

Biological Sciences, PHD

Chairperson: Michelle Mynlieff, Ph.D.

Department of Biological Sciences website (<http://www.marquette.edu/biology/graduate-studies.shtml/>)

Degree Offered

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.

CAREER SKILLS REQUIREMENT FOR Ph.D. STUDENTS

Marquette University is committed to preparing our students to become exemplary leaders in their chosen academic and professional fields by preparing them for careers in which they find purpose and value by engaging in Ignatian pedagogical reflection and practice. The purpose of the career skills requirement is to ensure all doctoral students have the opportunity to reflect on their desired career and to acquire essential career-related skills needed for them to pursue their chosen path.

Students enrolled in Ph.D. programs in Fall 2024 and beyond at Marquette must complete three career skills requirements. Requirements are satisfied by one or more of approved courses, workshops, or practical experiences in each category, as approved by the Graduate School. Completion of each skill will be noted on the student's transcript.

Career Discernment

Students will be able to identify and prepare for career pathways that are consistent with their values.

Objectives:

1. Understand realities of academic job market for your discipline, creating space for career imagination and understand potential career paths.
2. Exploration of, and defining student's own identity/experiences/values/strengths/gifts and how the career pathway fits with those values.
3. Students will learn to identify and attain the skills and experiences necessary to obtain the career pathway they desire.

Code	Title	Hours
Choose 1:		
GRAD 8097	Career Discernment/Career Diversity Skills (Career Development Bootcamp)	0
GRAD 8097	Career Discernment/Career Diversity Skills (Seminar Series)	0
GRAD 8097	Career Discernment/Career Diversity Skills (Ph.D. Pathways)	0

Communication

Students will be able to communicate their ideas and scholarship effectively to audiences beyond those in their discipline.

Objectives:

1. Demonstrate the ability to communicate (e.g., research, expertise, experiences) effectively and ethically with disciplinary, cross-disciplinary, and nonacademic audiences.
2. Demonstrate the ability to communicate effectively and ethically within various contexts, formats, and media.
3. Demonstrate the ability to effectively deliver a presentation and facilitate discussion.

Code	Title	Hours
Choose 1:		
GRAD 8098	Communication Skills (Seminar Series)	0
GRAD 8098	Communication Skills (Three Minute Thesis)	0
BIOL 8005	Scientific Writing	2
GRAD 8961	Science Storytelling	1

Understanding Diversity, Equity and Inclusion

Students will understand the importance of diversity, equity and inclusion and how issues of DEI are relevant to their career pathways.

Objectives:

- 1. Be aware of and able to identify how explicit and implicit bias impacts work life and understand possible strategies to address this bias.
- 2. Be able to articulate the value of universal design principles and ethical application to area of study.
- 3. Be able to work and interact effectively with persons from diverse backgrounds with varied values, ideas, and opinions.

Code	Title	Hours
GRAD 8099	Diversity, Equity and Inclusion Skills	0

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 the required 2-credit courses BIOL 8005 Scientific Writing and BIOL 8004 Advanced Experimental Design, a minimum of five 2-3 credit graduate lecture courses, 5 credits of research courses, and five 1-credit seminar courses. All students must enroll in the no-credit BIOL 6952 Department Colloquium during each term in residence.

In order to meet the residency requirement, doctoral students in the Department of Biological Sciences must be enrolled with full-time status for at least two consecutive academic years while working under the direction of their advisory committee chair and advisory committee.

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

Code	Title	Hours
Required experimental design and writing courses:		4
BIOL 8004	Advanced Experimental Design	
BIOL 8005	Scientific Writing	
Lecture courses (2-3 cr. each) - Choose five courses from the following:		10-15
BIOL 5102	Experimental Molecular Biology	
BIOL 5201	Genomics and Bioinformatics	
BIOL 5532	Biochemistry 2: Bioenergetics and Metabolism	
BIOL 5401	Advanced Ecology	
BIOL 5403	Tropical Ecology in Panama	
BIOL 5404	Molecular Evolution	
BIOL 5703	Exercise Physiology	
BIOL 5806	Immunobiology	
BIOL 8007	Biometry	
BIOL 8101	Protein Structure and Function	
BIOL 8102	Biochemistry and Function of Nucleic Acids	
BIOL 8110	Proteostasis	
BIOL 8201	Epigenetics	
BIOL 8202	Principles of Eukaryotic Genetics	
BIOL 8301	Imaging and Cytoskeletons	
BIOL 8302	Protein Trafficking and Organelle Identity in Eukaryotic Cells	
BIOL 8603	Cell and Molecular Biology of Early Development	
BIOL 8701	Advanced Physiology and Organ Systems	

BIOL 8704	Cellular Homeostasis	
BIOL 8801	Prokaryotic Molecular Genetics	
BIOL 8802	Microbiomes in Health and the Environment	
BIOL 8803	Microbial Diversity and Ecology	
BIOL 8931	Topics in Biology	
BIOL 8995	Independent Study in Biological Sciences	
BISC 5140	Functional Neuroanatomy	
CHEM 5530	Biochemistry 1: Macromolecular Structure and Function	
COSC 5610	Data Mining	
MSSC 5720	Statistical Methods	
MSSC 5740	Biostatistical Methods and Models	
PSYC 8101	Advanced Statistics and Design 1	
Required research courses:		5
BIOL 6096	Laboratory Rotations in Biology	
BIOL 6097	Laboratory Research in Biology	
Seminar courses (1 cr. each) - Choose five courses from the following:		5
BIOL 8953	Seminar in Biochemistry and Genetics	
BIOL 8954	Seminar in Plant Molecular Biology	
BIOL 8955	Seminar in Neuroscience	
BIOL 8956	Seminar in Cell and Developmental Biology	
BIOL 8957	Seminar in Physiology	
BIOL 8958	Seminar in Ecology and Evolutionary Biology	
BIOL 8959	Seminar in Microbiology	
Required dissertation credits:		12
BIOL 8999	Doctoral Dissertation	
Total Credit Hours:		36-41

University Policies

- Academic Censure - Graduate School (<https://bulletin.marquette.edu/policies/academic-censure/graduate/>)
- Academic Integrity (<https://bulletin.marquette.edu/policies/academic-integrity/>)
- Academic Misconduct (<https://bulletin.marquette.edu/policies/academic-misconduct-policy/>)
- Academic Program Definitions (<https://bulletin.marquette.edu/policies/academic-programs-defined/>)
- Accelerated Degree Programs (<https://bulletin.marquette.edu/policies/accelerated-degree-programs/>)
- Attendance - Graduate School (<https://bulletin.marquette.edu/policies/attendance/graduate/>)
- Awarding Diplomas and Certificates (<https://bulletin.marquette.edu/policies/awarding-diplomas-certificates/>)
- Background Checks, Drug Testing (<https://bulletin.marquette.edu/policies/background-checks-drug-testing/>)
- Class Rank (<https://bulletin.marquette.edu/policies/class-rank/>)
- Commencement (<https://bulletin.marquette.edu/policies/commencement/>)
- Course Levels (<https://bulletin.marquette.edu/policies/course-levels/>)
- Credit Hour (<https://bulletin.marquette.edu/policies/credit/>)
- Credit Load - Graduate School (<https://bulletin.marquette.edu/policies/credit-load/graduate/>)
- Faculty Grading (<https://bulletin.marquette.edu/policies/faculty-grading/>)
- Family Education Rights and Privacy Act-FERPA (<https://bulletin.marquette.edu/policies/ferpa/>)
- Grade Appeals (<https://bulletin.marquette.edu/policies/grade-appeals/>)
- Grading System - Graduate School and Graduate School of Management (<https://bulletin.marquette.edu/policies/grading-system/graduate-management/>)
- Graduation - Graduate School (<https://bulletin.marquette.edu/policies/graduation/graduate/>)
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- Last Date of Attendance/Activity (<https://bulletin.marquette.edu/policies/last-dateof-attendance-activity/>)
- Military Call to Active Duty or Training (<https://bulletin.marquette.edu/policies/militarycall-active-duty-training/>)
- Registration - Graduate School (<https://bulletin.marquette.edu/policies/registration/graduate/>)
- Repeated Courses - Graduate School (<https://bulletin.marquette.edu/policies/repeated-courses/graduate/>)

- Student Data Use and Privacy (<https://bulletin.marquette.edu/policies/student-data-use-privacy/>)
- Transcripts-Official (<https://bulletin.marquette.edu/policies/transcripts-official/>)
- Transfer Course Credit - Graduate School (<https://bulletin.marquette.edu/policies/transfer-course-credit-policy/graduate/>)
- Withdrawal - Graduate School (<https://bulletin.marquette.edu/policies/withdrawals/graduate/>)

Graduate School Policies

- Academic Performance (<https://bulletin.marquette.edu/graduate/policies/academic-performance/>)
- Advising (<https://bulletin.marquette.edu/graduate/policies/advising/>)
- Certificate Concurrent Enrollment (<https://bulletin.marquette.edu/graduate/policies/certificate-concurrent-enrollment/>)
- Conduct (<https://bulletin.marquette.edu/graduate/policies/conduct/>)
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- Doctoral Degree Academic Program Overview (<https://bulletin.marquette.edu/graduate/policies/doctoral-program-overview/>)
- Graduate Credit (<https://bulletin.marquette.edu/graduate/policies/graduate-credit/>)
- Graduate School Policies (<https://bulletin.marquette.edu/graduate/policies/>)
- Independent Study (<https://bulletin.marquette.edu/graduate/policies/independent-study/>)
- Intellectual Property (<https://bulletin.marquette.edu/graduate/policies/intellectual-property/>)
- Master's Degree Academic Program Overview (<https://bulletin.marquette.edu/graduate/policies/masters-program-overview/>)
- Merit-Based Aid Registration Requirements (<https://bulletin.marquette.edu/graduate/policies/merit-based-aid-registration-requirements/>)
- Research Involving Humans, Animals, Radioisotopes or Recombinant DNA/Transgenic Organisms (<https://bulletin.marquette.edu/graduate/policies/research-involving-humans-animals-radioisotopes-recombinant-dnatransgenic-organisms/>)
- Temporary Withdrawal from Graduate Program (<https://bulletin.marquette.edu/graduate/policies/temporary-withdrawal-graduate-program/>)
- Time Limitations (<https://bulletin.marquette.edu/graduate/policies/time-limitations/>)
- Working with Minors (<https://bulletin.marquette.edu/graduate/policies/working-minors/>)

Biological Sciences Graduate Programs

- Biological Sciences, MS (<https://bulletin.marquette.edu/graduate/biological-sciences-ms/>)
- Biological Sciences, PHD (p. 1)

BIOL 5102 Experimental Molecular Biology (3 credits)

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.

Prerequisite: BIOL 3101 or CHEM 4530 and BIOL 4532 or equiv.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2019 Fall Term, 2018 Fall Term, 2017 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205102>)

BIOL 5201 Genomics and Bioinformatics (3 credits)

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.

Level of Study: Graduate

Last four terms offered: 2023 Fall Term, 2022 Fall Term, 2021 Fall Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205201>)

BIOL 5401 Advanced Ecology (3 credits)

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.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2020 Fall Term, 2018 Fall Term, 2017 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205401>)

BIOL 5403 Tropical Ecology in Panama (3 credits)

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.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2023 Spring Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205403>)

BIOL 5404 Molecular Evolution (3 credits)

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.

Level of Study: Graduate

Last four terms offered: 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205404>)

BIOL 5410 Conservation Biology (3 credits)

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.

Level of Study: Graduate

Last four terms offered: 2023 Fall Term, 2021 Fall Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205410>)

BIOL 5501 Cellular Neurobiology (3 credits)

General principles of the organization and function of the vertebrate nervous system. Topics include the cellular and molecular mechanisms of cell excitability, synaptic transmission, and how neuromodulators regulate these functions in neuronal networks; mechanisms of learning and memory at the synaptic level; sensory systems from transduction to higher-order processing; and motor systems from the neuromuscular junction to voluntary movement to provide an integrative understanding of the nervous system. A functional approach to neuroanatomy are integrated throughout the course. 3 hrs. lec., disc.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205501>)

BIOL 5532 Biochemistry 2: Bioenergetics and Metabolism (3 credits)

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.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2023 Spring Term, 2022 Spring Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205532>)

BIOL 5703 Exercise Physiology (3 credits)

Study of the effects of acute and chronic exercise on selected organ systems. Particular emphasis is placed on muscle, cardiovascular, respiratory and environmental physiology.

Level of Study: Graduate

Last four terms offered: 2015 Spring Term, 2012 Spring Term, 2010 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205703>)

BIOL 5806 Immunobiology (3 credits)

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.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2023 Spring Term, 2022 Spring Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%205806>)

BIOL 6001 Radioisotope Safety (2 credits)

Ionizing radiation: proper safety procedures in the independent use of radioisotopes and current regulatory guidelines and licensing procedures.

Prerequisite: BIOL 1002 and CHEM 1002; or BIOL 1009 and CHEM 1002; or cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2010 Summer Term, 2008 Summer Term, 2007 Summer Term, 2004 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%206001>)

BIOL 6096 Laboratory Rotations in Biology (1-3 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Summer Term, 2024 Spring Term, 2023 Fall Term, 2023 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%206096>)

BIOL 6097 Laboratory Research in Biology (1-3 credits)

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.

Prerequisite: BIOL 6096 and cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2023 Fall Term, 2023 Spring Term, 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%206097>)

BIOL 6952 Department Colloquium (0 credits)

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.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2023 Fall Term, 2023 Spring Term, 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%206952>)

BIOL 6995 Independent Study in Biological Sciences (1-3 credits)

Faculty-supervised, independent study/research of a specific area or topic in biology.

Prerequisite: Cons. of instr. and cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2014 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%206995>)

BIOL 6999 Master's Thesis (1-6 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2020 Fall Term, 2019 Spring Term, 2016 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%206999>)

BIOL 8004 Advanced Experimental Design (2 credits)

Designed to teach the central components of the scientific method with an emphasis on hypothesis development, experimental design, data analysis and data presentation.

Prerequisite: Cons. of dept.

Level of Study: Graduate

Last four terms offered: 2023 Fall Term, 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208004>)

BIOL 8005 Scientific Writing (2 credits)

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.

Prerequisite: Cons. of dept.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term, 2022 Spring Term, 2021 Fall Term, 2020 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208005>)

BIOL 8007 Biometry (2 credits)

Focuses on formalizing experimental design into a quantitative framework. Presented in a modern computational approach, emphasis is placed on model fitting, effect size estimation, and uncertainty, rather than strictly assessing 'significance' by means of p-values.

Prerequisite: BIOL 8004 or cons of instr.

Level of Study: Graduate

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208007>)

BIOL 8101 Protein Structure and Function (2 credits)

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.

Prerequisite: BIOL 3101 or equiv.; or cons. of instr.

Level of Study: Graduate

Last four terms offered: 2017 Fall Term, 2014 Spring Term, 2012 Spring Term, 2009 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208101>)

BIOL 8102 Biochemistry and Function of Nucleic Acids (2 credits)

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.

Prerequisite: BIOL 3101 or cons. of instr.

Level of Study: Graduate

Last four terms offered: 2013 Spring Term, 2010 Fall Term, 2006 Fall Term, 1998 Summer Session 1

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208102>)

BIOL 8110 Proteostasis (2 credits)

Designed to follow proteins from birth at the ribosome, through life as a functional component of the cell, and into degradation at the end of the life-cycle.

Prerequisite: BIOL 3101 or equiv., or cons. of instr.

Level of Study: Graduate

Last four terms offered: 2023 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208110>)

BIOL 8201 Epigenetics (2 credits)

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.

Prerequisite: BIOL 3201 or equiv. and BIOL 3301 or equiv. or cons. of instr.

Level of Study: Graduate

Last four terms offered: 2023 Fall Term, 2020 Spring Term, 2017 Spring Term, 2009 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208201>)

BIOL 8202 Principles of Eukaryotic Genetics (2 credits)

Genetics of eukaryotic model organisms with a focus on genetic approaches to the analysis of contemporary biological problems. Eukaryotic chromosome structure and function.

Prerequisite: BIOL 3201 or equiv.

Level of Study: Graduate

Last four terms offered: 2013 Fall Term, 2011 Fall Term, 2010 Fall Term, 2008 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208202>)

BIOL 8301 Imaging and Cytoskeletons (2 credits)

Discusses the principles of cytoskeleton and molecular motors and modern imaging tools developed for the studies of cellular mechanisms.

Prerequisite: BIOL 2301 or equiv.

Level of Study: Graduate

Last four terms offered: 2018 Fall Term, 2013 Fall Term, 2011 Fall Term, 2011 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208301>)

BIOL 8302 Protein Trafficking and Organelle Identity in Eukaryotic Cells (2 credits)

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.

Prerequisite: BIOL 3301 or equiv.

Level of Study: Graduate

Last four terms offered: 2020 Fall Term, 2019 Spring Term, 2012 Fall Term, 2010 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208302>)

BIOL 8603 Cell and Molecular Biology of Early Development (2 credits)

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.

Prerequisite: BIOL 3301 or equiv.; or BIOL 4601 or equiv.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2020 Fall Term, 2018 Fall Term, 2016 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208603>)

BIOL 8701 Advanced Physiology and Organ Systems (2 credits)

Focuses on organ systems and how organs contribute to the overall physiology of organisms. Topics include homeostatic control and disease states.

Prerequisite: BIOL 4701 or equiv.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208701>)

BIOL 8704 Cellular Homeostasis (2 credits)

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.

Prerequisite: BIOL 2301 or equiv., or cons. of instr.

Level of Study: Graduate

Last four terms offered: 2018 Spring Term, 2016 Spring Term, 2014 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208704>)

BIOL 8801 Prokaryotic Molecular Genetics (2 credits)

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.

Prerequisite: BIOL 3101 or BIOL 4801 or BIOL 8102 or an equiv. of any of these; or cons. of instr.

Level of Study: Graduate

Last four terms offered: 2012 Fall Term, 2010 Fall Term, 2008 Fall Term, 2006 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208801>)

BIOL 8802 Microbiomes in Health and the Environment (2 credits)

Exploration of the ways bacteria, archaea and viruses influence all ecosystems on the planet, from extreme environments to human bodies.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2018 Spring Term, 2015 Fall Term, 2013 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208802>)

BIOL 8803 Microbial Diversity and Ecology (2-3 credits)

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.

Level of Study: Graduate

Last four terms offered: 2017 Spring Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208803>)

BIOL 8931 Topics in Biology (1-3 credits)

Subject matter variable as determined by needs of biological sciences graduate students. Students may enroll more than once as subject matter changes.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Spring Term, 2021 Fall Term, 2021 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208931>)

BIOL 8953 Seminar in Biochemistry and Genetics (1 credits)

Topics of current interest in biochemistry and genetics.

Prerequisite: Cons. of instr.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2022 Fall Term, 2022 Spring Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208953>)

BIOL 8954 Seminar in Plant Molecular Biology (1 credits)

Topics of current interest in plant molecular biology.

Prerequisite: Cons. of instr.

Level of Study: Graduate

Last four terms offered: 2019 Fall Term, 2010 Fall Term, 2008 Fall Term, 2006 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208954>)

BIOL 8955 Seminar in Neuroscience (1 credits)

Topics of current interest in neuroscience.

Prerequisite: Cons. of instr.

Level of Study: Graduate

Last four terms offered: 2018 Fall Term, 2018 Spring Term, 2017 Fall Term, 2017 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208955>)

BIOL 8956 Seminar in Cell and Developmental Biology (1 credits)

Topics of current interest in cell and developmental biology.

Prerequisite: Cons. of instr.

Level of Study: Graduate

Last four terms offered: 2023 Fall Term, 2023 Spring Term, 2022 Spring Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208956>)

BIOL 8957 Seminar in Physiology (1 credits)

Topics of current interest in physiology.

Prerequisite: Cons. of instr.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2021 Fall Term, 2019 Fall Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208957>)

BIOL 8958 Seminar in Ecology and Evolutionary Biology (1 credits)

Topics of current interest in ecology and evolutionary biology.

Prerequisite: Cons. of instr.

Level of Study: Graduate

Last four terms offered: 2023 Fall Term, 2022 Fall Term, 2021 Fall Term, 2021 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208958>)

BIOL 8959 Seminar in Microbiology (1 credits)

Topics of current interest in microbiology.

Prerequisite: Cons. of instr.

Level of Study: Graduate

Last four terms offered: 2023 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208959>)

BIOL 8995 Independent Study in Biological Sciences (1-3 credits)

Faculty-supervised, independent study/research of a specific area or topic in biology.

Prerequisite: Cons. of instr. and cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2020 Spring Term, 2018 Fall Term, 2017 Spring Term, 2016 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208995>)

BIOL 8999 Doctoral Dissertation (1-12 credits)

S/U grade assessment.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2023 Fall Term, 2023 Spring Term, 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%208999>)

BIOL 9970 Graduate Standing Continuation: Less than Half-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Summer Term, 2024 Spring Term, 2023 Summer Term, 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209970>)

BIOL 9974 Graduate Fellowship: Full-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2021 Spring Term, 2020 Fall Term, 2020 Spring Term, 2019 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209974>)

BIOL 9975 Graduate Assistant Teaching: Full-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2022 Fall Term, 2021 Spring Term, 2020 Fall Term, 2020 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209975>)

BIOL 9976 Graduate Assistant Research: Full-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Spring Term, 2023 Fall Term, 2023 Spring Term, 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209976>)

BIOL 9984 Master's Comprehensive Examination Preparation: Less than Half-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2009 Fall Term, 2009 Summer Term, 2008 Fall Term, 2008 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209984>)

BIOL 9985 Master's Comprehensive Examination Preparation: Half-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Summer Term, 2016 Spring Term, 2015 Fall Term, 2015 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209985>)

BIOL 9986 Master's Comprehensive Examination Preparation: Full-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2016 Spring Term, 2015 Fall Term, 2015 Summer Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209986>)

BIOL 9987 Doctoral Qualifying Examination Preparation: Less than Half-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2009 Fall Term, 2009 Summer Term, 2008 Summer Term, 2008 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209987>)

BIOL 9988 Doctoral Qualifying Examination Preparation: Half-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2018 Summer Term, 2016 Spring Term, 2015 Fall Term, 2015 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209988>)

BIOL 9989 Doctoral Qualifying Examination Preparation: Full-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2016 Summer Term, 2016 Spring Term, 2015 Fall Term, 2015 Spring Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209989>)

BIOL 9995 Master's Thesis Continuation: Half-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Summer Term, 2023 Summer Term, 2021 Summer Term, 2018 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209995>)

BIOL 9996 Master's Thesis Continuation: Full-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Summer Term, 2023 Summer Term, 2021 Summer Term, 2020 Summer Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209996>)

BIOL 9998 Doctoral Dissertation Continuation: Half-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Summer Term, 2023 Summer Term, 2023 Spring Term, 2022 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209998>)

BIOL 9999 Doctoral Dissertation Continuation: Full-Time (0 credits)

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.

Prerequisite: Cons. of dept. ch.

Level of Study: Graduate

Last four terms offered: 2024 Summer Term, 2023 Summer Term, 2022 Summer Term, 2021 Fall Term

Schedule of Classes (<https://bulletin.marquette.edu/class-search/?details&code=BIOL%209999>)