Department of Biological Sciences

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Holly Gaff, Chair
Ian Bartol and David Gauthier, Associate Chairs
Daniel Barshis, Ecological Sciences Ph.D. Graduate Program Director
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The Department of Biological Sciences provides a broad selection of course offerings. The degree program in biology allows for the selection of elective subjects most suited to the individual's vocational interests. In addition, the Department of Biological Sciences partners with the Graduate School to offer an interdisciplinary Ph.D. in Biomedical Sciences.

Programs

Doctor of Philosophy Program

- Ecological Sciences (PhD) (http://catalog.odu.edu/graduate/sciences/biological-sciences/ecological-sciences-phd/)

Master of Science Programs

- Biology (MS) (http://catalog.odu.edu/graduate/sciences/biological-sciences/biology-ms/)
- Biology with a Concentration in Microbiology and Immunology (MS) (http://catalog.odu.edu/graduate/sciences/biological-sciences/biology-microbiology-immunology-ms/)
- Biology with a Concentration in One Health (MS) (http://catalog.odu.edu/graduate/sciences/biological-sciences/biology-one-health-ms/)

Doctor of Philosophy - Biomedical Sciences

Barbara Hargrave, Graduate Program Director

In this interdisciplinary program all students are required to master a broad knowledge of the basic biomedical sciences. Refer to the Graduate School (http://catalog.odu.edu/graduate/graduateschool/) page of this catalog for details.

Courses

Biological Sciences (BIOL)

BIOL 500 Plant Systematics (4 Credit Hours)
An evolutionary survey of vascular plant families and the principles and methodologies that define them; lab emphasis is placed on recognition and skills of identification. A lab and field intensive hands-on course.
Prerequisites: A botany course

BIOL 501 Entomology (4 Credit Hours)
A comprehensive survey of the insects, including taxonomy, morphology, physiology, reproductive and developmental biology, and ecology. Research techniques in entomology will be learned through both field and laboratory work.

BIOL 502 Scientific Diving Methods for Marine Research (4 Credit Hours)
This lecture/field experience course will train students in the common techniques used by marine scientists who employ scuba for their research. It satisfies the requirements for an American Academy of Underwater Scientist certification and covers other topics such as: use of underwater research equipment and marine resource surveys. A multi-day scuba trip is required.
Prerequisites: Open Water Scuba Certification and ODU Dive Physical Form signed/completed by a physician

BIOL 503 Medical Microbiology (3 Credit Hours)
This course integrates the disciplines of microbiology, immunology, and biochemistry with the pathophysiology of infections and the appropriate pharmacology in a problem-based learning setting. Students will learn the fundamental concepts and terminologies of infectious diseases. The material will be case studies in small group tutorials and emphasize independent learning.
Prerequisites: Microbiology and Biochemistry courses, anatomy course recommended, or instructor approval

BIOL 504 Conservation Biology and Sustainable Development (5 Credit Hours)
The application of fundamental biological principles to the preservation of biodiversity, including the role of ecological and evolutionary theory to the preservation of biotas on a regional and global basis. Lectures will cover modern approaches to conservation biology, including conservation ethics and management issues. Laboratories will include discussion of case studies, introduction to software applicable to conservation biology, presentations by regional conservation practitioners, and visits to relevant field sites.

BIOL 507 The Pharmacology and Neurobiology of How Recreational Drugs Work (3 Credit Hours)
This course in drug use and abuse is designed to distinguish between drug use and drug abuse as well as provide pharmacological knowledge of how recreational drugs work. Students will acquire knowledge regarding the abuse of prescription drugs, depressants, stimulants, hallucinogens, marijuana and inhalants. This information will be used to analyze pathophysiological conditions that can occur as a result of drug use and abuse.
Prerequisites: Background in cell biology
Pre- or corequisite: BIOL 508 recommended

BIOL 508 Introduction to Pharmacology (3 Credit Hours)
This is a general introductory course in pharmacology dealing with chemistry, general properties and pharmacological effects on various physiological systems, therapeutic usefulness and toxicities of drugs. The course is designed to prepare upper-level undergraduate and graduate students for more advanced courses in pharmacology.

BIOL 511 Zymology: Fermentation Science (4 Credit Hours)
This is an introductory course in the theory and practice of zymology (fermentation). Edible and potable products of fermentation (beer, wine, mead, yogurt, cheese) have been known since antiquity and play an important role in today's society. The science of fermentation touches on many biological disciplines, such as microbiology and biochemistry, and the study of yeasts has provided considerable foundation to the fields of cell biology and molecular biology. In this course, we will cover fundamentals of fermentation and its practical application to production of beer, one of the oldest beverages produced by humans.
Prerequisites: BIOL 293

BIOL 512 Plant Physiology (4 Credit Hours)
Discover the incredible secrets behind what makes our green friends tick. This course includes a traditional lecture covering the physiological and chemical processes occurring in plants. A laboratory, greenhouse, and/or field-oriented lab will provide hands-on opportunities to understand plant stress responses, nutrient use, cell metabolism-respiration, photosynthesis, hormones, and processes driving growth patterns.

BIOL 515 Marine Ecology (5 Credit Hours)
A lecture and laboratory course designed to introduce students to important ecological processes operating in coastal marine environments. The course covers synthetic topics as well as the ecology of specific marine habitats. The laboratory is designed to provide students with experience in marine research and the organisms and ecological conditions common in various marine habitats visited by the class.
Prerequisites: BIOL 291 and BIOL 331 and ENGL 211C or ENGL 221C or ENGL 231C must be passed with a grade of "C" or higher; instructor approval required

BIOL 516 Clinical Immunology (3 Credit Hours)
A description of common immunological problems seen in the clinic.
Prerequisites: Coursework in cell biology and immunology

BIOL 519 Wetland Plants (4 Credit Hours)
An exploration of the ecology of inland and coastal wetlands and their plants. This course emphasizes wetland and aquatic plant identification, field and laboratory methods, and core concepts important to wetland plants and their ecology. Linkages to wetland delineation and wetland adjacent systems will be made. Weekly field-based laboratories are expected to local wetlands focusing on hands on opportunities and research methods.
Prerequisites: A botany course

BIOL 520 Ichthyology (5 Credit Hours)
The biology of marine and freshwater fishes including morphology, physiology, evolution, distribution, ecology, and reproduction.

BIOL 522 Field Studies in Ornithology (4 Credit Hours)
A combined lecture and field study of birds with emphasis on identification, behavior, and field methods. Extensive field trips, including at least one weekend, are taken.

BIOL 523 Cellular and Molecular Biology (3 Credit Hours)
The molecular organization of eukaryotic cells is presented along with cell evolution, molecular genetics, the internal organization of the cell and the behavior of cells in multicellular organisms.
Prerequisites: course background in cell biology and genetics or permission of the instructor

BIOL 524 Comparative Animal Physiology (5 Credit Hours)
An introduction to the basic mechanisms by which different animals function. How organisms acquire and use energy, regulate their internal environment, circulate and exchange gases and wastes, receive and conduct information about their environment, and move and use muscles will be some of the topics covered. Emphasis will be on how organisms make changes in these basic mechanisms to deal with different environmental conditions.

BIOL 525 Cancer Biology (3 Credit Hours)
This course will examine how mutation leads to altered gene products and expression, subverted cell activity, cell immortalization, and tumor formation. Students will explore the differences between benign tumors and malignant tumors as well as the factors involved in malignancy. The course will conclude with the exploration of current cancer therapy.
Prerequisites: Cell Biology and Genetics courses

BIOL 526 Histology (5 Credit Hours)
The structure and function of cells, tissues and organs at both the light microscopic and ultrastructural levels.

BIOL 530 Microbial Pathogenesis (3 Credit Hours)
Examination of bacterium-host interactions with an emphasis on how bacteria cause disease, particularly the means by which the bacterium is able to circumvent host defense mechanisms
Prerequisites: microbiology course

BIOL 535 Marine Conservation Biology (3 Credit Hours)
This highly interdisciplinary science of conserving marine biodiversity will be taught through a review of old and new literature. This will include its history, marine ecology related to conservation biology, threats to marine biodiversity, assessment of extinction risk, conservation challenges of marine habitats and regions, and methods for conserving marine biodiversity.

BIOL 536 Infectious Disease Epidemiology (3 Credit Hours)
This lecture/lab course will focus on concepts related to the spread and control of infectious diseases. The lectures will focus on concepts while the labs will provide quantitative skills essential to the study of infectious diseases.
Prerequisites: Undergraduate coursework in statistics and biology

BIOL 537 One Health: People, Animals and the Environment (3 Credit Hours)
A course that examines the interdependence between human health, animal health and environmental health. The One Health approach to the threat of emerging infectious diseases includes understanding the interconnectedness of human and animal pathogens, epidemic zoonoses and corresponding environmental factors, insights into mechanisms of microbial evolution towards pathogenicity, new technologies and approaches towards disease surveillance, and political and bureaucratic strategies.
Pre- or corequisite: A Microbiology course is recommended

BIOL 540 Methods in Immunological Research (4 Credit Hours)
The major objective of this hands-on course is to prepare students to independently perform basic laboratory techniques, assays, and experiments commonly used in entry-level immunology laboratory positions. The course will cover theory, sample and reagent preparation, instrumentation, data analysis and interpretation, and applications in immunology. Several topics covered in-class include ELISAs, mammalian cell culture, and flow cytometry, however additional topics (such as confocal microscopy) will be covered using virtual technologies. This course is ideal for students who intend to pursue careers at the laboratory bench.
Prerequisites: microbiology laboratory course, immunology course

BIOL 541 Animal Behavior (5 Credit Hours)
Animal behavior with special attention to its evolution and ecological significance. Field and laboratory activities will emphasize observational and experimental techniques used to study behavior.

BIOL 544 Field Studies in Marine Biology (5 Credit Hours)
An intensive study abroad field course offered during the summer at a foreign marine laboratory where students will be engaged in lectures and field studies of coastal marine environments. Check with the Director of the Marine Biology Concentration Program for details.
Prerequisites: BIOL 331

BIOL 545 Community Ecology (3 Credit Hours)
The goal of this course is to introduce and evaluate both classical and emerging paradigms in community ecology. This will be achieved by examining those processes (biotic and abiotic) that structure ecological communities, and by exposing students to quantitative and theoretical aspects of these paradigms.
Prerequisites: Ecology course

BIOL 546 Comparative Biomechanics (3 Credit Hours)
The principles of fluid and solid mechanics will be applied to a variety of plant and animal systems to understand how organisms deal with the immediate physical world and its accompanying constraints. A diverse range of topics will be covered, including aerial flight in insects, wind resistance in trees, jet propulsion in squid, flow within blood vessels, forces on intertidal organisms, viscoelasticity in biological materials, and energy storage during terrestrial movement.
Prerequisites: Cell biology course and physics course recommended

BIOL 550 Principles of Plant Ecology (4 Credit Hours)
This course explores theoretical concepts in plant ecology through review of classical and cutting-edge literature and practice with field-based experimental design and statistical methods. This course emphasizes the structure, development, and processes that drive patterns in plant communities and the ecological communities they support. Weekly field-based laboratories involve hands-on experience and opportunities to explore field methods in ecological research.

BIOL 551 Bioinformatics and Genomics I (4 Credit Hours)
The application of computer science to biology has led to major breakthroughs in the ability to read and understand the code written in genomes. This course will give students the skills to participate in the computational revolution in biology. The course will give students hands-on experience in writing simple yet powerful computer programs in the Python programming language and making beautiful data visualizations in the R programming language. Students will also learn how to combine existing pieces of bioinformatics software for their own workflows.
Prerequisites: background in introductory-level biology and permission of the instructor

BIOL 552 Bioinformatics and Genomics II (4 Credit Hours)
The application of computer science to biology has led to major breakthroughs in the ability to read and understand the code written in genomes. This course will give students the skills to participate in the computational revolution in biology. The course will build on the knowledge of writing programs. Students will learn about some key techniques "under the hood" of software that have been critical to the genomics revolution. Topics will include: graph algorithms, evolutionary trees, probability models for DNA and protein sequences, and an introduction to deep learning in biology.
Prerequisites: BIOL 551 or permission of the instructor

BIOL 553 Molecular Ecology (4 Credit Hours)
This course will explore the biology of organisms by using molecular (nucleic acid and/or protein) techniques and data. It covers a wide variety of subdisciplines within Biology, including genetics, physiology, ecology, and evolution. This course will explore basic theory in population genetics, ecology, and evolution and cover DNA, RNA, and Protein techniques and their application to biological research.

BIOL 554 Research in Pathogen Biology I: Laboratory Investigation (4 Credit Hours)
This is the first course of a two-semester laboratory and analysis sequence that is designed to provide a genuine research experience for students. Students will design a novel research question in pathogen biology, then use modern laboratory techniques such as polymerase chain reaction and next-generation DNA sequencing to examine this question and test hypotheses. Data generated in this course will be analyzed in the second course in the series, BIOL 555. Data and analyses generated during these courses may be used for publication in scientific journals.
Prerequisites: BIOL 294

BIOL 555 Research in Pathogen Biology II: Analysis (4 Credit Hours)
This is the second course of a two-semester laboratory and analysis sequence that is designed to provide a genuine research experience for students. In this semester, students will analyze data generated during the previous semester in BIOL 554. Modern methods of data analysis will be used, including statistical and bioinformatics techniques. Data and analyses generated during these courses may be used for publication in scientific journals.
Prerequisites: BIOL 294; BIOL 554 preferred

BIOL 557 General Virology (3 Credit Hours)
A basic course covering the history of virology, viral taxonomy, genetics, and the molecular biology and host responses to the major mammalian virus groups. Examples of recent impacts of viruses on human health such as influenza pandemics will also be covered.
Prerequisites: courses in cell biology and genetics

BIOL 560 Frontiers in Nanoscience and Nanotechnology (1 Credit Hour)
Review of the structure, synthesis and properties of key nano-materials and their impact on living systems.
Prerequisites: graduate standing

BIOL 561 Human Cadaver Dissection (5 Credit Hours)
Students will dissect a human cadaver fully and learn all of the major structures. The course will divided into three sections: backs and limbs, TAP (thorax, abdomen and pelvis), and head and neck. Instructor demonstrations include brain removal and dissection.
Prerequisites: BIOL 241 or BIOL 251, or its equivalent, must be passed with a grade of C (2.0) or higher

BIOL 562 Microbial Genetics (3 Credit Hours)
This course emphasizes the fundamental concepts of microbial genetics including the study of gene structure, gene regulation, operons, DNA replication, RNA biology, protein synthesis, plasmid biology, mobile genetic elements, and recombinant DNA technology.
Prerequisites: Courses in cell biology, genetics and general microbiology

BIOL 563 Cell Signaling in Host Pathogen Interactions (3 Credit Hours)
This course will emphasize cell dynamics including host and pathogen induced cellular signaling, the regulation of actin cytoskeleton rearrangement, and the modulation of host transcription and translation by different pathogens.
Prerequisites: A cell biology course

BIOL 564 Biomedical Applications of Low Temperature Plasmas (3 Credit Hours)
This course is cross listed between ECE and Biology. It is intended for senior undergraduate students and first year graduate students. The course contents are multidisciplinary, combining materials from engineering and the biological sciences. The course covers an introduction to the fundamentals of non-equilibrium plasmas, low temperature plasma sources, and cell biology. This is followed by a detailed discussion of the interaction of low temperature plasma with biological cells, both prokaryotes and eukaryotes. Potential applications in medicine such as wound healing, blood coagulation, sterilization, and the killing of various types of cancer cells will be covered.

BIOL 565 Biotechnology (3 Credit Hours)
This course provides an overview of how microbes are manipulated to solve practical problems through biotechnology. Topics to be covered include basic concepts in microbial technology, industrial microbiology, microbes in drug development, food microbiology, microbial interactions, gut microbiota, and metagenomics.

BIOL 566 Introduction to Mitigation and Adaptation (3 Credit Hours)
Students will be introduced to the science underpinning mitigation of human-induced changes in the Earth system, including but not limited to climate change and sea level rise, and adaptation to the impacts of these changes. The course will cover the environmental hazards and the opportunities and limitations for conservation, mitigation and adaptation. Cross listed with OEAS 566.

BIOL 567 Sustainability Leadership (3 Credit Hours)
In this class, students will discover what makes a leader for sustainability. They will consider a range of global and local crises from a leadership point of view in the context of sustainability science, which addresses the development of communities in a rapidly changing social, economic, and environmental system-of-systems environment. The course will be based on taking a problem-motivated and solution-focused approach to the challenges considered. The course includes a service learning project focusing on a leadership experience in solving a real-world environmental problem.
Prerequisites: BIOL 566 or OEAS 566

BIOL 570 Diseases that Changed our World (3 Credit Hours)
Despite advancements in the development of antimicrobials and vaccines and in securing clear water and food supplies, modern civilizations are not immune to epidemic diseases. This course will provide insight into the role of different technologies in the struggle to attain disease control and eradication and explore the challenge of forecasting emerging plagues, describing the nature and evolution of diseases and conveying their significance in shaping Western culture and civilization, their impact, their consequences, their costs, and the lessons learned.

BIOL 571 Marine Vertebrate Ecology, Management & Conservation (3 Credit Hours)
Course will explore the biology, diversity and major life history patterns of a suite of marine megafauna, including sea turtles, marine mammals, seabirds and sharks. Students will determine the major drivers behind large-scale declines of many marine megafauna species and be challenged to understand and attempt to solve conservation and management issues.
Prerequisites: A Marine Biology course

BIOL 575 Neurobiology (3 Credit Hours)
This course will focus on understanding brain structure as well as the morphology and function of the central nervous system in general. Fundamental processes such as neuron morphogenesis, guidance, polarity, migration, and growth cone motility will be emphasized. The cellular and molecular basis of neurological disorders also will be discussed.
Prerequisites: BIOL 250 or BIOL 293 must be passed with a grade of "C" or higher or permission of instructor

BIOL 576 Cancer Immunology and Immunotherapy (3 Credit Hours)
Introduction to the immune system, tumor antigens, immunosuppressive cells and molecules, and cancer immunotherapy treatment approaches.
Prerequisites: BIOL 123N, BIOL 124N, and BIOL 293 (Cell Biology), or equivalent undergraduate coursework or permission of the instructor

BIOL 578 Microbial Ecology (3 Credit Hours)
Study of the interactions between microorganisms, particularly bacteria, and their environment. Emphasis is placed on nutrient cycling and the influence of microbes on global mineral dynamics. The effects of physical and chemical factors on distribution and activity of microbes in their environments and applications of these interactions are studied (biotechnology).
Prerequisites: a general microbiology course

BIOL 579 Microbial Ecology Laboratory (1 Credit Hour)
A laboratory for measurement of microbial numbers and activity in natural environments.
Pre- or corequisite: BIOL 578

BIOL 581 Forensic and Medical Entomology (5 Credit Hours)
This course provides a comprehensive survey of the insects used in legal investigations and medically important insects. Topics covered include the taxonomy, morphology, physiology, reproductive and developmental biology, and ecology of these insects along with the diseases they may vector. Research techniques in forensic and medical entomology will be learned through both field and laboratory activities.

BIOL 582 Human and Veterinary Parasitology (3 Credit Hours)
The course will emphasize the principles of parasitism, including biology, physiology, genetics, morphology, and phylogeny of the major parasitic groups with a specific focus on the significant parasites of humans and animals of veterinary importance. The general biology of parasites including their life cycles, diagnosis, and treatment will be included as well.
Pre- or corequisite: A cell biology course

BIOL 590 Advanced Human Physiology (4 Credit Hours)
All major physiological systems with emphasis on normal physiology. Some clinical applications made but not stressed.

BIOL 596 Topics in Biological Sciences (1-4 Credit Hours)
A structured specialty course for students at the senior level. Courses may include lecture and laboratory components.
Prerequisites: Permission of the instructor

BIOL 598 Independent Study in Biology (1-3 Credit Hours)
Supervised (non-lab/field) project selected to suit the needs of the individual student. Requires completion of formal scientific paper documented with appropriate primary technical literature (see GPD for details). Unstructured course.
Prerequisites: permission of the GPD and permission of instructor

BIOL 609 Special Readings in Biology (3 Credit Hours)
Reading and discussion course designed to explore a field of specific interest.

BIOL 640 Microbial Toxins (3 Credit Hours)
This course will focus on the mechanisms of action of microbial toxins, including those affecting the host's nervous system, immune function, metabolism, protein synthesis, and homeostasis. The structure and function of representatives of several toxin types will be analyzed for their potential applications to biotechnology and medicine.
Prerequisites: A general microbiology course required and a microbial pathogenesis course recommended

BIOL 661 Topics in Biology (1-3 Credit Hours)
Supervised projects and practica selected to meet the specific objectives of the student.

BIOL 669 Internship in Biology (3 Credit Hours)
With approval of Advisory Committee.

BIOL 671 Molecular and Immunological Techniques (4 Credit Hours)
A lab-intensive course emphasizing current methods in molecular biology.

BIOL 695 Topics in Biology (1-3 Credit Hours)
A specially designed course concerning specific topics in the biological, environmental or allied health fields.

BIOL 698 Research in Biology (1-9 Credit Hours)
Supervised research.

BIOL 699 Thesis (1-3 Credit Hours)
This course is selected with the recommendation of the faculty advisor.

BIOL 700 Cardiovascular Physiology (4 Credit Hours)
This physiology course will focus solely on cardiovascular physiology. Lectures will focus on basic and advance cardiovascular principles. The laboratory will focus on the use of current cardiovascular research.

BIOL 701 Practical Computing for Biology (3 Credit Hours)
This hands-on training course emphasizes the use of general computing tools to work more effectively in the biological sciences. It integrates a broad range of powerful and flexible tools that are applicable to ecologists, molecular biologists, physiologists, and anyone who has struggled analyzing large or complex data sets. Text file manipulation with regular expressions, basic shell scripting, programming in Python and R, interaction with remote devices, and basic graphical concepts will be reviewed.

BIOL 702 Biomedical Sciences Journal Club (1 Credit Hour)
Review and discussion of current papers in the areas of biomedical sciences. Student presentation, discussions and readings in this field required.

BIOL 703 Advanced Genomics Data Analysis (3 Credit Hours)
This course is designed to teach students the various steps involved in analyzing next-generation sequencing data for gene expression profiling and polymorphism identification and analyses. The class will follow a workshop setting with a combination of lectures, paper discussions, and instructor and student led programming sessions.

BIOL 704 Animal Ecophysiology (3 Credit Hours)
This course integrates the physiological and biochemical function of wild animals with population-scale and community-scale ecological patterns. Both organismal mechanisms and comprehensive theories will be included. The course primarily draws on peer-reviewed literature and includes lecture and discussion.

BIOL 705 Advanced Microbiology (3 Credit Hours)
Investigate microbiology from historical perspectives to modern molecular microbiology; ecological and biomedical components; bacteria and viruses. Discussions will include how to design experiments and evaluate results.
Prerequisites: A microbiology course

BIOL 706 Core Concepts in Biology (3 Credit Hours)
This course is designed to equip students with core concepts and fundamental skill sets for all sub-disciplines in the biological sciences. Major topics will include evolutionary and ecological processes, foundational concepts in comparative physiology, cellular biology, microbiology, immunology, genetics, advanced molecular biology, and the interrelatedness of the human, animal, and environmental domains. The course emphasizes the integration of topics and builds the analytical skills and conceptual framework that prepares students for advanced study and research in the biological sciences.

BIOL 707 Ecosystem Ecology (5 Credit Hours)
Ecological principles at ecosystem level of biological organization. Discussion of energy flow, nutrient cycling, ecosystem stability and ecosystem modeling. Laboratory involves field trips and methods of measuring ecosystem parameters.
Prerequisites: a general ecology course

BIOL 708 Biology Seminar (1 Credit Hour)
This graduate seminar offers a dynamic exploration of the biological sciences through a rotating roster of faculty presenting diverse topics. Participants will engage in discussions of contemporary research papers, receive training in science communication and career development, and/or analyze seminal texts that have shaped the field.

BIOL 709 Current Issues in Biology (1 Credit Hour)
The course is a weekly lecture series of invited external and internal experts in Biology that will highlight the broad nature of biology research. Students will achieve a comprehensive understanding of biology through reinforcement of key fundamental concepts and exposure to a wide range of sub-disciplines.

BIOL 710 Advanced Cell Biology (3 Credit Hours)
This course will cover selected current topics in cell biology that reflect recent advances in the field. Major topics include membranes and transport, signal transduction, cell adhesion and motility, cell cycle, apoptosis, and specialized cell functions. Students will read current research papers that describe the latest innovations in microscopic and molecular analysis of cellular function. This course is built on previous coursework in cell biology by reinforcing key fundamental concepts and performing a more in-depth examination of cellular mechanisms.
Prerequisites: Course background in cell biology recommended

BIOL 711 Advanced Skills in Biology (2 Credit Hours)
This course provides hands-on training in cutting-edge methodologies for biological sciences research. Students will engage in supervised laboratory or field exercises, depending on their disciplinary focus, mastering advanced techniques, instrumentation, and data collection methodologies. By applying these methods to real research problems, this course aims to bridge theoretical knowledge with practical application, preparing students to contribute effectively to the advancement of biological research.

BIOL 712 Biological Microscopy (4 Credit Hours)
Lectures will cover theory and concepts of specimen preparation and operation of various microscopes used in the biological sciences. The laboratory experience will include specimen preparation to viewing.
Prerequisites: permission of the instructor

BIOL 713 Biology Education and Teaching (1 Credit Hour)
This graduate-level course is designed to prepare future faculty for effective teaching in the biological sciences at the university level. Students will explore pedagogical theories and practices specifically tailored for higher education, focusing on instructional strategies, assessment methods, and curricular design principles that foster student engagement and success. Through a combination of theory and hands-on applications, participants will critically examine the integration of technology, inclusivity, and active learning techniques in university classrooms. Emphasis will be placed on developing reflective teaching practices that empower future faculty to inspire and mentor the next generation of scientists

BIOL 714 Biomedical Sciences Laboratory (2 Credit Hours)
Three laboratory rotations (6 credits) are required by the curriculum.
Prerequisites: approval of the program director

BIOL 715 Biomedical Sciences Laboratory (2 Credit Hours)

BIOL 716 Endocrinology (5 Credit Hours)
The biochemical integration of hormones and related agents on vertebrate physiology with emphasis on human endocrinology. Recent literature will be stressed.

BIOL 720 Systematic Ichthyology (3 Credit Hours)
A systematic survey of fishes emphasizing life history, anatomy, identification and classification.
Prerequisites: BIOL 520

BIOL 724 Neuromuscular Physiology (3 Credit Hours)
This course will provide a comprehensive discussion of the physiological and chemical properties of nerve and muscle cells.

BIOL 730 Emerging Infectious Diseases (3 Credit Hours)
Discussion on current studies into new and reemerging infectious diseases with an examination of the infectious agent and factors involved in disease emergence, prevention and elimination.
Prerequisites: A microbiology course

BIOL 731 Systematics and Speciation (3 Credit Hours)
Principles of systematic biology and discussion of speciation theory, with emphasis on generation, analysis, and interpretation of taxonomic data and application of these data to a better understanding of classification and speciation processes. Modern theories of evolutionary biology and phylogenetics will be stressed. A research paper is required.

BIOL 732 GIS in the Life Sciences (3 Credit Hours)
This course is designed to introduce students to geographic information systems through examples and applications in the life sciences.

BIOL 737 Advanced One Health (3 Credit Hours)
One Health is a concept that stresses the interconnectedness of human, animal, and environmental/ecosystem health and seeks an integrative approach to human and animal health issues. The concept provides a framework for examining complex health issues such as vector-borne and emerging infectious diseases, antimicrobial resistance, and food safety and security. In our globalized world, new approaches to preventing, treating, and controlling diseases are urgently needed as emerging diseases are increasing in frequency due to interconnected ecosystems and the close connections between humans and animals.
Prerequisites: An introductory One Health course (BIOL 437W or BIOL 537 or equivalent)

BIOL 740 Vaccinology (3 Credit Hours)
This course will explore a broad range of concepts important to the field of vaccinology. Primary literature will be used to discuss vaccine development topics such as vaccine design and production, delivery methods, adjuvants, One Health, and zoonotic vaccines. HIV, TB, malaria, influenza, and parasite vaccines will be included.

BIOL 745 Advanced Immunology (3 Credit Hours)
Current concepts in cellular and molecular immunology and host defense based on critical review of the primary literature.

BIOL 747 Responsible and Ethical Conduct of Research (3 Credit Hours)
Required of all graduate students admitted to Biology programs. The course will introduce students to the responsible conduct of science and scientific research.

BIOL 748 Functional Genomics and Proteomics in Animal Models (3 Credit Hours)
The purpose of this course is to show how animal models of human diseases can be created and analyzed using genomic and proteomic technologies. The course will overview high throughput methods of generating disease models in mice and describe ongoing efforts in this field. Attempts to identify molecular mechanisms of the disease will be presented with particular emphasis on drug target discovery.
Pre- or corequisite: An immunology course

BIOL 749 Biogeography (3 Credit Hours)
Emphasis on historical biogeography, utilizing both dispersal and vicariance models for explanations of the geographic distribution of organisms. Ecological explanations are also considered. Useful techniques for biogeographic analyses, such as comparison of area cladograms are discussed at length.

BIOL 750 Marine Benthic Ecology (4 Credit Hours)
Application of ecological principles at the community level to marine benthic environments. Discussion of community structure, animal-sediment relationships, roles of benthic communities in marine ecosystems.
Prerequisites: BIOL 515 or equivalent

BIOL 754 Phylogeny and Molecular Lecture and Laboratory (5 Credit Hours)
This course is intended to be an introduction to the processes and procedures used to reconstruct the evolutionary history of living organisms. Topics include project planning, sampling strategies, molecular techniques, and analytical and tree-building programs used to infer phylogeny. Lab provides computer experience in multiple phylogenetic software packages.
Prerequisites: Instructor approval required

BIOL 755 Molecular Genetics (3 Credit Hours)
Current molecular understanding of genetic processes will be reviewed. Applications to areas such as development and evolution will also be covered.

BIOL 756 Phylogeny and Molecular Systematics (5 Credit Hours)
This course is intended to be an introduction to the processes and procedures used to reconstruct the evolutionary history of living organisms. Topics include project planning, sampling strategies, molecular techniques, and analytical and tree-building programs used to infer phylogeny. Lab provides computer experience in multiple phylogenetic software packages.

BIOL 757 Statistics in Biology (4 Credit Hours)
Both a refresher course and an introduction to commonly used modern statistical methods for graduate students in Biology. The focus is on application and hypothesis testing with examples drawn from the #eld of biology. The course requires a substantial amount of homework and self-initiative outside the classroom.
Prerequisites: course background in statistics

BIOL 758 Molecular Ecology (4 Credit Hours)
Scientist are increasingly using molecular methods to help them address fundamental questions in the population ecology and evolution of biological species. This class will introduce graduate students to the basic concepts and methods in molecular evolution, phylogenetics and methods into their research. Theory and concepts from lecture will be illustrated through reading and discussion of current scientific literature. Students will also directly apply the course material to a class project investigating population structure of marine species from the tropical Indo-Pacific, for which they will be trained in methods of DNA extraction, PCR and sequencing. They will present their results orally in a mini-symposium at the end of the course.
Prerequisites: BIOL 671

BIOL 759 Foundations and Principles in Ecology (3 Credit Hours)
A survey of the seminal ideas and perspectives in historical and contemporary ecology. The course is designed to provide a broad overview of the important theoretical and conceptual paradigms in ecology.

BIOL 762 Restoration Ecology (3 Credit Hours)
This course will cover the field of environmental restoration guided by ecological theory and empirical research and connects with many broad themes in ecology, including physiology, genomics, biodiversity, conservation, species dispersal and migration, and population dynamics. This course will cover underlying principles guiding successful restoration, foundational and recent empirical research in this field, and restoration policies and practice.

BIOL 770 Advanced Study in Biology (3 Credit Hours)
Under the guidance of members of the graduate faculty and with the approval of the program track coordinator, the student will carry out in-depth studies of selected topics relevant to the area of specialization. Extensive surveys and analyses of the literature. Written reviews, comprehensive and synoptic, and oral presentations are required of each student.

BIOL 771 Vector-Borne Diseases (3 Credit Hours)
Study of the role of insects, ticks and other invertebrates in the transmission of disease. Different areas of disease transmission will be examined, including physiological and biochemical aspects of microbial survival in the vector and transmission to vertebrate hosts, as well as ecological aspects.

BIOL 772 Modeling and Simulation in the Life Sciences (4 Credit Hours)
Course is designed to introduce students to modeling and simulation techniques using examples and applications in the life sciences.

BIOL 775 Grant Writing in Biology (3 Credit Hours)
Provides students with the skills to write competitive grant proposals to both private and federal funding sources (emphasis on NIH and NSF). Students will learn how to find the most appropriate funding mechanisms and how to position themselves to be competitive. Different grant writing formats will be illustrated through proposal development projects.

BIOL 781 Autoimmunity and Transplantation (3 Credit Hours)
Major research advances in immunology have resulted in substantially increasing the understanding of the molecular and cellular basis of autoimmune diseases and transplantation. The course will focus on these new advances to improve the understanding of these diseases. Topics will include a brief review of the immune system; multiple sclerosis, arthritis and other immune diseases; and the molecular and cellular basis of transplantation and chronic rejection of organ grafts.
Prerequisites: course background in cell biology and immunology recommended

BIOL 789 Gross Anatomy (6 Credit Hours)
An intense study of all systems from a regional approach. Extensive dissections required in lab. Clinical applications utilized.
Prerequisites: An anatomy course recommended

BIOL 795 Special Topics in Biology (1-4 Credit Hours)
Study of special topics.
Prerequisites: permission of the instructor

BIOL 800 Cardiovascular Physiology (4 Credit Hours)
This physiology course will focus solely on cardiovascular physiology. Lectures will focus on basic and advance cardiovascular principles. The laboratory will focus on the use of current cardiovascular research.

BIOL 801 Practical Computing for Biology (3 Credit Hours)
This hands-on training course emphasizes the use of general computing tools to work more effectively in the biological sciences. It integrates a broad range of powerful and flexible tools that are applicable to ecologists, molecular biologists, physiologists, and anyone who has struggled analyzing large or complex data sets. Text file manipulation with regular expressions, basic shell scripting, programming in Python and R, interaction with remote devices, and basic graphical concepts will be reviewed.

BIOL 802 Biomedical Sciences Journal Club (1 Credit Hour)
Review and discussion of current papers in the areas of biomedical sciences. Student presentation, discussions and readings in this field required.

BIOL 803 Advanced Genomics Data Analysis (3 Credit Hours)
This course is designed to teach students the various steps involved in analyzing next-generation sequencing data for gene expression profiling and polymorphism identification and analyses. The class will follow a workshop setting with a combination of lectures, paper discussions, and instructor and student led programming sessions.

BIOL 804 Animal Ecophysiology (3 Credit Hours)
This course integrates the physiological and biochemical function of wild animals with population-scale and community-scale ecological patterns. Both organismal mechanisms and comprehensive theories will be included. The course primarily draws on peer-reviewed literature and includes lecture and discussion.

BIOL 805 Advanced Microbiology (3 Credit Hours)
Investigate microbiology from historical perspectives to modern molecular microbiology; ecological and biomedical components; bacteria and viruses. Discussions will include how to design experiments and evaluate results.
Prerequisites: A microbiology course

BIOL 806 Core Concepts in Biology (3 Credit Hours)
This course is designed to equip students with core concepts and fundamental skill sets for all sub-disciplines in the biological sciences. Major topics will include evolutionary and ecological processes, foundational concepts in comparative physiology, cellular biology, microbiology, immunology, genetics, advanced molecular biology, and the interrelatedness of the human, animal, and environmental domains. The course emphasizes the integration of topics and builds the analytical skills and conceptual framework that prepares students for advanced study and research in the biological sciences.

BIOL 807 Ecosystem Ecology (5 Credit Hours)
Ecological principles at ecosystem level of biological organization. Discussion of energy flow, nutrient cycling, ecosystem stability and ecosystem modeling. Laboratory involves field trips and methods of measuring ecosystem parameters.
Prerequisites: a general ecology course

BIOL 808 Biology Seminar (1 Credit Hour)
This graduate seminar offers a dynamic exploration of the biological sciences through a rotating roster of faculty presenting diverse topics. Participants will engage in discussions of contemporary research papers, receive training in science communication and career development, and/or analyze seminal texts that have shaped the field.

BIOL 809 Current Issues in Biology (1 Credit Hour)
The course is a weekly lecture series of invited external and internal experts in Biology that will highlight the broad nature of biology research. Students will achieve a comprehensive understanding of biology through reinforcement of key fundamental concepts and exposure to a wide range of sub-disciplines.

BIOL 810 Advanced Cell Biology (3 Credit Hours)
This course will cover selected current topics in cell biology that reflect recent advances in the field. Major topics include membranes and transport, signal transduction, cell adhesion and motility, cell cycle, apoptosis, and specialized cell functions. Students will read current research papers that describe the latest innovations in microscopic and molecular analysis of cellular function. This course is built on previous coursework in cell biology by reinforcing key fundamental concepts and performing a more in-depth examination of cellular mechanisms.
Prerequisites: Course background in cell biology is recommended

BIOL 811 Advanced Skills in Biology (2 Credit Hours)
This course provides hands-on training in cutting-edge methodologies for biological sciences research. Students will engage in supervised laboratory or field exercises, depending on their disciplinary focus, mastering advanced techniques, instrumentation, and data collection methodologies. By applying these methods to real research problems, this course aims to bridge theoretical knowledge with practical application, preparing students to contribute effectively to the advancement of biological research.

BIOL 812 Biological Microscopy (4 Credit Hours)
Lectures will cover theory and concepts of specimen preparation and operation of various microscopes used in the biological sciences. The laboratory experience will include specimen preparation to viewing.
Prerequisites: permission of the instructor

BIOL 813 Biology Education and Teaching (1 Credit Hour)
This graduate-level course is designed to prepare future faculty for effective teaching in the biological sciences at the university level. Students will explore pedagogical theories and practices specifically tailored for higher education, focusing on instructional strategies, assessment methods, and curricular design principles that foster student engagement and success. Through a combination of theory and hands-on applications, participants will critically examine the integration of technology, inclusivity, and active learning techniques in university classrooms. Emphasis will be placed on developing reflective teaching practices that empower future faculty to inspire and mentor the next generation of scientists.

BIOL 814 Biomedical Sciences Laboratory (2 Credit Hours)
Three laboratory rotations (6 credits) are required by the curriculum.
Prerequisites: approval of the program director

BIOL 816 Endocrinology (5 Credit Hours)
The biochemical integration of hormones and related agents on vertebrate physiology with emphasis on human endocrinology. Recent literature will be stressed.

BIOL 820 Systematic Ichthyology (3 Credit Hours)
A systematic survey of fishes emphasizing life history, anatomy, identification and classification.
Prerequisites: BIOL 520

BIOL 824 Neuromuscular Physiology (3 Credit Hours)
This course will provide a comprehensive discussion of the physiological and chemical properties of nerve and muscle cells.

BIOL 830 Emerging Infectious Diseases (3 Credit Hours)
Discussion on current studies into new and reemerging infectious diseases with an examination of the infectious agent and factors involved in disease emergence, prevention and elimination.
Prerequisites: A microbiology course

BIOL 831 Systematics and Speciation (3 Credit Hours)
Principles of systematic biology and discussion of speciation theory, with emphasis on generation, analysis, and interpretation of taxonomic data and application of these data to a better understanding of classification and speciation processes. Modern theories of evolutionary biology and phylogenetics will be stressed. A research paper is required.

BIOL 832 GIS in the Life Sciences (3 Credit Hours)
This course is designed to introduce students to geographic information systems through examples and applications in the life sciences.

BIOL 837 Advanced One Health (3 Credit Hours)
One Health is a concept that stresses the interconnectedness of human, animal, and environmental/ecosystem health and seeks an integrative approach to human and animal health issues. The concept provides a framework for examining complex health issues such as vector-borne and emerging infectious diseases, antimicrobial resistance, and food safety and security. In our globalized world, new approaches to preventing, treating, and controlling diseases are urgently needed as emerging diseases are increasing in frequency due to interconnected ecosystems and the close connections between humans and animals.
Prerequisites: An introductory One Health course (BIOL 437W or BIOL 537 or equivalent)

BIOL 840 Vaccinology (3 Credit Hours)
This course will explore a broad range of concepts important to the field of vaccinology. Primary literature will be used to discuss vaccine development topics such as vaccine design and production, delivery methods, adjuvants, One Health, and zoonotic vaccines. HIV, TB, malaria, influenza, and parasite vaccines will be included.

BIOL 845 Advanced Immunology (3 Credit Hours)
Current concepts in cellular and molecular immunology and host defense based on critical review of the primary literature.

BIOL 847 Responsible and Ethical Conduct of Research (3 Credit Hours)
The course will introduce students to the responsible conduct of science and scientific research.

BIOL 848 Functional Genomics and Proteomics in Animal Models (3 Credit Hours)
The purpose of this course is to show how animal models of human diseases can be created and analyzed using genomic and proteomic technologies. The course will overview high throughput methods of generating disease models in mice and describe ongoing efforts in this field. Attempts to identify molecular mechanisms of the disease will be presented with particular emphasis on drug target discovery.
Pre- or corequisite: An immunology course

BIOL 849 Biogeography (3 Credit Hours)
Emphasis on historical biogeography, utilizing both dispersal and vicariance models for explanations of the geographic distribution of organisms. Ecological explanations are also considered. Useful techniques for biogeographic analyses, such as comparison of area cladograms are discussed at length.

BIOL 850 Marine Benthic Ecology (4 Credit Hours)
Application of ecological principles at the community level to marine benthic environments. Discussion of community structure, animal-sediment relationships, roles of benthic communities in marine ecosystems.
Prerequisites: BIOL 515 or equivalent

BIOL 854 Phylogeny and Molecular Lecture and Laboratory (5 Credit Hours)
This course is intended to be an introduction to the processes and procedures used to reconstruct the evolutionary history of living organisms. Topics include project planning, sampling strategies, molecular techniques, and analytical and tree-building programs used to infer phylogeny. Lab provides computer experience in multiple phylogenetic software packages.
Prerequisites: Instructor approval required

BIOL 855 Molecular Genetics (3 Credit Hours)
Current molecular understanding of genetic processes will be reviewed. Applications to areas such as development and evolution will also be covered.

BIOL 856 Phylogeny and Molecular Systematics (5 Credit Hours)
This course is intended to be an introduction to the processes and procedures used to reconstruct the evolutionary history of living organisms. Topics include project planning, sampling strategies, molecular techniques, and analytical and tree-building programs used to infer phylogeny. Lab provides computer experience in multiple phylogenetic software packages.

BIOL 857 Statistics in Biology (4 Credit Hours)
Both a refresher course and an introduction to commonly used modern statistical methods for graduate students in Biology. The focus is on application and hypothesis testing with examples drawn from the #eld of biology. The course requires a substantial amount of homework and self-initiative outside the classroom.
Prerequisites: course background in statistics

BIOL 858 Molecular Ecology (4 Credit Hours)
Scientist are increasingly using molecular methods to help them address fundamental questions in the population ecology and evolution of biological species. This class will introduce graduate students to the basic concepts and methods in molecular evolution, phylogenetics and methods into their research. Theory and concepts from lecture will be illustrated through reading and discussion of current scientific literature. Students will also directly apply the course material to a class project investigating population structure of marine species from the tropical Indo-Pacific, for which they will be trained in methods of DNA extraction, PCR and sequencing. They will present their results orally in a mini-symposium at the end of the course.
Prerequisites: BIOL 671

BIOL 859 Foundations and Principles in Ecology (3 Credit Hours)
A survey of the seminal ideas and perspectives in historical and contemporary ecology. The course is designed to provide a broad overview of the important theoretical and conceptual paradigms in ecology.

BIOL 861 Ecological Sciences Internship (3-6 Credit Hours)
Internship experience.
Prerequisites: approval of advisory committee

BIOL 862 Restoration Ecology (3 Credit Hours)
This course will cover the field of environmental restoration guided by ecological theory and empirical research and connects with many broad themes in ecology, including physiology, genomics, biodiversity, conservation, species dispersal and migration, and population dynamics. This course will cover underlying principles guiding successful restoration, foundational and recent empirical research in this field, and restoration policies and practice.

BIOL 871 Vector-Borne Diseases (3 Credit Hours)
Study of the role of insects, ticks and other invertebrates in the transmission of disease. Different areas of disease transmission will be examined, including physiological and biochemical aspects of microbial survival in the vector and transmission to vertebrate hosts, as well as ecological aspects.

BIOL 872 Modeling and Simulation in Life Sciences (4 Credit Hours)
Course is designed to introduce students to modeling and simulation techniques using examples and applications in the life sciences.

BIOL 875 Grant Writing in Biology (3 Credit Hours)
Provides students with the skills to write competitive grant proposals to both private and federal funding sources (emphasis on NIH and NSF). Students will learn how to find the most appropriate funding mechanisms and how to position themselves to be competitive. Different grant writing formats will be illustrated through proposal development projects.

BIOL 880 Advanced Study in Biology (3 Credit Hours)
Under the guidance of members of the graduate faculty and with the approval of the program track coordinator, the student will carry out in-depth studies of selected topics relevant to the area of specialization. Extensive surveys and analyses of the literature. Written reviews, comprehensive and synoptic, and oral presentations are required of each student.

BIOL 881 Autoimmunity and Transplantation (3 Credit Hours)
Major research advances in immunology have resulted in substantially increasing the understanding of the molecular and cellular basis of autoimmune diseases and transplantation. The course will focus on these new advances to improve the understanding of these diseases. Topics will include a brief review of the immune system; multiple sclerosis, arthritis and other immune diseases; and the molecular and cellular basis of transplantation and chronic rejection of organ grafts.
Prerequisites: course background in cell biology and immunology recommended

BIOL 889 Gross Anatomy (6 Credit Hours)
An intense study of all systems from a regional approach. Extensive dissections required in lab. Clinical applications utilized.
Prerequisites: Anatomy and Physiology course

BIOL 890 Biomedical Doctoral Seminar (2 Credit Hours)
Doctoral students in the Biomedical Sciences program will attend seminars, learn how to properly give a seminar, and present a seminar on their own research.

BIOL 895 Special Topics in Biology (1-4 Credit Hours)
Study of special topics.
Prerequisites: permission of the instructor

BIOL 898 Research in Biology (1-9 Credit Hours)
Supervised research.

BIOL 899 Dissertation (1-6 Credit Hours)

BIOL 998 Master's Graduate Credit (1 Credit Hour)
This course is a pass/fail course for master's students in their final semester. It may be taken to fulfill the registration requirement necessary for graduation. All master's students are required to be registered for at least one graduate credit hour in the semester of their graduation.

BIOL 999 Doctoral Graduate Credit (1 Credit Hour)
This course is a pass/fail course doctoral students may take to maintain active status after successfully passing the candidacy examination. All doctoral students are required to be registered for at least one graduate credit hour every semester until their graduation.