

BIO - Biology Graduate Program

Biology Program

Biology: Aquatic Science Concentration

Biology: Cellular and Molecular Biology Concentration

Biology: Environmental Science Concentration

Biology: Physiology Concentration

Director: Anita Davelos

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Biology: Nurse Anesthesia Concentration

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www.uwlax.edu/academics/grad/biology/ (<https://www.uwlax.edu/academics/grad/biology/>)

The Master of Science in Biology Program is a multi-disciplinary program that allows students advanced study in several traditional and non-traditional areas of biology. Students have the option of a general M.S. degree in biology (Build your own degree!) or may obtain an M.S. degree in biology with a formal concentration in aquatic science, cellular and molecular biology, nurse anesthesia, environmental science, or physiology.

Admission to the program is based, in part, on undergraduate grade point average (GPA), letters of recommendation, and on individually prescribed undergraduate course work to meet prerequisite requirements for each concentration. Each student will choose a major advisor and an advisory committee before the first semester of residence. This committee will assist the student in drafting the student's plan of study, which will dictate the student's curriculum for the ensuing semesters.

All students complete a capstone experience. Students in the general M.S. option and in all but one of the concentrations complete a thesis or seminar paper. Students obtaining the M.S. in biology with a nurse anesthesia concentration instead complete extensive clinical training in affiliation with Mayo Clinic Health System - Franciscan Healthcare, and most will go on to complete additional advanced degree coursework with Viterbo University.

Program length

The Master of Science (M.S.) in biology programs are typically two-year programs. Number of credits required varies by program. The program length is based on how long the required UWL coursework would take to complete for a full-time student who does not need to complete any prerequisite coursework. Program length may be extended if students attend part-time (if approved by program) or due to the requirements of an individual student's plan of coursework, research, or capstone project.

2025-26 Faculty/Staff

The following is the graduate faculty as of the publication date of this catalog. This list will not be updated again until the next catalog is published in July.

Professor

Scott Cooper

Tisha King-Heiden

Barrett Klein

Jennifer Klein

Sumei Liu

Jennifer Miskowski

Todd Osmundson

Gregory Sandland

Eric Strauss

Meredith Thomsen

Associate Professor

Sierra Colavito

Anita Davelos

Anne Galbraith

Anton (Tony) Sanderfoot

David Schumann

Christine Schwartz

Bradley Seebach

Ross Vander Vorste

Jaclyn Wisinski

Alder Yu

Assistant Professor

Cord Brundage

Doug Brusich

Arthur Grupe II

Jessica Judson

Jaspreet Kaur

Markus Mika

Adam Schneider

Mary Zimmerman

Teaching Professor

Faye Ellis

Associate Teaching Professor

Kristin Greany

Assistant Teaching Professor

Jason Freund

Graduate degrees

- Biology - MS (<https://catalog.uwlax.edu/graduate/programrequirements/biology/biology-ms/>)
- Biology - MS: Aquatic science concentration (<https://catalog.uwlax.edu/graduate/programrequirements/biology/biology-aquatic-science-concentration-ms/>)
- Biology - MS: Cellular and molecular biology concentration (<https://catalog.uwlax.edu/graduate/programrequirements/biology/biology-cellular-molecular-biology-concentration-ms/>)
- Biology - MS: Environmental science concentration (<https://catalog.uwlax.edu/graduate/programrequirements/biology/biology-environmental-science-concentration-ms/>)
- Biology - MS: Nurse anesthesia concentration (<https://catalog.uwlax.edu/graduate/programrequirements/biology/biology-nurse-anesthesia-concentration-ms/>)
- Biology - MS: Physiology concentration (<https://catalog.uwlax.edu/graduate/programrequirements/biology/physiology-concentration-ms/>)

Courses

BIO 401/501 Cr.4

Comparative Vertebrate Anatomy

Comparative anatomy is fundamental for investigating vertebrate function and evolutionary biology. The course integrates anatomy, evolution, and development of the chordate body, system-by-system and across the group's diversity from flying and running vertebrates to sea squirts and lampreys. Labs will raise insight and skill through comprehensive, respectful dissection of minks, dogfish sharks, lampreys, and representative organ specimens. One lab period per week is dedicated to a main dissection and exploration of anatomy. The next lab period integrates lecture, dissection refinement, and collaborative reinforcement of learning. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 2, Lab 4. Offered Spring.

BIO 404/504 Cr.3

Plant Systematics and Evolution

This course comprises four broad themes: the evolutionary history and trajectory of major lineages of plants, worldwide diversity within these groups, the scientific tools and questions that inform this knowledge, and a survey of the vascular flora of Wisconsin. Principles of phylogenetic biology, plant taxonomy, evolution of plant diversity, as well as current research areas are covered. Lab activities and required field trips focus on practical identification. This course is taught largely at an undergraduate level. Graduate students have additional course requirements/expectations. Lect. 1, Lab 4. Prerequisite: BIO 203. Offered Spring - Odd Numbered Years.

BIO 405/505 Cr.2

Aquatic and Wetland Vascular Plants

Identification and collection of vascular plants of aquatic and marsh habitats with emphasis on adaptive morphology and ecology of local species. Field trips required. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 1, Lab 2. Prerequisite: BIO 203 or BIO 304. Offered Fall - Even Numbered Years.

BIO 406/506 Cr.4

Parasitology

A survey of the major groups of animal parasites with regard to their taxonomy, morphology, life histories, host-parasite relationships, and economic importance. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 2, Lab 4. Prerequisite: BIO 203 or BIO 210 or BIO 303. Offered Fall.

BIO 408/508 Cr.4

Developmental Biology

An exploration of the cellular and molecular mechanisms that underlie embryonic development in several model organisms. Topics include fertilization, regulation of gene expression, cell fate determination, stem cells, early pattern formation, morphogenesis of tissues/organs, and limb formation. The course primarily focuses on animal models with an emphasis on evolutionarily conserved processes, structures, and molecular pathways. Technological advances and relevance to human development and disease are highlighted throughout. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 2, Lab 4. Prerequisite: BIO 203 or BIO 210 or BIO 303; BIO 306 or MIC 416; BIO 315. Offered Spring.

BIO/PAS/PTS 509 Cr.3

Human Gross Anatomy

This comprehensive course provides an in-depth examination of human gross anatomy for graduate students in Physical Therapy (PT), Physician Assistant (PA), and Certified Registered Nurse Anesthetist (CRNA) Programs. It covers the musculoskeletal, neurological, urogenital, gastrointestinal, and cardiopulmonary systems, emphasizing functional anatomy, development, and topographic correlations. The course integrates biomechanical principles and clinical applications relevant to each discipline, focusing on physical assessment techniques, surgical considerations, anesthesia management, and therapeutic interventions as appropriate. By bridging anatomical knowledge with practical skills, this course aims to enhance students' clinical reasoning, diagnostic capabilities, and treatment planning across these allied health professions, providing a robust foundation for their respective fields of practice. Prerequisite: admission to the Biology CRNA Program, PAS Program, or DPT Professional Program; concurrent enrollment in BIO/PAS/PTS 510 under same department. (Cross-listed with BIO/PAS/PTS; may only earn credit in one department.) Offered Summer.

BIO/PAS/PTS 510 Cr.3

Applied Human Gross Anatomy

This comprehensive course provides an in-depth examination of human gross anatomy for graduate students in Physical Therapy (PT), Physician Assistant (PA), and Certified Registered Nurse Anesthetist (CRNA) Programs. The course covers the musculoskeletal, neurological, urogenital, gastrointestinal, and cardiopulmonary systems; emphasizing functional anatomy, development, and topographic correlations. The course integrates biomechanical principles and clinical applications relevant to each discipline focusing on physical assessment techniques, surgical considerations, anesthesia management, and therapeutic interventions as appropriate. By bridging anatomical knowledge with practical skills, this course aims to enhance students' clinical reasoning, diagnostic capabilities, and treatment planning across these allied health professions, providing a robust foundation for their respective fields of practice. Prerequisite: admission to the Biology CRNA Program, PAS Program, or DPT Professional Program; concurrent enrollment in BIO/PAS/PTS 509 under same department. (Cross-listed with BIO/PAS/PTS; may only earn credit in one department.) Offered Summer.

BIO 412/512 Cr.4

Mycology

A survey of all the major groups of fungi of the fungal kingdom (and relatives) in terms of systematics, anatomy, morphology, ecology, physiology, genetics, evolutionary relationships, and human and plant pathology. Laboratory includes microscopic and macroscopic study of the fungi, as well as making a collection of cultures and of fungal reproductive structures (including mushrooms) from selected groups. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 2, Lab 4. Prerequisite: BIO 203 or BIO 304 or MIC 230. Both the microbiology course and one of the biology courses are strongly recommended. Offered Fall.

BIO 413/513 Cr.3

Medical Mycology

A study of the increasing number of medically important fungi, including the yeasts, molds, other fungi, and actinomycetes that are pathogenic to humans and other animals. Emphasis is on laboratory techniques for isolation and identification of these pathogenic fungi. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 2, Lab 2. Prerequisite: BIO 412/512 or MIC 230. Offered Spring.

BIO 414/514 Cr.3

Freshwater Invertebrate Zoology

This course introduces the ecology and taxonomy of the metazoan, non-parasitic freshwater invertebrates. This is an extensive course designed to provide a foundation for taxonomic knowledge, and basic understanding of the biology and ecology of freshwater invertebrates for advanced students in aquatic and environmental sciences. Lectures focus on ecology; labs on taxonomy and quantitative skills. A student reference collection and weekend field trips are required. Graduate students have additional course requirements/expectations. Lect. 2, Lab. 2. Prerequisite: BIO 203 or BIO 210 or BIO 341. Offered Fall - Even Numbered Years.

BIO 419/519 Cr.3

Quantitative Methods in Ecology

An introduction to field and laboratory procedures used by ecologists to describe and analyze the interactions between organisms and their environments. The course will emphasize quantitative techniques, including the use of computer technology, for collecting, recording and interpreting ecological data. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 2, Lab 2. Prerequisite: BIO 307, BIO 341, or equivalent coursework; STAT 145, MTH 265, or equivalent experience with statistics. Offered Fall.

BIO 420/520 Cr.3

Applied Mycology

In this course students study the history of fungi within the context of commercial industry. The course is broadly organized under four units: 1) fungal cultivation techniques and the production of fungal food products such as tempeh, blue cheeses, and cured meats; 2) fungal fermentation and products (e.g., alcohol, miso, soy sauce); 3) use of fungi as antimicrobial-producing agents through selective screening of environmental samples against common bacteria; and 4) the issues fungi cause in commercial industries (i.e., agricultural pathogens, post-harvest rots, food spoilage, etc.). Additionally, the role of fungi in production of textiles as enzyme washes, dye agents, and production of packing materials from fungi are discussed. This course is taught largely at an undergraduate level. Graduate students have additional course requirements/expectations. Lect. 2, Lab 2. Prerequisite: BIO 105, BIO 203, CHM 103, or MIC 230. Offered Spring - Even Numbered Years.

BIO 421/521 Cr.3

Comparative Vertebrate Endocrinology

A comprehensive study of the production, regulation, structure, molecular to whole-body actions, metabolism, and excretion of biochemical signaling molecules across vertebrates with a focus on amphibians, fish, birds, and mammals. Hormone and neurotransmitter pathways will be examined with relationship to evolutionary and environmental influences using lecture, review of primary literature, and case studies. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 313 or BIO 458/558. Offered Spring.

BIO 422/522 Cr.3

Ichthyology

A study of the taxonomy, anatomy, physiology, and ecology of fish, with emphasis on the fresh water fishes. Lect. 2, Lab. 2. Prerequisite: BIO 203 or BIO 210 or BIO 303. Offered Fall - Odd Numbered Years.

BIO 423/523 Cr.3

21st Century Mycology

This course covers an in-depth examination of contemporary research on fungi, including systematics and evolution, genetics, molecular ecology, biotechnology, bioremediation, physiology, plant or animal pathology, and/or developmental biology, through critical analysis and discussion of primary literature sources. Readings exemplify major questions, experimental approaches, and methods, and are analyzed to identify important contemporary research themes, paradigm shifts, and unanswered questions. Graduate students have additional course requirements/expectations. Prerequisite: BIO 306; BIO 412/512. Offered Occasionally.

BIO 424/524 Cr.3

Human Endocrinology

A comprehensive study of the production, regulation, structure, molecular to whole body actions, metabolism, and excretion of biochemical signaling molecules in humans. The classical and more recently recognized neurotransmitter and hormone pathways and clinical and pharmacology considerations of each will be explored with lectures, primary literature and case studies. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 313, BIO 458/558, or equivalent coursework. Offered Fall.

BIO 428/528 Cr.3

Advanced Nutrition for the Health Professions

A comprehensive study of nutrition-related diseases and nutrition assessment, evaluation, and management in clinical settings that people working in healthcare may encounter. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 313 or NUT 200. Offered Fall, Spring.

BIO 429/529 Cr.3

Evolution

Consideration of the principles and the record of organic evolution of plants and animals. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 306. Offered Spring.

BIO 432/532 Cr.2

Biology of Cancer

A survey of the current knowledge of cancer biology. The course will include lectures on a wide range of cancer topics including: characteristics of cancer cells, carcinogenesis, cancer genes, tumor classification, invasion, metastasis, inheritance, immunology, drug development, treatment, and prevention. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 303 or BIO 313; BIO 306 or MIC 416. Offered Fall, Spring.

BIO 435/535 Cr.3

Molecular Biology

This course is a study of molecular biology with an emphasis on eukaryotic systems. The course focuses on the molecular aspects controlling biological processes. The impact of recombinant DNA technology on biotechnology and medicine are also examined. This course is taught largely at an undergraduate level. Graduate students have additional course requirements/expectations. Prerequisite: BIO 306 or MIC 416/516; BIO 315 or CHM 325 or CHM 417 or MIC 425/525. BIO 436/536 is an optional laboratory which can be taken concurrently. Offered Fall, Spring.

BIO 436/536 Cr.1

Molecular Biology Laboratory

A study of molecular biology with an emphasis on eukaryotic systems. Laboratory emphasis is on recombinant DNA technology, current techniques used to express recombinant proteins in eukaryotic cells, computer based DNA analysis, macromolecular modeling using computers, and quantitative assay techniques. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lab. 3. Prerequisite: taken concurrently with BIO 435/535. This lab is optional for those enrolled in BIO 435/535. Offered Fall, Spring.

BIO 437/537 Cr.3

Plant Growth and Development

Discussion of experiments and analysis of research data obtained from the living plant. Prerequisite: BIO 203 or BIO 304 or equivalent. Offered Occasionally.

BIO 439/539 Cr.3

Plant Anatomy

A detailed examination of plant structure and development as revealed with the light and electron microscopes. Primarily seed plants will be examined. Structure and development will be studied as a means by which plants cope with their ecology, evolution and function. Lect. 2, Lab. 2. Prerequisite: BIO 203 or BIO 304 or an equivalent general botany course. Offered Occasionally.

BIO/MIC 440/540 Cr.2

Bioinformatics

In this course, students will use computers to study and compare the sequence of nucleotides in DNA or RNA, or the amino acids in a protein. Computers also are used to examine the three dimensional structure of protein. Being able to manipulate and study this information is the basis for the current revolution in biotechnology. Topics include evolution, taxonomy, genomics and understanding disease. This course provides students an opportunity to explore the relationships between biology, microbiology, chemistry, and computer science. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 1, Lab 2. Prerequisite: BIO 306 or MIC 416/516. (Cross-listed with BIO/MIC; may only earn credit in one department.) Offered Spring, Winter.

BIO 441/541 Cr.3

Aquatic Toxicology

This course studies the lethal and sublethal effects of chemical contaminants on aquatic ecosystems and humans. Topics covered include environmental legislation, chemical distribution and fate in the environment, methods of toxicity testing, assessment of exposure and risk, effects of chemical contaminants on humans, fish and aquatic invertebrate populations, communities and ecosystems, and toxicity of specific chemical groups. This course is taught largely at an undergraduate level. Graduate students have additional course requirements/expectations. Prerequisite: BIO 307 or BIO 341; CHM 104. Offered Spring - Odd Numbered Years.

BIO/MIC 442/542 Cr.3

Plant Microbe Interactions

This course explores in-depth various ways that plants interact with microbes in the environment, at the macroscopic, cellular, and molecular levels. Case studies include both parasitic and mutualistic (symbiotic) interactions. Microbes include fungi, bacteria, nematodes, and viruses. Includes plant pathology and studies of the beneficial relationships between plants and microbes. Inquiry-based labs are integrated into the lecture and discussion sessions. This course is taught largely at an undergraduate level. Graduate students have additional course requirements/expectations. Lect. 2, Lab 2. Prerequisite: BIO 203 or MIC 230. (Cross-listed with BIO/MIC; may only earn credit in one department.) Offered Fall - Odd Numbered Years.

BIO 443/543 Cr.3

Molecular Mechanism of Disease and Drug Action

A survey of the leading non-infectious and non-cancerous diseases in the industrialized world. This course will explore the molecular mechanisms of disease, clinical symptomatology, and pharmacological treatment. Students will be expected to conduct thorough research on a given disease and present their results in a poster session. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 306, BIO 313; CHM 300 or CHM 304. Offered Spring.

BIO 444/544 Cr.4

Entomology

Insects and their close relatives are ubiquitous, affecting humans' lives in profound ways. We will investigate the anatomy, behavior, evolution, and ecology of insects, as well as how insects impact human culture. Discussions, presentations, illustrations, field research, curation of specimens, and other activities offer opportunities for students to apply insect research knowledge and skills. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 3, Lab 2. Prerequisite: BIO 203. Offered Fall - Odd Numbered Years.

BIO 446/546 Cr.3

Animal Behavior

We will explore factors that help to explain how and why animals behave as they do. Example topics include social behavior, learning, symbiotic relationships, sensory systems, communication, mating systems, defense, and parental care. Emphasis will be placed on non-human animals. Discussions, presentations, illustrations, and other activities offer opportunities for students to apply behavioral research knowledge and skills. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Offered Annually.

BIO 447/547 Cr.3

Standard Methods/Quality Assurance Water Analyses

This course will instruct students on the use of standard methods for analyses of selected biological, chemical, and physical constituents commonly included in water quality analyses. Quality assurance procedures, including Good Laboratory Practice Standards (GLPS) will be integrated into all activities. Materials covered include: principles of methods used; evaluation of precision, bias, and contamination; proper reporting and interpretation of results; and environmental sources and significance of constituents analyzed. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 1, Lab 4. Prerequisite: BIO 203 or BIO 210 or BIO 303 or BIO 304, and three semesters of college chemistry. BIO 341 recommended. Offered Spring.

BIO 449/549 Cr.3

Advanced Microscopy and Biological Imaging

Principles and techniques used in modern microscopy and biological image analysis. Emphasis will be on student projects to become proficient at confocal, fluorescence, and scanning electron microscopy. Students will also learn specimen preparation, digital imaging, and image processing and analysis for biological applications. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 2, Lab 2. Prerequisite: BIO 315 or MIC 230. Offered Fall - Even Numbered Years.

BIO 456/556 Cr.4

Plant Ecology

Conservation biology, ecological restoration, and predicting the effects of climate change all require an understanding of plant ecology. This course is focused on the interactions among plants, other organisms, and the environment. We will work across the individual, population, and community levels, and emphasize an exploratory approach to plant ecology. Class activities will include lectures, the discussion of ecological journal articles, and carrying out student-designed experiments. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 3, Lab 2. Offered Fall - Even Numbered Years.

BIO 458/558 Cr.4

Comparative Animal Physiology

This course has both a lecture and a laboratory component. It aims to provide a thorough understanding of animal physiology from a comparative perspective. Emphasis will be placed on the basic physiological principles by which animals perform their life sustaining functions. Lectures will focus on vertebral animals, but will span both invertebrate and vertebrate models to illustrate how largely divergent groups have evolved different (or similar) mechanisms to cope with environmental challenges. The laboratory component will provide an active learning environment and hands-on experience in physiological experimentation. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Lect. 3, Lab 2. Offered Fall.

BIO 460/560 Cr.1-4

Symposium in Biology

Studies in biology of interest to specific groups. Varying topics will be offered at intervals with a specific title assigned to each. May be staffed by resident faculty or visiting lecturers. Other departments may be invited to participate. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Repeatable for credit - maximum 16. Variable offerings - check registration schedules. Prerequisite: four semesters of biology. Offered Occasionally.

BIO 561 Cr.1-4

Directed Studies

This course provides opportunity for directed readings or presentation of material not available in departmental graduate courses. Repeatable for credit - maximum four. Consent of instructor. Offered Fall, Spring.

BIO 464/564 Cr.3

Stream and Watershed Ecology

Introduces key concepts and theory pertinent to understanding and managing fluvial ecosystems (rivers and streams) and their watersheds. The course will emphasize rivers as large-scale physical and biological systems. Course work includes a comparative case study of distinctive types of temperate, tropical, and polar rivers. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 341 or BIO 307. Offered Spring.

BIO 465/565 Cr.3

Neurophysiology

An examination of the nervous system beginning at the cellular level and working up to neuronal systems. Topics covered include the ionic basis of membrane potentials, synaptic communication, organization of functional circuits of neurons, and systems within the brain and/or spinal cord which control learning and memory, vision and motor function. Exploration of these fundamental neurophysiology topics form the basis for understanding a variety of student-selected topics which will be covered later in the semester. Late-semester topics often include higher-order aspects of brain function or challenges to the nervous system, such as the repair of brain or spinal cord injury, degenerative disease states, dyslexia, or consciousness. BIO 467/567 is an optional laboratory course which can be taken concurrently. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 105, CHM 103, and either BIO 312 or NEU 200. Offered Spring.

BIO 466/566 Cr.3

Human Molecular Genetics

A study of the basic principles of heredity in humans. Focus will be on modern molecular techniques used in isolating human disease genes and modes of inheritance of human traits and disorders. Ethical issues in human genetics will also be discussed. This course is taught largely at a graduate level. BIO 468/568 is an optional laboratory course which can be taken concurrently. Prerequisite: BIO 306. Offered Fall.

BIO 467/567 Cr.2

Neurobiology Laboratory Techniques

An introduction to common laboratory techniques in neurobiology, including electrophysiology with invertebrate preparations, mammalian neuronal cell culture, and computational modeling. Students will receive training in techniques while performing classical experiments, then design their own novel experiments and carry them out. Lab. 4. Prerequisite: BIO 312; BIO 465/565 or concurrent enrollment. Offered Spring - Odd Numbered Years.

BIO 468/568 Cr.1

Human Molecular Genetics Lab

A study of the techniques used in doing research in human molecular genetics with a focus on commonly used model organisms in the study of human genetic disorders. Laboratory emphasis is on phenotype analysis, library screening, DNA microarray analysis, gene mapping, and bioinformatics. This course is taught largely at a graduate level. This lab is optional for those enrolled in BIO 466/566. Lab 3. Prerequisite: BIO 306. BIO 466/566 must be taken concurrently. Offered Fall.

BIO 473/573 Cr.3

Marine Biology

Marine biology is an interdisciplinary field that includes elements of geology, physics, chemistry and biology. Students will gain an introduction to how biological organisms deal with varying physical, geological and chemical conditions found in marine ecosystems. Emphasis will be placed on current conservation concerns and marine invertebrate diversity. Prerequisite: BIO 203 and CHM 103. Offered Spring - Odd Numbered Years.

BIO 476/576 Cr.3

Ecosystem Ecology

Ecosystems include the living and non-living components of an environmental system and have emergent properties that can only be understood by examining the system as a whole. This course will examine advanced ecological topics centered around the structure and function of aquatic and terrestrial ecosystems. Topics covered will include the development of the ecosystem concept, ecosystem succession, production/decomposition, energy transfer in food webs, and nutrient cycling. The course will consist of classroom lectures, problem sets, and reading/discussion of relevant literature. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: BIO 307 and one semester of chemistry. Offered Spring - Even Numbered Years.

BIO 483/583 Cr.3

Cell Signaling

Cell signaling controls the inner workings of organisms, allowing them to survive, reproduce, develop, respond, and adapt. Course topics will include how cells perceive changes in the environment by receptors, how they transmit the signal from receptors to other signaling molecules, and how signaling results in a cellular response. The course will integrate cell biology, genetics, and biochemistry. It will also complement several biology topics, such as biology of cancer, developmental biology, molecular biology, and endocrinology. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Prerequisite: CHM 325, CHM 417, or both BIO 306 and BIO 315 (BIO 315 may be taken concurrently). Offered Annually.

BIO 488/588 Cr.3

Mammalogy

A study of the diversity and biology of mammals. The origins and evolutionary history of mammals grounds a survey of modern mammalian groups, including their phylogenetic relationships, ecology, adaptations, and complex behaviors. Wisconsin species will be highlighted. Graduate students will assist with instruction on the mammal groups of their choice. Prerequisite: graduate standing in biology. Offered Fall.

BIO 490/590 Cr.1-3

Current Topics in Biology Education

Biological researchers produce new discoveries almost daily. The purpose of this course is to train K-12 pre-service and in-service teachers in the current technologies and theories used in biology and to demonstrate the current approaches to teaching these materials. This course is taught largely at an undergraduate level. Graduate students will have additional course requirements/expectations. Repeatable for credit under different topics. Departmental option for pass/fail grading. Pass/Fail grading. Offered Occasionally.

BIO 700 Cr.2

Biology Graduate Program Orientation

First semester course for all biology/microbiology M.S. students. Introduction to program policies and timelines, responsible conduct of research/ethics, reference management tools, and design of a research plan. Students will prepare a grant application. Prerequisite: admitted to a Biology or Microbiology Graduate Program. Offered Fall.

BIO 701 Cr.4

Communication in the Biological Sciences

This course covers in detail the preparation and submission of scientific manuscripts for publication and the presentation of papers at scientific conferences. Topics covered include experimental design, preparation of manuscript sections, figures, and tables; writing with clarity, precision, and word economy; dealing with journal editors and reviewers; reviewing and editing of manuscripts; presentations at scientific conferences; preparation of visual aids; and communicating with the public, the press, and politicians. Lect. 3, Lab 2. Offered Spring.

BIO 713 Cr.2

Physiology of Drug Action

A study of the general principles of pharmacodynamics and pharmacokinetics of drugs in human systems with emphasis on the physiological responses at the cellular and organ levels. Prerequisite: BIO 718 or concurrent enrollment. Offered Occasionally.

BIO/MIC 714 Cr.3

Advanced Genetics

The application of molecular-genetic analysis to problems in modern biology. The course will cover the fundamentals of genetic analysis in both prokaryotic and eukaryotic systems. Assigned readings from current literature will be discussed and evaluated. A variety of topic areas will be considered including ecology, biotechnology, bioremediation, food science, medicine and basic research. Prerequisite: a previous course in genetics, microbial genetics, or molecular biology. (Cross-listed with BIO/MIC; may only earn credit in one department.) Offered Spring - Odd Numbered Years.

BIO 715 Cr.2

Pathophysiology I

A study of diseases of the human central nervous system, pulmonary, cardiovascular, and renal systems with an emphasis on pathophysiology, treatment, and interaction with other organ systems. Prerequisite: BIO 718; BIO 719; admission to the Biology Certified Registered Nurse Anesthetist (CRNA) program. Offered Fall.

BIO 716 Cr.3

Current Topics in Physiology

Consideration of selected topics in physiology such as advanced cellular physiology, membrane and endocrinological physiology, and systemic physiology. Assigned readings will be largely from current literature. Offered Occasionally.

BIO 717 Cr.1

Pathophysiology II

A study of diseases of the human hepatic, gastrointestinal, immune, neuromuscular, and endocrine systems with an emphasis on pathophysiology, treatment, and interaction with other organ systems. Prerequisite: BIO 718; BIO 719; admission to the M.S. Biology Certified Registered Nurse Anesthetist (CRNA) Program. Offered Spring.

BIO 718 Cr.4

Advanced Human Physiology I

An in-depth study of the physiology (including associated anatomic structures) of human organ systems. Covers basic cell physiology, introduction to endocrinology, and the reproductive, nervous, and muscular systems. Prerequisite: B.S. in biology or allied health related field. Offered Fall.

BIO 719 Cr.4

Advanced Human Physiology II

An in-depth study of the physiology (including associated anatomic structures) of human organ systems. Covers the respiratory, cardiovascular, blood, immunologic, digestive and urinary systems. Prerequisite: BIO 718. Offered Spring.

BIO 720 Cr.2

Research in Anesthesia

The student will conduct a critical review and analysis of the primary literature and/or patient records (after IRB approval) in the area of clinical anesthesia or applied physiology. The results and analysis will be summarized and presented in a poster format. Students will be required to present their poster at a professional meeting. Prerequisite: BIO 718; BIO 719; admission to the M.S. Biology Certified Registered Nurse Anesthetist (CRNA) Program. Offered Summer.

BIO/MIC 721 Cr.1-2

Directed Studies

Directed readings or presentation of material not available in formal departmental courses. Repeatable for credit - maximum four between BIO and MIC. (Cross-listed with BIO/MIC.) Consent of instructor. Offered Occasionally.

BIO 725 Cr.1-3

Forum in Biology

An in-depth examination of selected topics in biology through critical analysis of the primary literature. Participants will be required to read and discuss the experimental design, methods, results and major conclusions of scientific research. Repeatable for credit - maximum six. Variable offerings - check registration schedules. Offered Occasionally.

BIO 726 Cr.1-3

Advanced Laboratory Techniques in Biology

Development of accessory research skills in specialized areas of biology. Repeatable for credit - maximum six. Variable offerings - check registration schedules. Offered Occasionally.

BIO 732 Cr.2

Effective Teaching Strategies for Grad Teaching Assts in the Science Lab

This course aims to improve proficiency of graduate teaching assistants in the science laboratory. Topics covered may include, but are not limited to, students learning styles, lecture and question techniques, design of assessment tools, portfolio development, and grading techniques. Offered Fall.

BIO/MIC 751 Cr.1

Graduate Seminar

Oral presentation and discussion of student-selected topics in biology and microbiology. Repeatable for credit - maximum two. (Cross-listed with BIO/MIC.) Offered Fall, Spring.

BIO 761 Cr.2

Research and Seminar in Biology

Principles of research in biology. As part of the requirements for this course and for the degree, each student must complete an acceptable scientific communication (such as a seminar paper, manuscript, or poster) unless pursuing Plan A and writing a master's thesis. Offered Fall, Spring, Summer.

BIO 779 Cr.1-2

Biology Laboratory Assistant

Allows graduate students to gain experience in assisting with preparation and teaching 300 and 400 level laboratory-based courses in conjunction with the regular instructor. Students will be expected to assist in preparation of course materials, demonstrate proper techniques, and evaluate students' performance. Repeatable for credit - maximum three. Lab. 2-6. Prerequisite: graduate standing. Not applicable to students assisting in 100 or 200 level courses. Consent of instructor. Offered Fall, Spring.

BIO 799 Cr.1-9

Research: Master's Thesis

Independent research on a problem selected for a thesis under the direction of an assigned staff member. For students following Plan A. Repeatable for credit - maximum 15. Maximum of six credits applicable to the M.S. in biology degree. Offered Fall, Spring, Summer.