) and in cellular, molecular, health, and disease (CMHD) biology.

- Biology, M.A. (<https://catalog.baylor.edu/graduate-school/curriculum-departments-institutes-instruction/college-arts-sciences/biology/ma/>)
- Biology, M.S. (<https://catalog.baylor.edu/graduate-school/curriculum-departments-institutes-instruction/college-arts-sciences/biology/ms/>)
- Biology, Ph.D. (<https://catalog.baylor.edu/graduate-school/curriculum-departments-institutes-instruction/college-arts-sciences/biology/phd/>)

### Biology (BIO)

#### BIO 4102 General Microbiology Lab (1)

Co-requisite(s): BIO 4302

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better  
Laboratory experiments and techniques to culture microorganisms. Analyses of biochemical tests, quantitative and qualitative procedures, and identification of unknown organisms.

#### BIO 4104 Medical Entomology Laboratory (1)

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better; upper-level standing and credit or concurrent enrollment in BIO 4304, or consent of instructor

Collection, preservation, identification, taxonomy and biology of medically important arthropods, especially insects. Survey collection required for graduate credit.

#### BIO 4106 Molecular Genetics and Genomics Laboratory (1)

Co-requisite(s): BIO 4306

Pre-requisite(s): Either BIO 2306 or CHE 4341; each with a grade of C or better  
Individual and group projects in computational genomic and genetic analysis using supplied datasets

#### BIO 4108 Genes and Development Laboratory (1)

Co-requisite(s):

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; and BIO 2306 all with grades of C or better; and credit for or concurrent enrollment in BIO 4308

Modern experimental techniques of developmental biology.

#### BIO 4117 Plant Physiology Lab (1)

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and BIO 1306, or BIO 1406; all with grades of C or better; and credit or concurrent enrollment in BIO 4317

Laboratory experiments illustrating modern concepts in plant physiological research, with emphases on form, function relationships, technological innovations, and organismal adaption.

#### BIO 4123 Laboratory for Parasitology (1)

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better; credit or concurrent enrollment in BIO 4323 and consent of instructor; and upper-level or graduate standing

Detection and identification of human parasite diagnostic forms. Power Point presentation required for graduate credit.

#### BIO 4301 Immunology (3)

Pre-requisite(s): BIO 2306 and one of the following: BIO 3342, 4302, 4306, 4308, or CHE 4341 all with grades of C or better

Basic principles of resistance to disease, host-antigen interactions, immunologic response mechanisms, immunologic techniques, and correlations of disease and the immune response.

#### BIO 4302 General Microbiology (3)

Co-requisite(s): BIO 4102

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better

An introduction to the major areas of microbiology, including microbial morphology, metabolism, genetics, evolution, taxonomy, ecology, and disease.

#### BIO 4304 Medical Entomology (3)

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better; upper-level standing or consent of instructor

Identification, biology, and management of arthropod pests, especially insects, transmitting diseases affecting man, livestock and wildlife.

#### BIO 4306 Molecular Genetics and Genomics (3)

Co-requisite(s): BIO 4106

Pre-requisite(s): Either BIO 2306 or CHE 4341, each with a grade of C or better

Techniques and strategies central to the analysis of genomic and genetic experimental data with emphasis on experimental design. Training in computational methods such as R and Unix; no previous computing experience is required.

#### BIO 4307 Biochemistry and Physiology of the Cell (3)

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better; and CHE 3331 or consent of instructor; and credit or concurrent enrollment in BIO 2306

The roles of biologically important molecules in cellular structure and function, emphasizing an integrated understanding of the characteristic of the four major classes of biological molecules and the chemical interactions that support living systems. May not receive credit for both BIO 4307 and CHE 4341.

#### BIO 4308 Genes and Development (3)

Co-requisite(s):

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; and BIO 2306; all with grades of C or better

Examination of mechanisms that regulate the development of multicellular organisms using biochemical genetic and cell biological approaches. Investigates the role that gene regulation, cell-cell communication, cell adhesion, cell motility, signal transduction, and intracellular trafficking play in the commitment, differentiation and assembly of stem cells into specialized cell types and organs.

**BIO 4310 Biogeography (3)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better  
Patterns of geographic distributions of animals and plants, and the physical and biological factors, and processes affecting geographic distributions.

**BIO 4317 Plant Physiology (3)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better  
Experimental studies of important physical and chemical processes related to plant function.

**BIO 4320 Pathophysiology (3)**

Pre-requisite(s): BIO 3322 with a grade of B or better  
Pathophysiology of disease with emphasis on immunology, communicable disease, neoplasia, heredity, congenital problems, and degeneration as expressed in each organ system.

**BIO 4323 Parasitology (3)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better; upper-level or graduate standing or consent of instructor  
Introduction to study of parasites and vectors, emphasizing life cycles and control of those affecting humans. Research paper required for graduate credit.

**BIO 4333 Science Leadership: Improvement of Science Education (3)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better; and upper-level standing and consent of instructor  
Development of science leadership skills through community-based research on improvement of science education.

**BIO 4339 Advanced Marine Field Studies (3)**

Cross-listed as GEO 4339  
See GEO 4339 for course information.

**BIO 4344 Fundamentals of Toxicology (3)**

Cross-listed as ENV 4344  
See ENV 4344 for course information.

**BIO 4350 Pathogenic Microbiology (3)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and BIO 1106 and 1306, or BIO 1406; all with grades of C or better; and BIO 4401  
Introduction to medically relevant pathogens with an emphasis on bacterial pathogenesis.

**BIO 4354 Neglected Tropical Diseases (3)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better  
Core principles in genetics and cellular and molecular biology to understand the causation, pathogenesis, and control of the major neglected tropical diseases, defined as a group of poverty-promoting chronic infectious diseases.

**BIO 4365 Topics in Evolution (3)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better; and BIO 2306 or consent of instructor  
Processes which establish or eliminate variation in populations and how these mechanisms affect biological diversity.

**BIO 4381 Restoration Ecology (3)**

Cross-listed as ENV 4380  
See ENV 4380 for course information.

**BIO 4386 Remote Sensing (3)**

Cross-listed as AVS 4386, ENV 4386, GEO 4386  
See GEO 4386 for course information.

**BIO 4405 Limnology (4)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better  
Lecture, laboratory, and field studies of lakes and streams. Emphasis on analysis and interpretation of physical, chemical, and biological factors relating to metabolism and production of aquatic communities. Overnight trips may be required.

**BIO 4406 Aquatic Biology (4)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better  
Laboratory and field studies of lakes, streams, and estuaries. Primarily for advanced students of zoology and botany who are interested in aquatic organisms and their ecology. Emphasis is on collection, preservation, and identification of all aquatic biota except fishes. Overnight trips may be required.

**BIO 4415 Human Evolutionary Anatomy (4)**

Cross-listed as ANT 4416  
See ANT 4416 for course description.

**BIO 4418 Biology of Wetland and Aquatic Vascular Plants (4)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better; and any taxonomic course  
Taxonomy, ecology, structure, distribution, and economic significance of aquatic vascular plants.

**BIO 4422 Ichthyology (4)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better  
Fish fauna of the area with emphasis on morphology, ecology, economics, and systematics. Overnight trips may be required.

**BIO 4426 Vertebrate Histology (4)**

Pre-requisite(s): BIO 3322 with a grade of C or better  
Microscopic structure of vertebrate tissues and organs.

**BIO 4428 Ornithology (4)**

Pre-requisite(s): Either BIO 1105 and 1305, or BIO 1405; and either BIO 1106 and 1306, or BIO 1406; all with grades of C or better  
Evolution, morphology, physiology, behavior, reproduction, ecology, geography, and migration of birds of the world. Includes field identification of Central Texas species.

**BIO 5100 Seminars in Biology (1)**

Graduate standing in biology and related fields. Topics of current interest in various subdisciplines of biology. Topics change each semester. Involves presentation of seminars by enrolled graduate students. May be repeated only with changes in topics.

**BIO 5101 Graduate Scientific Communications (1)**

Examination of various methods of scientific communication including leading undergraduate student groups in critical analysis and evaluation of scientific presentations and the current scientific literature.

**BIO 5199 Non-Thesis Degree Completion (1)**

To fulfill requirements for non-thesis master's students who need to complete final degree requirements other than coursework during their last semester. This may include such things as a comprehensive examination, oral examination, or foreign language requirement. Students are required to be registered during the semester they graduate.

**BIO 5201 Research Methods in Biology (2)**

Description and application of the major tools of professional biology, especially instruction on effective writing for obtaining graduate fellowships and research grants, and methods for presenting results of scientific research.

**BIO 5202 Res Meth In Bio II (2)**

Application of the major tools of professional biology, especially introductory programming, data management and visualization, and exploratory data analysis.

**BIO 5203 Tropical and Emerging Infectious Diseases (2)**

Provides a comprehensive overview of major neglected tropical diseases, HIV/AIDS, malaria, TB and emerging infections in the context of lecture-based learning and student-led evaluation of current literature emphasizing the rapidly changing global infectious disease climate.

**BIO 5204 Applied Epidemiology, Biostatistics, and Public Health (2)**

Reinforces the principles of public health as it applies to tropical medicine through epidemiologic investigations, statistical analyses, and evaluation of public health policy.

**BIO 5205 Vector Biology and Vector Borne Diseases (2)**

Pre-requisite(s): BIO 4102, 4302

Biology, entomology, and transmission dynamics of vector-borne diseases as they relate to the human and animal hosts.

**BIO 5206 Biotechnology Operations (2)**

Introduction to key principles and practices of a biotechnology operation, including lectures on management and project planning, product discovery, development and testing, clinical development, and the regulatory and quality management systems.

**BIO 5207 Preclinical Models in Biotechnology (2)**

Fundamentals of pre-clinical models used for vaccine development. The course emphasizes basic immunologic principles applied to vaccine development, natural and experimental animal models for efficacy testing, and design and execution of GXP animal studies. Additionally, fundamentals of US and international regulations governing human therapeutic development are covered.

**BIO 5208 Bench to Bedside: Biopharmaceuticals, vaccine antigen production and transition to the clinic (2)**

Pre-requisite(s): BIO 4307 or BIO 3342 or the consent of the instructor

Fundamental principles of discovering and designing modern biopharmaceuticals including recombinant vaccine antigens. Discussion of issues facing the transition from bench to bedside.

**BIO 5209 Topics in Advocacy and Policy for the Neglected Tropical and Emerging Infectious Diseases (2)**

Introduction to key topics of advocacy and policy to communicate scientific or technical information effectively in a variety of public and professional interactions. Lectures include best practices for use of different communication methods and understanding the different types of public audiences.

**BIO 5210 GIS and Health (2)**

Provides a comprehensive overview of how dynamic geospatial and environmental factors influence human health and how GIS-based tools can be applied for analysis.

**BIO 5211 Diagnostics of Neglected Tropical and Emerging Infectious Diseases (2)**

Examination and evaluation of modern molecular and other point-of-care methods for detection of tropical and emerging infectious diseases.

**BIO 5213 Research Methods in Biology III (2)**

Investigation of the parameters necessary for effective experimental design and interpretation in the biological and biomedical research fields.

**BIO 5220 Pathophysiology (2)**

Pre-requisite(s): At least one year of coursework in chemistry, physics, organic chemistry, and biology

In addition to concurrent enrollment in the Medical Sciences M.S. degree program. Provides a framework for applying fundamental principles of human anatomy and physiology to the diagnosis and treatment of disease.

**BIO 5300 Advanced Studies in Biology (3)**

Special and advanced topics in biology. May be repeated up to three times with change in content.

**BIO 5302 Virology (3)**

Cross-listed as BMS 5305

Pre-requisite(s): BIO 4106 and 4306 or equivalent

Material covered includes viral replication, molecular regulation, cellular life cycle, and pathogenesis; evolution, emerging diseases, and epidemiology; and prevention and control of viral diseases. Viruses which infect humans, domestic animals, and plants will be the focus. The global health perspective will be addressed throughout.

**BIO 5303 Behavioral Ecology (3)**

Pre-requisite(s): BIO 3403 or equivalent

Relationships among animal behavior, ecology, and evolution. Emphasis is on integrating current models with comparative and experimental evidence on how a particular behavior pattern contributes to an animal's chances of survival and its reproductive success.

**BIO 5304 Nucleic Acids (3)**

This course examines recent developments in both DNA and RNA fields.

Topics include nucleic acids structure, protein-nucleic acid interactions, techniques applied to nucleic acids, RNA decay, noncoding RNAs, RNA regulons, riboswitches, RNA bioinformatics and micro RNAs.

**BIO 5305 Ecosystem Biogeochemistry (3)**

This course provides the opportunity to synthesize the principles and current research in the discipline of Ecosystem Biogeochemistry through student-led teaching modules and a research synthesis project.

**BIO 5306 Molecular Evolution (3)**

Pre-requisite(s): BIO 2306 and 2106

Research in molecular genetics and its implications for evolutionary theory. Topics to be discussed include the evolutionary role of plasmids, temperate phage, transposons, introns, multigene families, organelle DNA, and DNA sequence divergence.

**BIO 5307 Advanced Cell Biology (3)**

Cross-listed as BMS 5307

Pre-requisite(s): BIO 4307 or 4308 or equivalents; or consent of instructor

Advanced topics in current cell biology research, including organelle and cytoskeleton structure and function, intra- and inter-cellular signaling, intracellular trafficking, cell cycle regulation, and cell division.

**BIO 5310 Advanced Microbiology (3)**

Pre-requisite(s): BIO 4401 or consent of instructor

Microorganisms, especially their mechanics of pathogenesis with emphasis on their distribution in nature, their beneficial and detrimental effects on humans, and the potential role of certain organisms in biowarfare.

**BIO 5311 Advanced Genetic Analysis (3)**

Pre-requisite(s): BIO 1105, 1106, 1305, 1306, 2306, 3342, and 4306 or equivalents; or consent of instructor

Principles and practice of classical and modern genetic analysis as applied to eukaryotic organisms, including yeast, nematodes, *Drosophila*, mice, and humans; isolation and analysis of mutations; gene mapping; suppressor analysis; chromosome structure; control of gene expression; and developmental genetics.

**BIO 5315 Genomics & Infectious Diseases (3)**

Pre-requisite(s): BIO 2306, 3342, 4308 or equivalents or consent of instructor

This course concerns new principles of genome science and explores their applications in infectious disease research. Topics include how pathogen and vector genomes are studied, how they function, and how they evolve. The importance of comparative and functional genomics along with use of arthropod disease vectors in identifying control mechanisms of human pathogens are highlighted.

**BIO 5320 Ecological Biophysics (3)**

Pre-requisite(s): BIO 3303 or BIO 3403; and MTH 1321, PHY 1408 and PHY 1409

First principle approaches that are used to describe microenvironments of living organisms and the energy and mass transfer between organisms and their external environment.

**BIO 5325 Advanced Topics in Evolutionary Biology (3)**

Pre-requisite(s): Consent of instructor

This course provides an opportunity to explore advanced evolutionary theory and its implementation. Emphasis on evolution as an integrative principle of biological science.

**BIO 5327 Microbiomes in Humans & the Environment (3)**

This interdisciplinary graduate-level (BIO5327) and advanced undergraduate-level course (BIO4390) will allow students to explore topics in molecular microbiology, microbial diversity, and microbial biochemistry to better understand the roles of microbes in ecosystems. The course will be weighted toward the gut microbiome but will include exploration of microbiomes from diverse ecosystems such as soil and the plant rhizosphere.

**BIO 5330 Conservation Biology (3)**

Cross-listed as ENV 5330

Pre-requisite(s): BIO 2306 and 3403 or equivalent

Biological forces influencing scarcity and diversity, emphasizing: genetics, fitness, population viability, extinction, endemism, habitat fragmentation, and community structure and stability.

**BIO 5335 Climate Change and Biodiversity (3)**

Pre-requisite(s): BIO 3303 and MTH 1320, or equivalents

Biological and conservation responses to naturally and human-induced climate change. Greenhouse gas levels, recent climate trends, range and abundance changes, phenological changes, evolutionary effects, climate change models and projections, designing landscapes and seascapes for change, managing the landscape matrix, and the future of biodiversity.

**BIO 5337 Advanced Limnology (3)**

This course introduces the field of limnology through lectures, class discussions, reading, writing, and field and laboratory activities. The main goal is that each student continues to grow as a scientist by learning aspects of physics, chemistry, and biology as they relate to inland aquatic ecosystems. Assignments are designed to practice critical thinking, interpretation of scientific literature, data analysis, and scenarios thinking within the context of global and local environmental change.

**BIO 5340 Ecosystem Process Modeling (3)**

Pre-requisite(s): MTH 1321 (or equivalent) and BIO 3403 (or equivalent)  
Interactions among ecosystem elements are formalized in computer simulation. Identification of ecosystem sources/sinks, reservoirs, and flux pathways is presented with the biological interpretation of mathematical representation of ecological processes.

**BIO 5345 Molecular Biology of Disease Vectors (3)**

Pre-requisite(s): BIO2306 Genetics: BIO4308 Cell and Developmental Biology; or consent of instructor

This course provides an important foundation of knowledge of the biology of disease vectors, followed by current topics in vector biology, cell and developmental biology, physiology, gene drive system, old and new strategies in vector control and control of vector-borne diseases and vector/pathogen/host interactions.

**BIO 5349 Research Proposal Writing and Development (3)**

Overview of effective grant writing skills, mechanics of proposal writing, and approaches to grantsmanship. Skills are developed for honing a scientific rationale and tailoring a proposal to the interests of specific audiences.

**BIO 5350 Biocomputing (3)**

Pre-requisite(s): Consent of instructor

An introduction to the Python language and its specific application to genomic, proteomic, and environmental research. Emphasis on strings, data storage/access, and creating custom modules. Weekly coding projects will be based on each student's dissertation research. No coding experience is required.

**BIO 5351 Advanced Biocomputing (3)**

Pre-requisite(s): Consent of instructor

A Python-based course covering protein structure, phylogeny, DNA sequencing and transcriptome analysis, Markov chains, clustering, and machine learning. Weekly coding projects will be completed which are relevant, where possible, to each student's dissertation research. Strong skills in Python are required.

**BIO 5355 Genomic Analysis (3)**

Cross-listed as BMS 5355

Provides comprehensive instruction on the analysis of genomic data. An overview of basic genome biology, study design, NGS technology, and galaxy analysis tools is provided in addition to current best practices in the analysis of genomic data. Genomic Analysis focuses on analysis and detection of variants and transcriptomics from next-generation sequencing data including RNA-seq, ChIP-seq, and SNP-seq.

**BIO 5360 Biological Invasions: Ecology and Management (3)**

Cross-listed as ENV 5360

Pre-requisite(s): BIO 3403 or equivalent

The biology of invasive alien plants and animals, emphasizing evolutionary ecology, impacts on native species, and effects on biodiversity. Biological invasion causes, pathways, vectors, and management strategies in terrestrial and aquatic systems.

**BIO 5377 Landscape Ecology (3)**

Cross-listed as ENV 5377

Pre-requisite(s): BIO 3403, MTH 1304, or equivalent

Ecological factors influencing landscape structure and dynamics. Emphasis on landscape structure, exchanges among landscape components, and landscape stability and management.

**BIO 5380 Integrative Ecophysiology (3)**

Pre-requisite(s): BIO 4431 or instructor approval

Application of the basic principles of nutrition to the study of fish, reptiles, birds, and mammals in their natural environments.

**BIO 5399 Experimental Design and Research Communications for Molecular Biologists (3)**

Cross-listed as BMS 5399

Pre-requisite(s): Consent of instructor

This course provides in-depth training on how to formulate research hypothesis and questions and how to present the specialized areas of student research to general and professional audiences.

**BIO 5400 Population Genetics (4)**

Pre-requisite(s): BIO 2306 or equivalent

Basic concepts and current research in population genetics. Topics covered include genetic variation in natural populations, evolutionary forces causing change in gene frequency, linkage disequilibrium, quantitative variation, and the genetics of speciation.

**BIO 5401 Microbial Ecology (4)**

Interactions and transformations of microorganisms in soil, air, and water. Emphasis on methodology and practical relationships of microorganisms in the environment.

**BIO 5402 Invertebrate Zoology (4)**

Diversity and phylogenic development of all non-vertebrate phyla. Current areas of research in invertebrate biology are examined.

**BIO 5403 Population Ecology (4)**

Pre-requisite(s): BIO 3403 or equivalent; and BIO 5412 or MTH 2381 or STA 3381 Lectures, discussions, and field studies that illustrate basic concepts and current research in theoretical and applied population ecology

Topics include life tables, census techniques, single-species population and metapopulation dynamics, population regulation, population dynamics in competitive and predator/prey interactions, and the conservation of populations. Includes an independent research project.

**BIO 5404 Wetland Ecology and Management (4)**

Cross-listed as ENV 5404

Prerequisite(s): BIO 3403 or equivalent. Lecture, laboratory, and field studies of the ecology and management of North American wetland environments. Emphasis will be placed on the ecology of aquatic and wetland plants and their role in determining wetland structure and function. Overnight field trip required.

**BIO 5405 Stream Ecology (4)**

Cross-listed as ENV 5405

Physical, chemical and biological organization of streams. Topics include geomorphology and hydrology, water chemistry, ecosystem processes in streams, watershed-stream linkages, and bioassessment methods.

**BIO 5407 Bioenergetics (4)**

Discussion and laboratory experiences on the processes, pathways, and rate of biological energy transformation.

**BIO 5408 Plankton Ecology (4)**

Pre-requisite(s): BIO 3303 or equivalent; or consent of instructor  
Plankton comprise the most important community of oceans and most lakes. Their metabolism drives the global carbon cycle and supports global fisheries. We consider all plankton, but focus on the middle of the food web, i.e., the zooplankton as an intermediary between the phytoplankton producers and the fish consumers. The course has a strong hands-on component with experimental laboratory experiences.

**BIO 5409 Cancer Biology (4)**

Pre-requisite(s): BIO 4306 or 4307 or 4308 or consent of the instructor  
Basic concepts and current research in cancer biology. Topics include the cell intrinsic regulation of growth control, the accumulation of mutations, and the cell biological and micro-environmental changes associated with cancer, as well as therapeutic strategies. Current literature is discussed.

**BIO 5412 Biometrics (4)**

Pre-requisite(s): MTH 1304 or equivalent

Principles and methods for experimental design, quantitative analysis, and interpretation of biological data, including application of mainframe computer packages.

**BIO 5413 Advanced Ecological Data Analysis (4)**

Cross-listed as ENV 5413

Pre-requisite(s): BIO 5412 or equivalent

Current approaches to analyzing and interpreting complex biological data. Emphasis on integrative analysis strategies using modern statistical modeling techniques. Hands-on analysis of data sets using the statistical package R.

**BIO 5420 Transmission Electron Microscopy (4)**

Pre-requisite(s): Consent of instructor

Use and operation of the transmission electron microscope and ancillary equipment as instruments of biological research, with special emphasis on tissue preparation, sectioning, examination, data acquisition, and photography.

**BIO 5421 Scanning Electron Microscopy (4)**

Pre-requisite(s): Consent of instructor

Use and operation of the scanning electron microscope and support equipment. Specimen preparation, specimen examination, data acquisition, and data analysis are emphasized.

**BIO 5425 Molecular Ecology (4)**

Pre-requisite(s): Consent of instructor

Basic concepts and current laboratory techniques in molecular ecology. Emphasis is on use of these skills in addressing basic and advanced ecological questions.

**BIO 5432 Microbiology and Immunology (4)**

Pre-requisite(s): At least one year of coursework in organic chemistry and biology

In addition to concurrent enrollment in the Medical Sciences M.S. degree program. The primary aim of this course is to aid MSMS students in concentrating on the fundamental concepts of immunology and microbiology pertaining to medicine and biomedical science. The topic of microbiology consists of the classification of microorganisms, microbial transmission, and viral multiplication.

**BIO 5V90 Special Problems (1-6)**

Pre-requisite(s): Consent of instructor

Advanced work in biology. Subject and hours of credit agreed upon by student and professor prior to registration. For master's and doctoral students.

**BIO 5V99 Thesis (1-6)**

Pre-requisite(s): Consent of major professor

Research, data analysis, writing, and oral defense of an approved master's thesis. At least six hours of BIO 5V99 are required.

**BIO 6101 Research Rotation (1)**

The research rotation allows students to become familiar with different areas of research, learn new experimental techniques, obtain experience in different research laboratories, and ultimately identify a lab in which to conduct dissertation research.

**BIO 6V00 Graduate Research (1-10)**

Pre-requisite(s): Graduate standing

For research credit prior to admission to candidacy for an advanced degree. Credit will be given for the amount of work done. May be repeated for credit through 45 hours.

**BIO 6V10 Doctoral Prospectus Research (1-2)**

Pre-requisite(s): Consent of Instructor

Supervised research for writing a dissertation research proposal and designing experimental approaches that will be the subject of a preliminary exam that will admit students to candidacy. A student may repeat this course for credit, with a maximum of 4 total hours.

**BIO 6V99 Dissertation (1-12)**

Pre-requisite(s): Consent of major professor

Research, data analysis, and writing and oral/written defense of an approved doctoral dissertation. At least twelve hours of BIO 6V99 are required.