Biological Sciences (BSCI)

Chairperson: Michelle Mynlieff, 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, and offers students research experiences using all areas of modern biological techniques to study molecular, cellular, tissue, organ, systems and organism functioning.

Prerequisites for Admission

Applicants are expected to have completed a bachelor’s degree in biology or related field. As a general rule, strong preference is given to applicants to the doctoral program (https://www.marquette.edu/grad/programs-biological-sciences.php). Only in exceptional circumstances are students admitted to the master's program. A master's degree is not a prerequisite for admittance to the doctoral program.

Application Deadline

Priority deadline is December 1. This program accepts applicants on a rolling basis as space permits, but first consideration for admission and funding is given to those applications submitted by the priority deadline.

Application Requirements

Applicants must submit, directly to the Graduate School:

1. A completed online (http://marquette.edu/grad/future_apply.shtml/) application form and fee.
2. Copies of all college/university transcripts except Marquette.
3. A personal statement that outlines the applicant’s professional goals and that explains how the Marquette Biological Sciences graduate program fits within these goals. The statement should be as specific as possible, mentioning specific research laboratories or courses of study, as appropriate.
4. Three letters of recommendation that give evidence of the applicant's scholarly promise.
5. (For international applicants only) a TOEFL score or other acceptable proof of English proficiency.

Optional application requirements: GRE scores (General Test); GRE scores (Subject Test).

Upon admission, final official transcripts from all previously attended colleges/universities, with certified English translations if original language is not English, must be submitted to the Graduate School within the first five weeks of the term of admission or a hold preventing registration for future terms will be placed on the student’s record.

Biological Sciences Master of Science

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.

Master’s students must complete a total of 30 credit hours, including 21 credit hours of course work and research, three credit hours of seminar courses and six credit hours of thesis work. Eighteen of the 30 credit hours must be taken in biological sciences. During each term in residency, master's students are also required to enroll in BIOL 6952 Department Colloquium.

Master's students must submit a thesis outline to their advisory committee and successfully defend the outline. This defense constitutes the qualifying exam. At the completion of the program, master's students must submit a thesis that is approved by their advisory committee and must present a public seminar on their thesis research.

Required course work:
Biological Sciences Doctorate

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

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 their advisory committee, 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. Following advancement to candidacy, students must submit a Dissertation Research Plan that is approved by their advisory committee.

A typical doctoral student completes a minimum required 24 credit hours of course work and 12 credit hours of dissertation work. Course work includes a minimum of six 2-3 credit graduate lecture courses, 5 credits of research, a required writing course BIOL 8005 Scientific Writing, and 5 one-credit seminar courses. All students must enroll in BIOL 6952 Department Colloquium during each term in residence.

The student must submit and defend a dissertation and present a public research seminar after completing all other formal requirements for the doctoral degree.

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<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>BIOL 5102</td>
<td>Experimental Molecular Biology</td>
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<td>Genomics and Bioinformatics</td>
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<td>BIOL 5532</td>
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<td>BIOL 5401</td>
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<td>BIOL 8801</td>
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<td>BIOL 8802</td>
<td>Microbiology in the Environment</td>
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<td>BIOL 8803</td>
<td>Microbial Diversity and Ecology</td>
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<td>BIOL 8931</td>
<td>Topics in Biology</td>
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<td>BIOL 8995</td>
<td>Independent Study in Biological Sciences</td>
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<td>BISC 5140</td>
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<td>CHEM 5530</td>
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<td>COSC 5610</td>
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<td>MSSC 5720</td>
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<td>PSYC 8101</td>
<td>Advanced Statistics and Design 1</td>
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Required Research courses:

| BIOL 6096 | Laboratory Rotations in Biology                     | 3     |
| BIOL 6097 | Laboratory Research in Biology                      | 3     |

Required writing course:

| BIOL 8005 | Scientific Writing                                  | 3     |

Seminar courses (1 cr. each) - Choose five courses from the following:

| BIOL 8953 | Seminar in Biochemistry and Genetics               | 3     |
| BIOL 8954 | Seminar in Plant Molecular Biology                 | 3     |
| BIOL 8955 | Seminar in Neuroscience                            | 3     |
| BIOL 8956 | Seminar in Cell and Developmental Biology          | 3     |
| BIOL 8957 | Seminar in Physiology                               | 3     |
| BIOL 8958 | Seminar in Ecology and Evolutionary Biology        | 3     |

Required dissertation credits: 12
Courses

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 3101 or equiv.

BIOL 5201. Genomics and Bioinformatics. 3 cr. hrs.
The analysis of the structure, organization, function and evolution of prokaryotic and eukaryotic genomes. Students gain an understanding of how recent technological advances have revolutionized the field of genomics and of how large genomic datasets are generated, analyzed and visualized.

BIOL 5401. Advanced Ecology. 3 cr. hrs.
Attain in-depth understanding of the ecology of the natural world beyond the scope of introductory-level general ecology. Learn about patterns and processes of ecological populations and communities, the mechanisms believed to be responsible for these processes, and the emergent properties of ecosystems. Focus on major theories in ecology and the empirical investigations that support or refute these theories. Read classic papers that introduced or popularized major theories in ecology, as well as more recent empirical tests of those theories.

BIOL 5403. Tropical Ecology in Panama. 3 cr. hrs.
Tropical Ecology is the study of the biotic and abiotic interactions that shape the origin, maintenance and consequences of species diversity in the tropics. The incredibly high species diversity found in tropical forests has intrigued biologists for centuries, including such luminaries as Darwin and Wallace and continues to engage biologists today. Explores a variety of different forest types within the Republic of Panama to gain an appreciation for the basic patterns and processes of tropical forests and the mechanisms believed to be responsible for them. Modeled after the Organization for Tropical Biology’s Tropical Ecology Field Course.

BIOL 5404. Molecular Evolution. 3 cr. hrs.
Covers introductory topics in molecular evolution based on readings from the literature. Topics include online sequence databases, sequence alignment, detecting natural selection, building phylogenetic trees, testing alternative phylogenetic hypotheses, molecular clocks, reconstructing ancestral sequences and gene duplication and loss. Students learn to use several software packages to perform these analyses.

BIOL 5410. Conservation Biology. 3 cr. hrs.
The goals of conservation biology are to understand the causes and consequences of biodiversity loss – from genes to populations to species to ecosystems – and to develop tools and techniques to conserve biodiversity. Reviews what is known about the causes and consequences of current biodiversity loss, established and emerging strategies and tools to conserve biodiversity, and the ecological and evolutionary theory underlying these strategies. Includes population-modeling approaches such as population viability analysis, life-history tables, and sustainable harvest models, and conservation techniques such as species recovery plans, reserve design, habitat suitability models, seed banks, and restoration ecology. Focuses on the implications of biodiversity for ecosystem function and services, as well as the implications of conservation for policy, economics, and society. Builds essential skills for a career in biology, natural-resource management or conservation, including critical review of evidence and scientific literature, quantitative and conceptual modeling and practical decision making.

BIOL 5532. Biochemistry 2: Bioenergetics and Metabolism. 3 cr. hrs.
An exploration of the thermodynamic, cellular and molecular features contributing to the organization and regulation of major metabolic pathways in plants and animals. Major topics focus on the thermodynamic and mechanistic principles governing pathways associated with carbohydrate, nucleic acid, lipid and amino acid metabolism. The integration, regulation and origins of these metabolic systems are explored in the context of biotechnology and disease.

BIOL 5703. Exercise Physiology. 3 cr. hrs.
Study of the effects of acute and chronic exercise on selected organ systems. Particular emphasis is 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 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: Cons. of dept. ch.

BIOL 6097. Laboratory Research in Biology. 1-3 cr. hrs.
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: BIOL 6096 and 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.
Faculty-supervised, independent study/research of a specific area or topic in 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 8005. Scientific Writing. 2 cr. hrs.
Focuses on the basics of scientific writing and introduces effective writing techniques. Focuses on manuscript and proposal writing. Introduces students to different facets of the writing process such as figure design, peer review and plagiarism. Prereq: Second-year graduate student; or cons. of instr.

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 3101 or equiv.; or cons. of intr.

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 3101 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 3201 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 3301 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 3301 or equiv.; or BIOL 4601 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 3101 or BIOL 4801 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 4801 or equiv. or cons. of instr.

BIOL 8803. Microbial Diversity and Ecology. 2-3 cr. hrs.
Study of microbial phylogenetic 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.
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: Cons. of instr.

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

BIOL 8958. Seminar in Ecology and Evolutionary Biology. 1 cr. hr.
Topics of current interest in Ecology and Evolutionary Biology are studied. Prereq: Cons. of instr.

BIOL 8995. Independent Study in Biological Sciences. 1-3 cr. hrs.
Faculty-supervised, independent study/research of a specific area or topic in 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. Designated as less than half-time status only, cannot be used in conjunction with other courses, and does not qualify students for financial aid or loan deferment. Prereq: Cons. of dept. ch.

BIOL 9974. Graduate Fellowship: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed. Prereq: Cons. of dept. ch.

BIOL 9975. Graduate Assistant Teaching: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed. Prereq: Cons. of dept. ch.

BIOL 9976. Graduate Assistant Research: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Designated as full-time status. If a student is already registered in other courses full time, this continuation course is not needed. Prereq: Cons. of dept. ch.

BIOL 9984. Master’s Comprehensive Examination Preparation: Less than Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week toward their master’s comprehensive exam. Prereq: Cons. of dept. ch.

BIOL 9985. Master’s Comprehensive Examination Preparation: Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week toward their master’s comprehensive exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department. Prereq: Cons. of dept. ch.

BIOL 9986. Master’s Comprehensive Examination Preparation: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week toward their master’s comprehensive exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department. Prereq: Cons. of dept. ch.

BIOL 9987. Doctoral Qualifying Examination Preparation: Less than Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of less than half-time status. Requires that the student is working less than 12 hours per week toward their doctoral qualifying exam. Prereq: Cons. of dept. ch.

BIOL 9988. Doctoral Qualifying Examination Preparation: Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week toward their doctoral qualifying exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department. Prereq: Cons. of dept. ch.

BIOL 9989. Doctoral Qualifying Examination Preparation: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week toward their doctoral qualifying exam. May be taken in conjunction with credit-bearing or other non-credit courses to result in the status indicated, as deemed appropriate by the department. Prereq: Cons. of dept. ch.
BIOL 9995. Master's Thesis Continuation: Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation. Prereq: Cons. of dept. ch.

BIOL 9996. Master's Thesis Continuation: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their master's thesis. All six thesis credits required for the degree should be completed before registering for non-credit Master's Thesis Continuation. Prereq: Cons. of dept. ch.

BIOL 9998. Doctoral Dissertation Continuation: Half-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of half-time status. Requires that the student is working more than 12 to less than 20 hours per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation. Prereq: Cons. of dept. ch.

BIOL 9999. Doctoral Dissertation Continuation: Full-Time. 0 cr. hrs.
Fee. SNC/UNC grade assessment. Allows a student to be considered the equivalent of full-time status. Requires that the student is working 20 hours or more per week on their doctoral dissertation. All 12 dissertation credits required for the degree should be completed before registering for non-credit Doctoral Dissertation Continuation. Prereq: Cons. of dept. ch.