MASTER OF SCIENCE IN BIOLOGICAL SCIENCES

Program Director

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Program Description

Biological Sciences offers a graduate program leading to the M.S. degree. This program provides both a strong foundation in fundamental principles and theories and an understanding of the advanced application of this information within the diverse disciplines of the life sciences. Students prepare, through coursework and faculty-guided original research, to pursue career paths in the professions, academia, research, business, and industry.

The Biological Sciences program includes faculty in:

1. molecular biology, microbiology, and genetics;
2. physiology and anatomy; and
3. environmental biology.

Students may pursue specific areas of specialization within and among these areas, including:

- ecology,
- microbiology,
- molecular biology,
- genetics,
- immunology,
- entomology,
- vertebrate physiology,
- neuroendocrinology,
- neurobiology,
- cell biology, or
- human anatomy.

The program is housed in Ward Beecher Hall. Specialized facilities include an analytical research laboratory housing modern analytical instruments, tissue culture laboratories, an animal facility, laboratories equipped for molecular and cellular research, and an extensive greenhouse facility. The department has exclusive use of two unique outdoor laboratories for field studies: the Youngstown State University Arboretum (a 115-acre reserve) and the Meander Reservoir (a 6,000-acre wildlife refuge and water impoundment), which collectively provide a valuable resource for environmental biology.

Advisement

Each student's course of study will be devised in consultation with the student's major advisor. The course of study will be based on the student's area of specialization, background, and career interests. Students must have their course schedules approved by their major advisor or the graduate director every semester.

Admission Requirements

Application Deadline

Summer and Fall Start – Applications accepted through **April 15th**

Spring Start – Applications accepted through **November 15th**

requirements

In addition to the minimum College of Graduate Studies admission requirements applicants must have completed:

- 3.0 GPA

- Undergraduate degree in Biological Sciences or related field.

- Must meet English language proficiency standards.

Students with deficiencies in these areas should contact the Graduate Program Director in Biological Sciences prior to applying for admission.

Graduate Faculty

David K. Asch, Ph.D., Associate Professor
Gene regulation in eukaryotic organisms; carbon catabolite repression in Neurospora crassa

Michael Butcher, Ph.D., Professor
Comparative biomechanics: muscle structure and function with regard to locomotion and adaptive behaviors

Jonathan J. Caguiat, Ph.D., Professor
Industrial microbiology and genetic and molecular biology techniques to characterize selenite and heavy metal resistant bacteria

Susan Ann Clutter, M.F.S., Professor
Crime scene investigation; blood spatter interpretation; forensic toxicology; fingerprint development at fire scenes

Chester R. Cooper, Ph.D., Professor
Molecular biology and microbiology; morphogenesis and virulence of pathogenic fungi; identification of anti-fungal targets

Thomas P. Diggins, Ph.D., Professor
Field-based community and ecosystem ecology of streams and riparian zones

Jill M. Gifford, Ph.D., Associate Professor
Effects of environmental influences on acute inflammatory and chronic neuropathic pain

Carl G. Johnston, Ph.D., Professor
Microbiology; microbial and fungal ecology; interactions within microbial communities

Xiangjia Min, Ph.D., Professor
Bioinformatics; gene and genome annotation and evolutionary analysis; knowledge database development for secretomes and alternatively spliced genes

Ian J. Renne, Ph.D., Associate Professor
Plant community ecology; invasive species; community structure; allelopathic systems; avian ecology

Robert E. Wardle, M.S., Associate Professor
Forensic science education; forensic chemistry; drug analysis; ethics in forensic science; investigation of the "CSI Effect"; fingerprint science

Degree Requirements

Students may pursue an M.S. degree in Biological Sciences in one of two options.

- The thesis option is a research-intensive program designed to provide students a strong foundation in fundamental biological principles and laboratory techniques through coursework and the completion of a faculty-supervised research project (Thesis).

- The non-thesis option allows students to gain an in-depth understanding of advanced principles in the Biological Sciences through coursework and the writing of a graduate review paper.

Thesis Option

Under this option, students work on a faculty-supervised, original research project and gain practical experience in research techniques and data collection and analysis. It is designed for students who wish to pursue careers in either academic or industrial laboratories, or those who plan to continue toward the terminal Ph.D. degree.

A minimum of 30 semester hours of credit is required for the M.S. degree with thesis option.

COURSE	TITLE	S.H.
Students must submit an acceptable thesis proposal, pass an oral review of the proposal, submit an acceptable thesis reporting the results of a faculty-supervised research project, and pass an oral defense of the thesis.		
BIOL 6990	Master's Thesis Research (may repeat up to a maximum of six semester hours)	1-3
BIOL 6991	Research Methods for Thesis	3
BIOL 6988	Seminar in Biological Sciences (must take two semester hours)	2
One semester hour of Topics (BIOL 6996-BIOL 7000)		1
An additional 21 semester hours of course work with no more than eight semester hours at the 5000 level		21
A minimum grade point average of 3.0 is required for graduation.		
Total Semester Hours		**30**

Non-thesis Option

This option provides students with a strong understanding of biological theories and principles, but does not require an original research project and publication. It is designed for students whose future goal is a non-research oriented career, such as professional school or pharmaceutical sales.

A minimum of 30 semester hours of credit is required for the M.S. degree with a non-thesis option.

COURSE	TITLE	S.H.
BIOL 6994	Research Methods for Nonthesis	2
BIOL 6998	Topics in Physiology (Any Topics course may be used.)	1
Graduate level Biology electives		24
BIOL 6988	Seminar in Biological Sciences (Course may be repeated)	3
Total Semester Hours		**30**

[1] Requires the submission of an acceptable graduate research paper and the oral review of this paper before their graduate committee.

Learning Outcomes

1. Students will be able to integrate and critique information in a specified sub-discipline of the Biological Sciences.
2. Students will be able to evaluate scientific literature in the Biological Sciences.
3. Thesis students will conduct independent research mainly in one of the numerous sub-disciplines of the Biological Sciences.
4. Students will produce a Thesis or review paper that critiques current literature, evaluates scientific data, and presents novel data along with a conclusion.

Graduate Courses

BIOL 5806 Field Ecology 4 s.h.
Field study involving quantitative methods for the collection, analysis, and interpretation of ecological data in populations and communities. Pre-field trip lectures, specified experiments, independent study, a written report, and an oral presentation of the independent study project. Required off-campus travel. Field conditions may be rigorous and/or primitive.
Prereq.: BIOL 3780.

BIOL 5811 Ornithology 4 s.h.
Structure, physiology, behavior, ecology, and evolution of birds. Natural history of common bird species and important bird groups, especially those in Ohio. Basic methods and skills for field study of birds. Three hours lecture, three hours lab.
Prereq.: BIOL 3741.

BIOL 5811L Ornithology Laboratory 0 s.h.
Ornithology Laboratory.

BIOL 5813 Vertebrate Histology 4 s.h.
The microscopic study of mammalian tissues and organs. Three hours lecture, two hours lab.
Prereq.: BIOL 3711 or BIOL 3730.

BIOL 5813L Vertebrate Histology Laboratory 0 s.h.
Vertebrate Histology Laboratory.

BIOL 5823 Advanced Eukaryotic Genetics 3 s.h.
Mechanisms and control of eukaryotic DNA replication, current advances in understanding the genetics basis of cancer and other genetic diseases, problems and benefits of the various eukaryotic genome projects (human and others), gene therapy and genetic engineering in animals and plants.
Prereq.: BIOL 3721 and BIOL 4890.

BIOL 5824 Behavioral Neuroscience 4 s.h.
Explores the biological basis of human experience and behavior. Topics include basic neuroanatomy and neuropharmacology, emotions, learning and memory, sleep and biological rhythms, reproductive behavior, and communication. Three hours lecture, three hours lab.
Prereq.: BIOL 3730.
Coreq.: BIOL 5824L.

BIOL 5824L Behavioral Neuroscience Laboratory 0 s.h.
Behavioral Neuroscience Laboratory.
Prereq.: BIOL 3730.
Coreq.: BIOL 5824.

BIOL 5827 Gene Manipulation 2 s.h.
Techniques of modern molecular biology including the use of restriction enzymes, plasmid and phage vectors, Southern blots and the polymerase chain reaction (PCR). Introduction and manipulation of foreign DNA in bacterial and eukaryotic systems. Six hours lab.
Prereq.: BIOL 4890.

BIOL 5833 Mammalian Endocrinology 3 s.h.
Detailed examination of the hormones of the hypothalamus, pituitary, thyroid, adrenal pancreas, gonads, and other organs with putative endocrine function. Focus on the physiological functions of hormones and their mechanisms of action with emphasis on the human.
Prereq.: BIOL 3730.

BIOL 5840 Advanced Microbiology 3 s.h.
Molecular mechanisms for virulence of pathogenic organisms.
Prereq.: BIOL 3702 or equivalent.

BIOL 5844 Physiology of Reproduction 3 s.h.
Current concepts of reproductive processes and their physiological control in mammalian systems.
Prereq.: BIOL 3730.

BIOL 5853 Biometry 3 s.h.
Application of fundamental theory and procedures to the statistical analysis of biological data.
Prereq.: 20 s.h. of Biological Sciences.

BIOL 5858 Computational Bioinformatics 3 s.h.
Project-based learning course with a focus on using a Linux environment and PERL for processing large genomic datasets and data mining. Relational database and BioPERL will also be introduced for genomic data analysis and display. Three hours of combined lecture and lab per week.

BIOL 5888 Environmental Biotechnology 3 s.h.
This course provides an overview of environmental biotechnology, engineering fundamentals, theory, and principles in application of biological treatment to solve environmental problems. Topics include relevant biological, chemical, and ecological processes, biological treatments of waste, land, and water. Environmental biotechnology is an essential tool to help humanity face enormous environmental health challenges, especially pollution, climate change, loss of habitat, and resulting threats to wildlife and human populations, their health outcomes and survival potential. This course is designed to summarize modern insights regarding evaluation and applications of environmental biotechnology.
Prereq.: CHEM 3719 or CEEN 3736.

BIOL 5888L Environmental Biotechnology Laboratory 0 s.h.
Environmental Biotechnology Laboratory.

BIOL 6900 Advanced Bioinformatics 3 s.h.
An examination of how computer and informatics technology is applied to biological data analysis, particularly in the area of genomics data mining, and its use in genomics, molecular, and systems biology research. Three hours of lecture per week.
Prereq.: BIOL 4890 or permission of instructor.

BIOL 6902 Ecology of Lakes 3 s.h.
A study of the physical, chemical, biological, and ecological structure and function of lake ecosystems.
Prereq.: permission of instructor.

BIOL 6903 Stream Ecology 3 s.h.
A study of the physical, chemical, biological, and ecological structure and function of stream ecosystems, and of their associated riparian zones.
Prereq.: permission of instructor.

BIOL 6904 Introduction to Biomedical Research 2 s.h.
This course is designed for a student who is interested in learning about preclinical and clinical biomedical research investigations. Students will develop an understanding of hypothesis development, searching for and critically evaluating academic manuscripts/literature, experimental design and implementation, data evaluation and biostatistics, and modes of scientific communication.
Prereq.: Graduate standing or permission from the instructor.
Cross-Listed: BIOL 4896.

BIOL 6906 Ecosystems Field Ecology 4 s.h.
Students will learn about destination ecosystems, including associated organisms, interactions, physical, chemical, climatic conditions, culture, and human impacts. Students must be in good health, hike, swim, and handle primitive conditions. Course may be taken more than once with different destination ecosystems. This course involves travel expenses in addition to lab fees.
Prereq.: permission of instructor.

BIOL 6909 The Human Microbiome 3 s.h.
This course covers microbial communities and their interactions associated with the human host. Scientific literature on the identity and roles of microbes associated with the human gut, oral cavity, skin, genital-urinary tract and respiratory system will be reviewed, presented, and discussed.
Prereq.: One of the following courses: undergraduate microbiology, physiology, biochemistry, immunology, or molecular biology.

BIOL 6911 Comparative Biomechanics 4 s.h.
Overview of biomechanical principles involved with the structure and function of animals. Topics include mechanical properties of biomaterials, comparative muscle architecture and physiology, and locomotor mechanisms of human walking and running. Three hours lecture and two hours lab.
Prereq.: BIOL 2602 or BIOL 3705, and PHYS 1501 or PHYS 2610.

BIOL 6911L Comparative Biomechanics Lab 0 s.h.
Comparative Biomechanics Lab.

BIOL 6919 Microbiome Gut Brain Axis 3 s.h.
This course covers the gut microbial communities and their interactions with the enteric and central nervous systems of humans and other animal hosts. Through its interactions with the nervous system, the gut microbiome influences the emotional and cognitive centers of the brain, whihc in turn may affect mental health, response to stress, and other nervous system disorders. This course explores these topics based on the scientific literature, discussions, and presentations.
Prereq.: BIOL 6909.

BIOL 6935 Advanced Physiology: Regulatory Mechanisms 3 s.h.
Examination of advanced human physiology through a detailed study of selected body systems. Systems examined may include the musculoskeletal, gastrointestinal, metabolic and thermoregulatory. Three hours lecture.
Prereq.: BIOL 3730 or equivalent.

BIOL 6935L Advanced Physiology: Regulatory Mechanisms Laboratory 1 s.h.
The experimental approach to the examination of advanced human physiology through a detailed study of selected body systems. Systems examined may include the musculoskeletal, gastrointestinal, metabolic and thermoregulatory. Three hours lab.
Prereq.: BIOL 6935 or concurrent enrollment in BIOL 6935.

BIOL 6937 Conservation Biology 3 s.h.
A socioeconomic, political and ecological approach to issues associated with the maintenance and value of biodiversity and ecosystem services; consequences of anthropogenic climate change, fragmentation, overharvesting, extinction, and invasion of non-native species; biofuels; ecological restoration, nature reserve design and sustainability.
Prereq.: BIOL 3759 or BIOL 3750 or permission from instructor.

BIOL 6940 Microbial Physiology 4 s.h.
This course will present advanced topics in biomolecule synthesis, molecular biology, bacterial genetics, gene expression, energy production photosynthesis, bacteriophages, and microbial stress response. An integrative laboratory project emphasizing some of these topics will be included. Three hours lecture and three hours laboratory.
Prereq.: Graduate standing.

BIOL 6948 Biology of Fungi 4 s.h.
Examination of fungal and fungal-like organisms with emphasis placed upon their taxonomy, phylogenetic relationships, structure, function, physiology, genetics, and ecology. Their role in agriculture, medicine, and scientific research is explored as well. Three hours lecture and three hours laboratory.
Prereq.: BIOL 3702 Microbiology and graduate standing.

BIOL 6949 Cellular and Molecular Mycology 3 s.h.
Specific cellular and molecular processes in fungal organisms will be examined in great detail. Topic areas include morphogenesis, dimorphism, signal transduction, gene expression and regulation, cellular differentiation, nutritional physiology, primary and secondary metabolism, and host/parasite interactions.
Prereq.: BIOL 3702 or equivalent, and graduate standing.

BIOL 6950 Comparative Animal Physiology 4 s.h.
The study of physiological mechanisms and adaptations of animals to environmental stresses of their habitats. Three hours lecture and three hours laboratory per week.
Prereq.: BIOL 3730 Human Physiology or equivalent.

BIOL 6950L Animal Physiology Lab 0 s.h.
Animal Physiology Laboratory.

BIOL 6954 Advanced Ecology 3 s.h.
Interrelationships of species within the community and their influence upon the ecosystem.
Prereq.: Permission of instructor.

BIOL 6957 Advanced Immunology 3 s.h.
Fundamentals of immunological systems, including both humoral and cellular immunological responses. Immune response to infections, transplantation rejection, autoimmune diseases, allergy, and autoimmunity. Three hours of lecture a week.
Prereq.: BIOL 3702 Microbiology or equivalent.

BIOL 6957L Advanced Immunology Laboratory 2 s.h.
Immunologic laboratory techniques. Four hours of laboratory a week. Should be taken concurrently with BIOL 6957.

BIOL 6961 Forest Ecology 2 s.h.
A study of the structure, function, and management/conservation of forest ecosystems, including the biology and taxonomy of woody plants. Major emphasis on eastern North America. Two hours lecture.
Prereq.: 20 semester hours in BIOL or GES, or combination thereof, or permission of instructor.
Coreq.: BIOL 6961L.
Cross-Listed: BIOL 4866.

BIOL 6961L Forest Ecology Laboratory 2 s.h.
Laboratory and field experiences in Forest Ecology. Two hours lab, twice a week.
Coreq.: BIOL 6961.

BIOL 6963 Virology 3 s.h.
Viral structure, replication, infection, and pathogesis. The molecular biology of viruses and their interactions with host cells, and the use of viruses as tools for gene therapy and genetic engineering. Current research and viruses important in world health, such as HIV, will be emphasized.
Prereq.: Graduate standing or permission of instructor.

BIOL 6963L Virology Lab 0 s.h.
Virology Laboratory.

BIOL 6964 Advanced Molecular Genetics 3 s.h.
An examination of the mechanisms of transcription, translation, DNA replication, and RNA processing and transposition in both prokaryotes and eukaryotes.
Prereq.: BIOL 4890 Molecular Genetics or permission of instructor.

BIOL 6967 Stem Cell Biology 3 s.h.
This course deals with the study of stem cells and their role in biology. Developmental aspects of stem cells and the relevance of stem cells to medicine and applied biology will be discussed.
Prereq.: BIOL 5827 or equivalent.

BIOL 6968 Cell Culture Methods Laboratory 2 s.h.
This course provides instruction and training in standard animal cell culture techniques. Theory and practice using established cell lines. In addition, more advanced cell cultivation will be explored, bio-reactors and 3D bio-printing.
Prereq.: permission of instructor.

BIOL 6974 Neuroendocrinology 3 s.h.
Current concepts of neuroendocrine processes will be discussed.
Prereq.: BIOL 5833 or equivalent, or permission of instructor.

BIOL 6975 Neuropharmacology 3 s.h.
An examination of how drugs interact with the nervous system, including the locus of action for neuroactive substances and the mechanisms by which these substances cause change in physiology and behavior.
Prereq.: Graduate standing or permission of instructor.

BIOL 6976 Cellular Neurophysiology 3 s.h.
Detailed study of ionic currents, regulation of neuronal firing patterns, synaptic transmission, and synaptic plasticity.
Prereq.: BIOL 5832 or permission of instructor.

BIOL 6978 Teaching Practicum 1: Principles of Biology 1 s.h.
A course dealing with principles of pedagogy for both classroom and laboratory settings. This is a broad-based course, which will address basic principles and concepts of modern biology. Emphasis is on relationships between instruction and learning outcomes. Required of all graduate teaching assistants in the Biological Sciences. Students will be assigned a grade of S/U. May be repeated.

BIOL 6979 Teaching Practicum: 1545 Anatomy and Physiology 1 s.h.
A course dealing with the principles of pedagogy for BIOL 1545 Allied Health Anatomy and Physiology. This course addresses classroom and laboratory topics in human anatomy and physiology, with an emphasis on the relationships between instruction and learning outcomes. Required of graduate teaching assistants providing instructional support for BIOL 1545. Students will be assigned a grade of S/U. May be repeated.

BIOL 6981 Teaching Practicum: 1551 Anatomy and Physiology 1 s.h.
A course dealing with the principles of pedagogy for BIOL 1551 Anatomy and Physiology I. This course addresses classroom and laboratory topics in human anatomy and physiology with an emphasis on the relationships between instruction and learning outcomes. Required of graduate teaching assistants providing instructional support for BIOL 1551. Students will be assigned a grade of S/U. May be repeated.

BIOL 6982 Teaching Practicum: 1552 Anatomy and Physiology 2 1 s.h.
A course dealing with the principles of pedagogy for BIOL 1552 Anatomy and Physiology II. This course addresses classroom and laboratory topics in human anatomy and physiology with an emphasis on the relationships between instruction and learning outcomes. Required of graduate teaching assistants providing instructional support for BIOL 1552. Students will be assigned a grade of S/U. May be repeated.

BIOL 6988 Seminar in Biological Sciences 1 s.h.
May be repeated up to two semester hours.

BIOL 6989 Graduate Research Experience 1-3 s.h.
Independent study for graduate students wishing to learn specific biological research techniques. Applicable only to biology graduate students following the nonthesis or biology education options. May be repeated for up to a total of three semester hours.
Prereq.: Permission of instructor or department chair.

BIOL 6990 Master's Thesis Research 1-6 s.h.
Research selected and supervised by departmental advisor and approved by graduate faculty of Biology Department and graduate dean. May be repeated for a maximum of six semester hours.
Prereq.: Acceptance by departmental committee.

BIOL 6991 Research Methods for Thesis 3 s.h.
Discussion and demonstration of current methods and concepts related to research in biological sciences and writing of a graduate thesis proposal. Not applicable for students enrolled in the nonthesis or biology education options. May be repeated once.
Prereq.: Permission of instructor.

BIOL 6994 Research Methods for Nonthesis 2 s.h.
A course focused on reviewing current biological concepts as reported in the scientific literature. Not applicable for students enrolled in the thesis or biology education options.
Prereq.: Permission of instructor.

BIOL 6996 Topics in Ecology 1 s.h.
An arranged course in terrestrial and aquatic ecology. May be repeated with a different subject up to 2 s.h.
Prereq.: Permission of instructor.

BIOL 6997 Topics in Molecular and Cellular Biology 1 s.h.
An arranged course in subjects at the molecular level of life. May be repeated with different subject up to 2 s.h.
Prereq.: Permission of instructor.

BIOL 6998 Topics in Physiology 1 s.h.
An arranged course for advanced subjects in vertebrate physiology. May be repeated with a different subject up to 2 s.h.
Prereq.: Permission of instructor.

BIOL 7000 Topics in Microbiology 1 s.h.
An arranged course on subjects of microbiology. May be repeated with a different subject up to 2 s.h.
Prereq.: Permission of instructor.