Biological Sciences (BSCI)

Chairperson: Edward Blumenthal, Ph.D.
Department of Biological Sciences website (http://www.marquette.edu/biology/graduate-studies.shtml)

Degrees Offered

Master of Science, Plan A only; Doctor of Philosophy

Program Description

The biological sciences graduate program aspires to train experimental scientists capable of teaching and directing independent research by providing a broad theoretical background and an appreciation for the rigor of the scientific method. This program provides excellent training in modern biology suitable for jobs in academia, industry, and government.

The department offers two areas of graduate study: biological sciences and neurosciences. Both provide students with research experiences using all areas of modern biological techniques to study molecular, cellular, tissue, organ, systems and organism functioning. The biological sciences area has several specializations including: cell and developmental biology, biochemistry and genetics, microbiology and ecology and physiology. The neuroscience area is offered in collaboration with the neuroscience faculty in the Department of Biomedical Sciences in the College of Health Sciences. In addition to general training in the biological sciences, students receive specialized course work in the neurosciences and choose a neuroscience laboratory from either department for their dissertation research. The main areas of research include: the neurobiology of addiction, stress and mental disorders, mechanisms of feeding behavior, neuronal regeneration, and ion channels.

Both areas of study offer 12-month support (academic and summer stipends), paid tuition credits and provide qualified reimbursement for university provided health insurance.

Prerequisites for Admission

Applicants are expected to have completed a bachelor's degree in biology or related field. As a general rule, strong preference will be given to applicants to the doctoral program. Only in exceptional circumstances will students be admitted to the master's program. A master's degree is not a prerequisite for admittance to the doctoral program.

Application Deadline

Although no official deadline exists for the master's or the doctoral programs, completed applications should be received by December 15th for full consideration. Applications for admission received after this date will be considered as space permits.

Application Requirements

Applicants must submit, directly to the Graduate School:

1. A completed application form and fee online (http://marquette.edu/grad/future_apply.shtml).
2. Official transcripts from all current and previous colleges/universities except Marquette.
3. A statement of professional goals and aspirations.
4. Three letters of recommendation that give evidence of the applicant’s scholarly promise.
5. GRE scores (General Test is required, Subject Test is recommended).
6. (For international applicants only) a TOEFL score or other acceptable proof of English proficiency.

Biological Sciences Master's Requirements

Specializations: Biochemistry, Cell Biology, Developmental Biology, Ecology, Genetics, Microbiology, Molecular Biology, Neurophysiology, Physiology

The program of course work and research for the master's degree is determined in consultation with the student's advisory committee. Each student is advised to take such courses as are properly related to academic background and research interests. All master's students are required to gain the equivalent of one year of teaching experience during the program.

A master's student must complete 24 credit hours of course work including at least twelve hours at the graduate level, five credits of research taken in the first two years and three credits of seminar courses. In addition, six credit hours of thesis work are required to graduate. Eighteen of the 24 credit hours must be taken in biological sciences. The student must pass a master's qualifying examination and submit an approved thesis.
Biological Sciences Doctoral Requirements

Specializations: Biochemistry, Cell Biology, Developmental Biology, Ecology, Genetics, Microbiology, Molecular Biology, Neurophysiology, Physiology, Neuroscience

The program of course work and research for the doctoral degree is determined in consultation with the student's advisory committee. Each student is advised to take such courses as are properly related to academic background and research interests. All doctoral students are required to gain the equivalent of one year of teaching experience during the program.

A doctoral student must complete a program of study, defined in conjunction with an adviser, on an approved Doctoral Program Planning Form. Advancement to candidacy for the doctoral degree is considered following successful completion of the lecture course work specified in the Doctoral Program Planning Form and after passing the qualifying exam. A typical doctoral student completes a minimum required 24 credit hours of course work, including a minimum of seven 2-3 credit graduate lecture courses (BIOL 8501 Molecular and Cellular Signaling, BIOL 8502 Systems Neuroscience, BIOL 8504 Advanced Survey in Neuroscience and BIOL 8506 Cellular Neurophysiology are mandatory for students in the neuroscience track), 5 credits of research and 5 one credit seminar courses, in addition to 12 credit hours of dissertation work. The student must submit and defend a dissertation after completing all other formal requirements for the doctoral degree.

Courses

BIOL 5101. Biochemistry and the Molecular Basis of Biology. 3 cr. hrs.
Major themes in biochemistry are examined in the context of mammalian physiology. Topics include: Protein structure and enzyme catalysis, carbohydrate and lipid metabolism in relation to energy production, protein and nucleic acid synthesis, and the nature of the genetic code. 3 hrs. lec., disc.

BIOL 5102. Experimental Molecular Biology. 3 cr. hrs.
Purification, characterization and molecular analysis of proteins, nucleic acids, lipids and other biomolecules with emphasis on standard techniques widely used in research laboratories. 1 hr. lec., 4 hrs. lab. Prereq: BIOL 4101 or equiv.

BIOL 5201. Genomics and Bioinformatics. 3 cr. hrs.
The analysis of gene structure and genetic regulation in selected prokaryotes and plant and animal systems, as well as transgenic organisms. Introduction to the principles of bioinformatics and proteomics as applied to genome comparisons and protein structure and function. Models and algorithms for predictions of the biological properties of genetically modified nucleotide sequences and proteins.

BIOL 5703. Exercise Physiology. 3 cr. hrs.
Study of the effects of acute and chronic exercise on selected organ systems. Particular emphasis will be placed on muscle, cardiovascular, respiratory, and environmental physiology.

BIOL 5806. Immunobiology. 3 cr. hrs.
Cellular and molecular mechanisms of the immune response. Nature of antigens and antibodies and their interactions. Special topics include complement, immediate and delayed hypersensitivity, transplantation and tumor immunobiology, immunosuppression, and immunological tolerance. 3 hrs. lec., disc.

BIOL 6001. Radioisotope Safety. 2 cr. hrs.
Ionizing radiation: proper safety procedures in the independent use of radioisotopes and current regulatory guidelines and licensing procedures. Prereq: BIOL 1002 and CHEM 1002; or BIOL 1009 and CHEM 1002; or cons. of dept. ch.

BIOL 6005. Scientific Writing Workshop. 1-3 cr. hrs.
Designed to teach basics of clear and effective scientific writing with emphasis on preparing and evaluating research manuscripts and proposals. Students learn editing techniques through deconstructing and revising others' work. Prereq: Second year grad. student or cons. of instr.

BIOL 6096. Laboratory Rotations in Biology. 1-3 cr. hrs.
Informal lab rotation of first-year graduate students based on mutual preferences of the student and faculty member including lab group meetings, literature research, bench work, presentation of findings and/or research plan to lab members. S/U grade assessment. Prereq: BIOL 6096 and cons. of dept. ch.

BIOL 6097. Laboratory Research in Biology. 1 cr. hr.
Independent research of second year graduate students based on their dissertation/thesis research laboratories, including lab group meetings, literature research, bench work and presentation of findings. S/U grade assessment. Prereq: Cons. of dept. ch.

BIOL 6952. Department Colloquium. 0 cr. hrs.
Scholarly reports on selected topics in modern biology by visiting and resident investigators and graduate students. Registration and attendance required of all full-time graduate students in biology. SNC/UNC grade assessment.

BIOL 6995. Independent Study in Biological Sciences. 1-3 cr. hrs.
Investigations in selected areas of biology. Prereq: Cons. of instr. and cons. of dept. ch.

BIOL 6999. Master's Thesis. 1-6 cr. hrs.
S/U grade assessment. Prereq: Cons. of dept. ch.
BIOL 8101. Protein Structure and Function. 2 cr. hrs.
Advanced protein biochemistry stressing methodology and primary literature. Topics include: structural and chemical properties of amino acids, peptides and proteins; protein folding and assembly; protein-protein and protein-ligand interactions; enzyme kinetics and regulation; and the determination of protein structure. Uses examples from glycolytic and gluconeogenic metabolic pathways to highlight the structural basis for catalysis and regulation. Prereq: BIOL 4101/5101 or equiv.; or cons. of instr.

BIOL 8102. Biochemistry and Function of Nucleic Acids. 2 cr. hrs.
The biochemistry of RNA and DNA with emphasis on biological function and evolution. Specific topics include: nucleic acid structure, biophysical properties, biosynthesis, and molecular function. Prereq: BIOL 4101/5101 or cons. of instr.

BIOL 8201. Epigenetics. 2 cr. hrs.
Focuses on the molecular biology of epigenetic gene expression states of eukaryotic model organisms and introduces molecular and genetic approaches to the analysis of epigenetic problems. In particular, the course addresses DNA methylation, RNA interference, chromatin structure, transposable elements and gene silencing.

BIOL 8202. Principles of Eukaryotic Genetics. 2 cr. hrs.
Genetics of eukaryotic model organisms with a focus on genetic approaches to the analysis of contemporary biological problems. Eukaryotic chromosome structure and function. Prereq: BIOL 2201 or equiv.

BIOL 8301. Imaging and Cytoskeletons. 2 cr. hrs.
Discusses the principles of cytoskeleton and molecular motors and modern imaging tools developed for the studies of cellular mechanisms. Prereq: BIOL 2301 or equiv.

BIOL 8302. Protein Trafficking and Organelle Identity in Eukaryotic Cells. 2 cr. hrs.
An in-depth analysis of protein trafficking and organelle identity in eukaryotic cells. Discusses, in detail, mechanisms of protein translocation across biological membranes and the genetic and biochemical analysis of protein sorting to diverse organelles. Prereq: BIOL 2301 or equiv.

BIOL 8501. Molecular and Cellular Signaling. 2 cr. hrs.
Comprehensive survey of the major neurotransmitter systems including biochemical synthesis and degradation, receptors and intracellular signaling pathways. Emphasizes modern laboratory techniques and primary literature. Prereq: Cons. of instr.

BIOL 8502. Systems Neuroscience. 2 cr. hrs.
Comprehensive survey of nervous system function at the systems level and includes motor, sensory and regulatory systems. Prereq: Cons. of instr.

BIOL 8504. Advanced Survey in Neuroscience. 1 cr. hr.
An introduction to current neuroscience literature with a focus on research at Marquette. Prereq: Cons. of instr.

BIOL 8506. Cellular Neurophysiology. 2 cr. hrs.
Biophysical properties of membranes and membrane-bound proteins. In-depth study of electrotonic properties of membranes, electrical potentials, voltage-dependent and ligand-dependent ion channels. Emphasizes techniques and data interpretation. Prereq: Cons. of instr.

BIOL 8520. Behavioral Neuroendocrinology. 2 cr. hrs.
Examines neuroendocrine systems as they relate to behavioral processes and their underlying neurobiological mechanisms with emphasis on the contribution of neuroendocrine dysfunction to neuropsychiatric disease. Prereq: Cons. of inst.

BIOL 8530. Glutamate Neurotransmission. 2 cr. hrs.
Reviews critical aspects of glutamatergic signaling including an overview of glutamate receptors, transporter, and release mechanisms. The contribution of abnormal glutamatergic neurotransmission is discussed in light of a number of pathological states including stroke and schizophrenia. Students integrate course material into a novel research proposal. Prereq: Cons. of inst.

BIOL 8601. Stem Cell Biology. 2 cr. hrs.
Examines fundamental principles of developmental biology as they relate to embryonic and adult stem cells. Includes: origin of stem cells, regulation of stem cell niches, pluripotency and differentiation, relationship to cancer and experimental approaches to stem cell research. Also includes discussion of recent advances in stem cell biology. Prereq: BIOL 2301 or equiv.; or BIOL 3601 or equiv.

BIOL 8603. Cell and Molecular Biology of Early Development. 2 cr. hrs.
Study of the cellular and molecular mechanisms underlying the specification of cell fate in a variety of model organisms including fruit flies, nematodes, mice and zebra fish. Emphasizes genetic, biochemical and molecular techniques used in studying these complex systems. Prereq: BIOL 2301 or equiv.; or BIOL 3601 or equiv.

BIOL 8702. Muscle Biology. 2 cr. hrs.
Topics covered include: skeletal, cardiac and smooth muscle relative to their regulation, structure and function. Emphasizes similarities and differences between these three muscle types with regard to structural organizations, composition, mechanics and kinetics. In addition, covers development, regulation and disease states. Emphasizes critical reading of primary scientific literature. Prereq: BIOL 3701 or equiv.

BIOL 8704. Cellular Homeostasis. 2 cr. hrs.
Detailed study of the proteins and pathways involved in the maintenance of cell volume, pH, and ionic balance, including the analysis of the function of plasma membrane transporter and channel proteins. The emphasis will be on eukaryotic cells, but prokaryotic cells will also be covered. Prereq: BIOL 2301 or equiv., or cons. of instr.
BIOL 8801. Prokaryotic Molecular Genetics. 2 cr. hrs.
Basic principles of bacterial genetics and regulation of gene expression. Points of emphasis: 1) how genetics and regulation shape and are shaped by the biology of the organism, 2) principles that are important to all biologists, including the manipulation of bacteria in genetic cloning and protein production, 3) application of genetics to elucidate cell physiology and biochemistry. Prereq: BIOL 3801 or BIOL 4101 or BIOL 8102 or an equiv. of any of these; or cons. of instr.

BIOL 8802. Microbiology in the Environment. 2 cr. hrs.
The detection of microbial diversity, activity, growth and abundance in the environment using molecular methods. Involves examples from literature. Prereq: BIOL 3801 or equiv. or cons. of instr.

BIOL 8803. Microbial Diversity and Ecology. 2-3 cr. hrs.
Study of microbial phyligenic and physiological diversity underlying the ecological interactions in natural communities. Emphasizes quantitative molecular techniques and sequencing used in studying microbial communities in the environment. Develops critical thinking and writing skills in determining research objectives and testing hypotheses. Prereq: none.

BIOL 8931. Topics in Biology. 1-3 cr. hrs.
Subject matter variable as determined by needs of biological sciences graduate students. Students may enroll more than once as subject matter changes. Prereq: Cons. of dept. ch.

BIOL 8953. Seminar in Biochemistry and Genetics. 1-3 cr. hrs.
Topics of current interest in biochemistry and genetics. Prereq: Cons. of instr.

BIOL 8954. Seminar in Plant Molecular Biology. 1-3 cr. hrs.
Topics of current interest in plant molecular biology. Prereq: Cons. of instr.

BIOL 8955. Seminar in Neuroscience. 1-3 cr. hrs.
Topics of current interest in neuroscience. Prereq: Cons. of instr.

BIOL 8956. Seminar in Cell and Developmental Biology. 1-3 cr. hrs.
Topics of current interest in cell and developmental biology. Prereq: BIOL 2301 or equiv.; or cons. of instr.

BIOL 8957. Seminar in Physiology. 1-3 cr. hrs.
Topics of current interest in physiology. Prereq: Cons. of instr.

BIOL 8955. Independent Study in Biological Sciences. 1-3 cr. hrs.
Investigations in selected areas of biology. Prereq: Cons. of instr. and cons. of dept. ch.

BIOL 8999. Doctoral Dissertation. 1-12 cr. hrs.
S/U grade assessment. Prereq: Cons. of dept. ch.

BIOL 9970. Graduate Standing Continuation: Less than Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9974. Graduate Fellowship: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9975. Graduate Assistant Teaching: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9976. Graduate Assistant Research: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9984. Master's Comprehensive Examination Preparation: Less than Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9985. Master's Comprehensive Examination Preparation: Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9986. Master's Comprehensive Examination Preparation: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9987. Doctoral Comprehensive Examination Preparation: Less than Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9988. Doctoral Comprehensive Examination Preparation: Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9989. Doctoral Comprehensive Examination Preparation: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9995. Master's Thesis Continuation: Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9996. Master's Thesis Continuation: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.
BIOL 9998. Doctoral Dissertation Continuation: Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.

BIOL 9999. Doctoral Dissertation Continuation: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Prereq: Cons. of dept. ch.