MASTER OF SCIENCE IN BIOLOGICAL SCIENCES

Program Director
Dr. Mark D. Womble
4063 Ward Beecher Science Hall
(330) 941-4727
mdwomble@ysu.edu

Program Description
The Department of 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 Department of Biological Sciences 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 department 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.

Admission Requirements
In addition to the minimum College of Graduate Studies admission requirements applicants must have completed:
- at least 20 semester hours of undergraduate biology courses (or equivalents which could include biochemistry) with at least a 3.0 grade point average,
- plus one year of organic chemistry,
- one year of introductory physics, and
- one semester of statistics.

Students with deficiencies in these areas should contact the Biology graduate director prior to applying for admission. The Graduate Record Examination (general test) is also required and students must obtain an acceptable score.

Advisement
Each student’s course of study will be devised in consultation with the student’s major advisor and will be approved by the student’s graduate committee. 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.

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

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

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

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

Diana L. Fagan, Ph.D., Professor
Microbiology and immunology; inflammation and regulation of immune responses; stem cell in wound healing

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

Johanna Krontiris-Litowitz, Ph.D., Professor
Neurobiology and physiology; regulation and phenotypic expression of collagen in ventricular hypertrophy and fibrotic diseases

Xiangjia Min, Ph.D., Associate 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

Gary R. Walker, Ph.D., Professor, Chair
Cellular growth and movement in embryonic tissue; molecular processes underlying cell division; biofuel production

Mark D. Womble, Ph.D., Professor
Human anatomy; neurophysiology; histological analysis of tissues and wound healing
Degree Requirements

Students may pursue the 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 theories through coursework and the completion of a faculty-guided research project (thesis).
- The nonthesis option allows students to gain an in-depth understanding of biology through coursework and the writing of a graduate research paper.

Thesis Option

Under this option, students work on a faculty-guided, original research project and gain practical experience in research techniques and data collection. It is designed for students who wish to pursue careers in academic or industrial laboratories or continue toward the Ph.D. degree. A minimum of 36 semester hours of credit is required for the M.S. degree with thesis option.

Nonthesis Option

This option provides students with a strong understanding of biological theories and principles but does not require an original research project. It is designed for students whose future goal is a nonresearch-oriented career, such as professional school or pharmaceutical sales. A minimum of 38 semester hours of credit is required for the M.S. degree with a nonthesis option.

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, 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.

BIOL 5824L Behavioral Neuroscience Laboratory 0 s.h.
Behavioral Neuroscience Laboratory.

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 4990.

BIOL 5832 Principles of Neurobiology 4 s.h.
Topics include cell and molecular biology of the neuron, properties of excitable membranes, functional neuroanatomy, integrated motor control, sensory signal transduction, developmental neurobiology, mechanisms of disease processes, and higher cortical function.
Prereq.: BIOL 3730.

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.

Learning Outcomes

1. Students will be able to integrate and critique information in a specified sub-discipline of biology.
2. Students will be able to evaluate the scientific literature in the biological sciences.
3. Thesis students will conduct independent research in the biological sciences.
4. Students will create a thesis or position paper that critiques current literature, evaluates scientific data and presents a conclusion.
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 5861 Animal Behavior 3 s.h.
Detailed examination of a variety of topics necessary for understanding animal behavior. Historical approaches to animal behavior, evolution and behavior genetics, physiology of behavior, behavioral ecology, and social organization and mating systems.
Prereq.: BIOL 3741 or permission of instructor.

BIOL 5865L Functional Human Gross Anatomy Lab 0 s.h.
Functional Human Gross Anatomy Lab.

BIOL 5868 Gross Anatomy 1 4 s.h.
Regional study of the human body with emphasis on functional and topographic anatomy and clinical correlations. Two hours lecture-demonstration, four hours lab.
Prereq.: Admission to the YSU Physical Therapy program or permission of instructor.

BIOL 5868L Gross Anatomy 1 Laboratory 0 s.h.
Gross Anatomy 1 Laboratory.

BIOL 5869 Gross Anatomy 2 4 s.h.
Regional study of the human body with emphasis on functional and topographic anatomy and clinical correlations. Two hours lecture-demonstration, four hours lab.
Prereq.: BIOL 5868.

BIOL 5869L Gross Anatomy 2 Laboratory 0 s.h.
Gross Anatomy 2 Laboratory.

BIOL 5888 Environmental Biotechnology 4 s.h.
Lectures will cover the use of microbes for solving environmental problems. In the laboratory, teams of students will design and implement experiments in bioremediation. This course is intended for students in biology, environmental studies, chemistry, and engineering. Two hours lecture and four hours lab.
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 6901 Computational Bioinformatics 2 s.h.
Project-based learning course with a focus on using a Linux environment and a script language such as PERL for processing large genomic datasets. Relational databases such as MySQL and BioPERL will also be covered for genomic data analysis and display. Two hours of combined lecture and lab per week.
Prereq.: BIOL 6900 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 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 6929 Functional Neuroanatomy 4 s.h.
An examination of the structure, function, integration, and cellular control of the brain and spinal cord. Three hours lecture, two hours lab. Students who have enrolled in BIOL 4929 will not receive credit for this course.
Prereq.: BIOL 3730 or equivalent.

BIOL 6929L Functional Neuroanatomy Lab 0 s.h.
Functional Neuroanatomy Lab.

BIOL 6934 Advanced Physiology: Integrative Mechanisms 3 s.h.
Examination of advanced human physiology through a detailed study of selected body systems. Systems examined may include the cardiovascular, respiratory, and renal systems, exchange dynamics among body fluid compartments, and acid-base balance. Three hours lecture.
Prereq.: BIOL 3730 or equivalent.

BIOL 6934L Advanced Physiology: Integrative Mechanisms Laboratory 1 s.h.
An experimental approach to the examination of advanced human physiology through a detailed study of selected body systems. Systems examined may include the cardiovascular, respiratory, and renal system, exchange dynamics among body fluid compartments, and acid-base balance. Three hours lab.
Prereq.: BIOL 3730 or equivalent.

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 6951 Developmental and Comparative Neurobiology 3 s.h.
The study of processes critical to the development, maintenance, and function of the nervous system. Topics will be presented from an experimental perspective using the scientific literature as a resource.
Prereq.: BIOL 3730 Human Physiology or equivalent.

BIOL 6952 Experimental Design 3 s.h.
Controlling variables, experimental design, and treatment of data from biological experiments.
Prereq.: BIOL 5853 or permission of instructor.

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 6959 Analytical Cell Biology 4 s.h.
Analytical concepts are applied to the study of cells and cellular processes. The use of microscopic techniques, including microtechniques, fluorescent microscopic analysis, and immunocytochemistry, are presented. Qualitative and quantitative analysis of macromolecular composition is used in answering contemporary questions in cell biology.
Prereq.: Graduate standing.
**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 6993 Biology of Proteins** 2 s.h.
This course engages the student in the world of proteins, from the basic structure and function of proteins in biological systems, to the applied sciences involved in the development of commercially valuable proteins. This course extends the students previous understanding and expertise in molecular biology to emphasize proteins.
**Prereq.:** BIOL 5827 or equivalent.

**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.

**BIOL 8868 Human Gross Anatomy 1** 4 s.h.
Regional study of the human body with emphasis on functional and topographic anatomy and clinical correlations. Two hours of lecture-demonstration four hours of lab. h.
**Prereq.:** Admission to the YSU Physical Therapy Program 4 s.

**BIOL 8868L Human Gross Anatomy 1 Lab** 0 s.h.
Human Gross Anatomy I Lab.

**BIOL 8869 Human Gross Anatomy 2** 4 s.h.
Regional study of the human body with emphasis on functional and topographic anatomy and clinical correlations. Two hours lecture. Four hours lab.
**Prereq.:** BIOL 8868.

**BIOL 8869L Human Gross Anatomy 2 Lab** 0 s.h.
Human Gross Anatomy Laboratory.