Biology

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Programs

- Biology, M.S. *master*

Biology, M.S. *master*

Required Credits: 30 (Thesis) or 36 (Non-Thesis)
Required GPA: 3.0

Biology, MS

Pathway 1: Thesis Option

I. REQUIRED CORE
Complete the following courses:

- BIOL 6338 Advanced Science Communication (3 credits)
- BIOL 6350 Computer Applications in Statistics (3 credits)
- BIOL 6890 Grants and Contracts (2 credits)

Must be taken 4 times over 4 semesters for 4 credits:

- BIOL 6880 Seminar (1 credit)

II. REQUIRED ELECTIVES
Select, with consent of advisor, a minimum of 12 semester credits of graduate level courswork in Biology or related field:

III. REQUIRED RESEARCH THESIS
Complete the following course for 6 credits:

- BIOL 6990 Thesis (1-3 credits)

COMPETENCY REQUIREMENT

Statistics: A working knowledge of applied statistics. This requirement my be satisfied by successfully completing BIOL 6350 Computer Applications in Statistics (3 credits).

Pathway 2: Non-Thesis Option

I. REQUIRED CORE
Complete the following courses:

- BIOL 6330 Current Topics in Biology (3 credits)
- BIOL 6338 Advanced Science Communication (3 credits)
- BIOL 6340 Controversies in Biology (3 credits)
- BIOL 6350 Computer Applications in Statistics (3 credits)
- BIOL 6450 Trajectories in Biology: Past, Present, and Future (3 credits)
- BIOL 6890 Grants and Contracts (2 credits)

II. REQUIRED ELECTIVES

Select, with consent of advisor, a minimum of 16 semester credits of graduate level courswork in
Biology or related field:

III. REQUIRED CAPSTONE (Note: Completed in student's final semester.)

- BIOL 6899 Capstone (3 credits)

COMPETENCY REQUIREMENT

Statistics: A working knowledge of applied statistics. This requirement my be satisfied by successfully completing BIOL 6350 Computer Applications in Statistics (3 credits).

Biology Courses

BIOL 5030 Wetland Delineation and Classification (3 credits)
This training course for the identification, delineation, and classification of wetlands covers the major types of wetlands and their general delineation procedures. Hydrological, soil, and vegetation characteristics will be used to identify and map wetland boundaries. Focuses on current regulations as established by the US Army Corps of Engineers' 1987 Wetland Delineation Manual with additional regulations specific for the state of Minnesota. Satisfies the requirements for basic delineation training as specified by the Corps of Engineers and certification programs in many states.

BIOL 5120 Soils (4 credits)
Introduction to principles of soil genesis, classification, physical and chemical properties, and biological significance. Lecture and laboratory.

BIOL 5200 Freshwater Invertebrates (4 credits)
Morphology and functional roles of representative freshwater invertebrates, their ecological and habitat interrelationships. Lecture and laboratory.

BIOL 5210 Parasitology (4 credits)
The biology of animal parasites, their identification, biochemistry, immunology, and epidemiology. Lecture and laboratory.

BIOL 5250 Human Anatomy (4 credits)
Anatomical structure of the human body, from individual organ systems to the integrated whole.

BIOL 5260 Human Physiology (4 credits)
Physiological and pathophysiological principles and control mechanisms of organ systems within humans. Lecture and laboratory.

BIOL 5270 Histology (4 credits)
Microscopic anatomy of vertebrate tissues and organs with functional correlations. Lecture and laboratory. Prerequisites: BIOL 5250, BIOL 5260

BIOL 5299 Virology (3 credits)
This course explores virology, which is the study of viruses that infect all manner of life on earth. We will focus on animal viruses and those that impact human health. Important discoveries from viruses that infect microbes, plants, and non-human animals will be included. Prerequisite(s): One year introductory biology or consent of instructor.

BIOL 5310 Entomology (3 credits)
The biology of insects and their importance.

BIOL 5330 Upland Wildlife Management (3 credits)
An advanced pre-professional course for majors in natural resources, biology, and related fields. Lectures cover the history, philosophy, evolution, and application of wildlife management with a focus on upland wildlife as a renewable, sustainable natural resource. The course fulfills some professional certification requirements of The Wildlife Society and is recommended for students planning graduate study or employment in natural resources management.

BIOL 5337 Science Communication (3 credits)
This online course includes training in the skills, tools, and habits of mind of the practicing scientist. These skills include navigating and understanding the scientific literature, framing evidence-based and model-driven scientific questions, proposing and testing hypotheses, conducting research responsibly and ethically, analyzing and visualizing data, and communicating scientific rationale and results in lab meetings, presentations, research funding applications, and job searches.

BIOL 5339 Bioethics (3 credits)
In this online Bioethics course we will grapple with the many philosophical, ethical, and practical questions created by advances in medicine and biology using a combination of readings, case studies, scientific literature, and popular culture. The course has undergraduate and graduate sections and is intended for students in their Junior year of college or later. Topics include prenatal testing, abortion, assisted suicide, human augmentation/transhumanism, cloning, disability rights, animal rights, genetically modified organisms, and environmental ethics.

BIOL 5360 Developmental and Tumor Biology (3 credits)
Investigation of the mechanisms leading to the development of multicellular animal organisms from a fertilized egg. In contrast, the course also investigates how cells within a multicellular organism can become misregulated, leading to cancer.

BIOL 5361 Limnology (4 credits)
Introduction to the biology, chemistry, geology, and physics of lakes and streams. Lecture, field, and laboratory work.

BIOL 5362 Streams and Rivers (4 credits)
An introduction to the physical characteristics, chemistry, and biology of lotic systems such as streams and rivers. Includes information on morphology, hydrology, and alteration of these natural systems. Includes laboratory simulations and field exercises. Lecture and laboratory.

BIOL 5380 Molecular Genetics (3 credits)
: Study of the structure, replication, repair, expression, regulation, and change of genetic material. Introduction to theory and procedures by which recombinant DNA molecules are formed, cloned, and expressed.

BIOL 5400 Fish & Wildlife Law and Administration (3 credits)
This course is for majors in natural resources, biology, and related fields. The lectures throughout the course will cover the history, philosophy, evolution, and application of these laws in the management of fish, wildlife, and other renewable resources for the benefit of the public. The course concludes with contemporary economic, administrative and political aspects of fish and wildlife management. The course fulfills some certification requirements of The Wildlife Society and the American Fisheries Society and is recommended for students planning graduate study or employment in natural resources management.

BIOL 5420 Human Dimensions of Wildlife and Fisheries Management (3 credits)
This course is for majors in natural resources, biology, and related fields. The lectures throughout the course will cover the history, philosophy, evolution, and application of human dimensions in wildlife and fisheries management. The course fulfills some certification requirements of The Wildlife Society and the American Fisheries Society and is recommended for students planning graduate study or employment in natural resources management.

BIOL 5447 Genomics (3 credits)
Genomics is the study of the content, structure, organization, evolution, and conservation of whole genomes. Because of its reliance on precision instrumentation and scale, and the unprecedented volume of data produced, genomics is unusual among biological disciplines in its integration of engineering, statistics, and information science. Genomics also requires the biologist to engage in systems thinking by taking a wide view of the dynamic physical and informational network that comprises a single genome. One must further consider the human genome as itself a component of an even larger network of genomes that make up the holobiont¿that¿s us plus our always-changing resident community of microbial pals. After covering these and other topics, and carrying out a substantial genome annotation project for the lab component of the course, we explore personal genomics, or how all this information and understanding affects our lives as 21st century human beings.

BIOL 5460 Stem Cells and Regenerative Medicine (3 credits)
This course is designed as an introduction to stem cell biology and the medical applications of stem cells including in the field of regenerative medicine.

BIOL 5470 Introduction to Vaccinology (4 credits)
This course will introduce students to the field of vaccinology and aspects of the bioscience industry related to vaccine discovery, production, and testing. Students will learn about the history of vaccines; the production of vaccines in a regulated environment; the benefits and concerns with vaccine use. The course will include a discussion of vaccine types, delivery, efficacy, and safety. Students will learn about the mechanism of action of different vaccines; traditional verses modern vaccine production methods, the process of clinical trials and approval for new vaccines; and discuss ethical concerns related to vaccine use.

BIOL 5510 Ornithology (3 credits)
Morphology, ecology, behavior, classification, distribution, and evolution of birds. Lecture, laboratory, and field study (early morning field trips and one or two all-day field trips).

BIOL 5520 Mammalogy (3 credits)
Morphology, ecology, behavior, classification, distribution, and evolution of mammals. Lecture and laboratory.

BIOL 5530 Ecology and Management of Large Mammals (3 credits)
Large mammals are socially and ecologically important components of the landscape and are intensively managed by wildlife agencies and private landowners. The primary focus of the course will be on life-histories, investigative techniques, and management of the major large mammals in Minnesota; white-tailed deer, black bear, wolves, moose, and elk. Biology, management, and research of large mammals from the western United States (i.e., mule deer, cougar, bison, pronghorn antelope, bighorn sheep, brown bear, etc.) will also be discussed. Students will be introduced to current issues concerning the political and social aspects of big game management.

BIOL 5534 Ichthyology (4 credits)
An overview of morphology, physiology, behavior, taxonomy, systematics, and ecology of fishes. This course emphasizes the evolution of ecological adaptations and the origin and conservation of biodiversity. Lecture, laboratory, and field work.

BIOL 5545 Fisheries Management (4 credits)
Theory and methods of fisheries management with an emphasis on quantitative methods and ecosystem management. Lecture and extensive field and laboratory work.

BIOL 5580 Immunology (3 credits)
The study of disease fighting mechanisms of the innate and adaptive immune systems.

BIOL 5590 Cell Biology (3 credits)
Microscopic anatomy and physiological mechanisms of plant and animal cells. Gene control of cellular metabolism, mechanism of energy utilization in cells and pathways of synthesis of molecules.

BIOL 5610 Principles of Wildlife Management (3 credits)
Introduction to the field of wildlife management, including the biological principles important to the understanding of wildlife populations and the management strategies implemented by natural resource managers.

BIOL 5620 Evolution (3 credits)
Patterns and processes of biological evolution. Topics include phylogenies, speciation, extinctions, biogeography, adaptations, sexual selection, and behavior, with an emphasis on vertebrates and invertebrates.

BIOL 5623 Forest Ecology (4 credits)
Fundamentals of forest ecology, including study of tree growth, tree demography, forest community dynamics, and ecosystem processes. Students also learn to identify forest trees native to the region and basic techniques of forest stand description.

BIOL 5630 Conservation Biology (3 credits)
Principles and theories of conservation biology. Topics include biodiversity, threats to biodiversity, extinctions, management of threatened and endangered species, managing habitats for conservation, and methods to mitigate biodiversity loss. Also GEOG 5630

BIOL 5710 Microbiology (4 credits)
Structure, classification, and physiology of bacteria and related microorganisms. Lecture and Laboratory.

BIOL 5720 Plant Form and Function (4 credits)
Structure, function, and development of vascular plants. Interrelation- ships between anatomical structures and physiological processes and how plants cope with environmental challenges. Lecture and laboratory.

BIOL 5723 Ecosystem Ecology (3 credits)
Fundamentals of the study of ecosystems, with emphasis on the integration of abiotic and biotic components in the development of ecosystem processes. Comparisons and interactions between terrestrial, wetland, aquatic, and atmospheric systems across the major biomes.

BIOL 5730 Plant Diversity (4 credits)
Classification, phylogeny, collection, field identification, and uses of wild plants. Lecture and laboratory.

BIOL 5780 Wildlife Management Techniques (5 credits)
This course emphasizes application of ecological principles, knowledge, and practical field skills to data collection used in the management of wildlife resources and their habitats. Use of literature, development of basic field and laboratory skills, and application of management and research principles are integral. Designed for upper level students who have met prerequisites, and graduate students, who are preparing for professional careers in wildlife conservation, natural sciences, and related areas of natural resources management. The course helps fulfill The Wildlife Society professional certification requirements.

BIOL 5830 Aquatic Plants and Algae (4 credits)
Survey of the morphology, physiology, taxonomy, systematics, and ecology of algae and aquatic vascular plants. Lecture, laboratory, and field study.

BIOL 5840 Wetlands Ecology (3 credits)
Survey course develops a basic understanding of the terminology, classification, ecology, values, and conservation of wetlands. Covers wetland systems from around the world, with emphasis on wetlands in North America.

BIOL 5844 Wetlands Ecology Lab (1 credit)
Laboratory course to supplement BIOL/ENVR 5840 Wetlands Ecology. Intended to strengthen a basic understanding of the terminology, classification, ecology, values, and conservation of wetlands. Prerequisite or Corequisite: BIOL/ENVR 5840 or consent of instructor.

BIOL 5850 Marine Biology (3 credits)
Lecture course introducing major concepts and theories. Includes physical and chemical components of the oceans, with special interest paid to the major groups of organisms living in marine systems. Emphasis on the different types of marine systems (coral reefs, mangroves, open water, etc.).

BIOL 6330 Current Topics in Biology (3 credits)
A critical analysis of scientific information distributed in social, popular, and traditional media.

BIOL 6338 Advanced Science Communication (3 credits)
This course is designed to prepare graduate students with practical analytical and communications skills for research and professional environments, whether that¿s a research lab, a classroom, a parks system, a fish hatchery, or anything in between. The goal is to help students develop skills that will facilitate achievement of their professional and intellectual goals.

BIOL 6340 Controversies in Biology (3 credits)
In this online graduate course, students will examine the responsible conduct and the social, economic, legal, and environmental impact of research across a wide range of the biological sciences, including the consequences of biological knowledge on humans, other animals, and the planet. Using a combination of readings, case studies, scholarly literature, and popular culture we will focus on practical decision-making frameworks in research, education, natural resources, and policy professions. Because controversial topics touch on deeply held personal beliefs and excite passionate disagreement, the course will also focus on communication, standards of evidence, and curiosity as tools to find common ground between differing positions. Topics will include genetic counseling and prenatal genetic testing, CRISPR and other gene editing and gene therapy technologies, cloning, biodiversity, hunting and fishing, invasive species, and the impact of climate change on organisms.

BIOL 6350 Computer Applications in Statistics (3 credits)
An examination of several computer-based packages for statistical analysis, focusing on selection of appropriate statistical procedures, processing by computer, and interpretation of results.

BIOL 6450 Trajectories in Biology: Past, Present, and Future (3 credits)
Trajectories in Biology is an expansive, wholistic view of how the history of biology laid the groundwork to the explosion of knowledge in the 19th and 20th century. As we grapple with technological, ethical, and biological possibilities we will imagine and explore how the vast field of biology might evolve in, and beyond, our lifetimes.

BIOL 6880 Seminar (1 credit)
This course is designed to guide biology graduate students in completion of their M.S. in Biology. Students will take the course four consecutive semesters. Each semester students will have specific requirements for completing the course, which will move them towards completion of their degree.

BIOL 6890 Grants and Contracts (2 credits)
A practical investigation of grantsmanship with emphases on funding sources, creative writing, effective conduct of project and reporting results. Gives students first-hand practice in all phases of grantsmanship. Review and critique both qualitative and quantitative model proposals.

BIOL 6894 Advanced Graduate Project (3 credits)
Students learn laboratory or field techniques and carry out research under the supervision of a faculty advisor.

BIOL 6899 Capstone (3 credits)
In this final course, students work closely with the professor of record and 2 additional professionals to design and implement a capstone project. Capstone projects involve scholarly and/or research-based pursuit of knowledge and content development. Though projects may vary based on individual interests, each will reflect a significant level of scholarship and creativity and build upon existing knowledge to create new learning experiences and an enhances level of expertise. Prerequisite(s): BIOL 6337 and BIOL 6890.

BIOL 6990 Thesis (1-3 credits)
Thesis

All-University Courses

The course numbers listed below, not always included in the semester class schedule, may be registered for by consent of the advisor, instructor, or department chair, or may be assigned by the department when warranted. Individual registration requires previous arrangement by the student and the completion of any required form or planning outline as well as any prerequisites.

1910, 2910, 3910, 4910 DIRECTED INDEPENDENT STUDY
1920, 2920, 3920, 4920 DIRECTED GROUP STUDY
1930, 2930, 3930, 4930 EXPERIMENTAL COURSE
1940, 2940, 3940, 4940 IN-SERVICE COURSE
1950, 2950, 3950, 4950 WORKSHOP, INSTITUTE, TOUR
1960, 2960, 3960, 4960 SPECIAL PURPOSE INSTRUCTION
1970, 2970, 3970, 4970 INTERNSHIP
1980, 2980, 3980, 4980 RESEARCH
1990, 2990, 3990, 4990 THESIS