BIOLOGICAL SCIENCES

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- Bioinformatics and Data Analysis (Undergraduate Certificate) (https://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/biological-sciences/bioinformatics-data-analysis-ug-cert/)
- Biological Sciences (B.A.) (https://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/biological-sciences/biological-science-ba/)
- Biological Sciences (B.S.) (https://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/biological-sciences/biological-sciences-bs/)

- Biological Sciences Minor (https://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/biological-sciences/biological-sciences-minor/)

BIO 1011 The Basics of Climate Change Cr. 3
Satisfies General Education Requirement: Natural Scientific Inquiry
Global climate change is the defining issue of our time because it impacts every aspect of life, from the economy, to agriculture, health, and ecology, in every nation on Earth. The complexity and multidisciplinary nature of climate change, not to mention the preconceptions held by individuals, results in most people having only a limited understanding of the evidence for, predicted effects, and potential solutions to this issue. This course will present students with the scientific background necessary to evaluate the evidence for the theory of anthropogenic climate change and the global effects of climate change. Using the scientific method as a basis, we will explore the multi-disciplinary evidence behind climate change and its global and cross-cultural effects and discuss potential solutions based in adaptation and mitigation. Offered Yearly.

BIO 1030 Biology Today Cr. 3
Satisfies General Education Requirement: Natural Scientific Inquiry
Challenges to modern society from population growth, new diseases, environmental degradation, urban pollution; medical advances and ethical dilemmas in decoding human genome; impact of biological findings on political and personal decisions; issues considered in context of principles and strategies of modern biological research. Optionally, students may add a lab component by enrolling in Bio 1040 concurrently. Not for biology major credit. Offered Fall, Winter.

BIO 1040 Exploring Life Cr. 1
Satisfies General Education Requirement: Natural Sci Inquiry w/ Lab
Students will explore key elements of the scientific process, including hypothesis testing, scientific rigor, statistical significance, and peer review. Students will be introduced to fundamental properties and explore basic attributes of various biological systems at a variety of scales. Students will connect knowledge to current societal issues and practice scientific evaluation of arguments and information sources. This lab course is geared towards students who are not majoring in Biology, and is intended to be taken concurrently with BIO 1030 or BIO 1050 lectures. This course may not be taken for credit after BIO 1500 or BIO 1510, or any BIO class at the 2000-level or above. Offered Fall, Winter.
Prerequisites: BIO 1030 with a minimum grade of C- (may be taken concurrently) or BIO 1050 with a minimum grade of C- (may be taken concurrently)
Fees: $30

BIO 1050 An Introduction to Life Cr. 3
Satisfies General Education Requirement: Natural Scientific Inquiry
A factual and conceptual treatment of modern biology at the cell, organismal, and population levels of organization. Students not intending to take BIO 1501 or BIO 1511 labs may optionally add a lab component by enrolling in Bio 1040 concurrently. No credit after BIO 1500 or BIO 1510. Offered Every Term.

BIO 1500 Basic Life Diversity Cr. 3
Satisfies General Education Requirement: Natural Scientific Inquiry
This course provides an overview of the diversity of life on Earth and the processes that impact it. The primary objective of BIO 1500 is to expose students to the great variety of plants, fungi, protists, and animals, examining their structure, function, growth, ecology, evolution, and distribution. BIO 1500 and BIO 1501 must be elected as corequisites when taken for the first time. No credit after former BIO 1520. Offered Every Term.
Prerequisites: BIO 1050 with a minimum grade of C-, BIO Permit to Reg ACT/SAT with a test score minimum of 2, BIO Permit to Reg-(L1-L2) BPE with a test score minimum of 2, or BIO 1510 with a minimum grade of C-
Corequisite: BIO 1501

BIO 1501 Basic Life Diversity Laboratory Cr. 1
Satisfies General Education Requirement: Natural Sci Inquiry w/ Lab
Students will explore the branches of life and scientific classification. This course will cover physiological systems, Mendelian genetics and ecological relationships. Students will be introduced to fundamental scientific skills including critical reading and scientific writing, microscopy and use of basic laboratory equipment. BIO 1500 and BIO 1501 must be elected as corequisites when taken for the first time. Offered Every Term.
Corequisite: BIO 1500
Fees: $35

BIO 1510 Basic Life Mechanisms Cr. 3
Satisfies General Education Requirement: Natural Scientific Inquiry
This course provides an understanding of the structure, metabolism and reproduction of living things from the perspective of the cell. The course will focus on the role of biochemical and subcellular components including proteins, nucleic acids, and organelles in the nutrition, inheritance and development of plants and animals. The course will also relate these concepts to topical issues such as nutrition, human genetics, and recombinant DNA technology. BIO 1510 and BIO 1511 must be elected as corequisites when taken for the first time. Offered Every Term.
Prerequisites: BIO 1050 with a minimum grade of C-, BIO Permit to Reg ACT/SAT with a test score minimum of 2, BIO Permit to Reg-(L1-L2) BPE with a test score minimum of 2, or BIO 1500 with a minimum grade of C-
Corequisite: BIO 1511

BIO 1511 Basic Life Mechanisms Laboratory Cr. 1
Satisfies General Education Requirement: Natural Sci Inquiry w/ Lab
Students will explore the molecules and biochemical reactions that are vital to life. This course will cover classes of biomolecules, enzymes and life processes including cellular respiration and photosynthesis. Students will be introduced to fundamental scientific skills including critical reading and scientific writing, microscopy and use of basic laboratory equipment. BIO 1510 and BIO 1511 must be elected as corequisites when taken for the first time. Offered Every Term.
Corequisite: BIO 1510
Fees: $40

BIO 2270 Principles of Microbiology Cr. 3
Students will be instructed in the basic principles of microbial structure and function, microbial growth and control, microbial mechanism of pathogenesis, human immune responses, and disease control. Offered Winter, Spring/Summer.
Prerequisites: BIO 1510 with a minimum grade of C- and BIO 1511 with a minimum grade of C-
Corequisite: BIO 2271

BIO 2271 Principles of Microbiology Lab Cr. 2
Students will gain insight into the nature of scientific inquiry, the process by which knowledge is accumulated and accepted as illustrated, and the strengths and limitations of the scientific process and its progressive, self-correcting qualities. Observational and experimental skills will be imparted to students, using both traditional and discovery-based learning. The students will experience the scientific method first hand in performing experiments that reflect the current state of the art and demonstrate the principles underlying major concepts of modern microbiology. Students will also learn to properly record their data in a laboratory notebook. Offered Winter, Spring/Summer.
Prerequisites: BIO 1510 with a minimum grade of C- and BIO 1511 with a minimum grade of C-
Corequisite: BIO 2270
Fees: $145

BIO 2550 Fundamentals of Cell Biology for Neuroscience Cr. 4
This course is designed for undergraduate students majoring in Neuroscience. It introduces the student to the structure and function of the cell, which is the fundamental unit of life, and underlies the functionality of neurons and glia, the cells that make up the brain. Offered Every Term.
Prerequisites: BIO 1510 with a minimum grade of C-

BIO 2600 Introduction to Cell Biology Cr. 4
This course builds on the students' earlier introduction to the basic mechanisms of life and focuses the students on the structure and function of the cell, which is the fundamental unit of all life. It is designed for undergraduates who major in the Biological Sciences or other science majors, including science education, pre-allied health, and engineering. It is also intended for all students who seek an introductory knowledge of cell biology. Offered Every Term.
Prerequisites: BIO 1500 with a minimum grade of C- and BIO 1510 with a minimum grade of C-

BIO 2700 Evolution: Basic Concepts and Applications Cr. 3
Evolution, i.e. "descent with modification," is key to understanding life at the genetic, genomic, and organismal level. Many of the concepts and tools developed by evolutionary biologists have become mainstream concepts and tools in a large number of science areas. This course introduces these basic concepts and tools, and how they relate to key processes that shaped the diversity of organismal life. Course cannot be taken for credit after successful completion of BIO 4200 with a C- or better. Offered Every Term.
Prerequisites: BIO 1500 with a minimum grade of C-

BIO 2870 Anatomy and Physiology Cr. 5
Detailed study of structure and function of the major systems of the body: skeletal, nervous, muscular, endocrine, circulatory, respiratory, digestive, excretory, and reproductive. No major credit for Biological Sciences majors. Offered Every Term.
Prerequisites: BIO 1510 with a minimum grade of C- and BIO 1511 with a minimum grade of C-
Fees: $30

BIO 3070 Genetics Cr. 5
Transmission, nature and action of genetic material in organisms. Laboratory experiments to demonstrate principles of genetics. Offered for five credits to Honors students only; includes lab experience. Offered Every Term.
Prerequisites: (BIO 2550 with a minimum grade of C- or BIO 2600 with a minimum grade of C-) and BIO 1511 with a minimum grade of C-
Fees: $75

BIO 3100 Cellular Biochemistry Cr. 3
Biosynthesis and metabolism of proteins, carbohydrates, lipids, steroids, amino acids and nucleic acids. The basic principles of enzyme kinetics in living systems. Offered Every Term.
Prerequisites: (BIO 2550 with a minimum grade of C- or BIO 2600 with a minimum grade of C-) and CHM 1240 with a minimum grade of D-

BIO 3200 Human Physiology Cr. 3
Basic principles of human physiology, including major systems from a cellular, molecular, and integrative approach. Offered Every Term.
Prerequisites: BIO 2550 with a minimum grade of C-, BIO 2600 with a minimum grade of C-, or BIO 2870 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 3250 Molecular Mechanisms of Microbiology Cr. 3
Introduce students to fundamental mechanisms and the broad spectrum of modern microbiology. An evolutionary approach is used, emphasizing the interrelationships of structure and function on a scale ranging from molecular systems to ecosystems. The course addresses the anatomy, physiology, genetics, and behavior of microorganisms, and interactions of microbes with humans, plants and the environment. The influence of microbes on society will be emphasized by introducing microbial application in commercial products and microbial diseases in their co-evolution with host responses. Offered Fall.
Prerequisites: (1 of (BIO 2550 with a minimum grade of C- or BIO 2600 with a minimum grade of C-) or (BIO 1510 with a minimum grade of C- and CHM 1240 with a minimum grade of C-))
Corequisite: BIO 3251

BIO 3251 Molecular Mechanisms of Microbiology Lab Cr. 2
From the laboratory course, students will gain insight into the nature of scientific inquiry, the process by which knowledge is accumulated and accepted as illustrated, and the strengths and limitations of the scientific process and its progressive, self-correcting qualities. Observational and experimental skills will be imparted to students, using both traditional and discovery-based learning. The students will experience the scientific method first hand in performing experiments that reflect the current state of the art and demonstrate the principles underlying major concepts of modern microbiology. Students will also learn to properly record their data in a laboratory notebook. Offered Fall.
Prerequisites: BIO 3250 with a minimum grade of C- (may be taken concurrently)
Fees: $215

BIO 3270 Introductory Immunology Cr. 3
This course will provide a comprehensive overview of key concepts of innate and adaptive immunity in mammalian organisms, build student appreciation of the elegance and complexity in immune responses against infectious agents, and introduce their implications in autoimmune diseases, organ transplantation and the emerging cancer immunotherapy. Offered Intermittently.
Prerequisites: BIO 2600 with a minimum grade of C- or BIO 2550 with a minimum grade of C-

BIO 3500 Ecology and the Environment Cr. 3
Introduction to key ecological concepts illustrated with contemporary environmental issues; basic population, community, ecosystem, landscape, and global ecology. Offered Fall.
Prerequisites: BIO 1500 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Equivalent: ESG 3500

BIO 3800 Botany Cr. 3
Introduction to plant morphology, systematics, development, and physiology. Lectures and hands-on laboratory, readings and discussions. Offered Every Other Year.
Prerequisites: BIO 3070 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Fees: $40

BIO 4050 Science Advocacy and Public Engagement Cr. 2
This course will provide students with the opportunity to understand diverse types of science media as well as best practices and strategies for interacting with different kinds of audiences. Offered Fall.
Prerequisites: BIO 2550 with a minimum grade of C-, BIO 2600 with a minimum grade of C-, or COM 3150 with a minimum grade of C-
Equivalent: NEU 4050

BIO 4110 Biomedical Technology and Molecular Biology Cr. 4
General principles of molecular biology of prokaryotes and eukaryotes. Includes structures of DNA, RNA, and protein, DNA replication and repair, transcription and translation, gene regulation and gene expression. Emphasis on applications in medical biology and biotechnology. Fulfills General Education Writing Intensive Course in the Major requirement; each student writes reports and one long research paper on topic approved by instructor, in addition to other course writing requirements. Offered Fall.
Prerequisites: BIO 3070 with a minimum grade of C- and BIO 3100 with a minimum grade of C-

BIO 4120 Comparative Physiology Cr. 4
Physiological processes at the molecular, cellular, and organismal levels. Comparison of major physiological systems across groups of organisms. Lab consists of physiology exercises and lab reports that allow students to explore major conceptual themes in physiology. Fulfills General Education Writing Intensive Course in the Major requirement; each student writes reports, and one long research paper on topic approved by instructor, in addition to other course writing requirements. Offered Every Term.
Prerequisites: BIO 1500 with a minimum grade of C-, BIO 3070 with a minimum grade of C-, and BIO 3200 with a minimum grade of C-
Fees: $30

BIO 4130 General Ecology Cr. 4
Principles of population, community, ecosystem, and landscape ecology. Fulfills General Education Writing Intensive Course in the Major requirement; each student writes reports and one long research paper on topic approved by instructor, in addition to other course writing requirements. Offered Winter.
Prerequisites: BIO 3070 with a minimum grade of C- and BIO 3500 with a minimum grade of C-
Fees: $20

BIO 4140 Hormones and Behavior Cr. 3
Examines the relationship between hormones and behavior, taking a biological approach to behavioral questions that have long been of interest to Psychologists, Biologists and Neuroscientists. Explores the research area of Behavioral Endocrinology, a field that seeks biologically (in particular hormone)-based explanations of behavior. Offered Intermittently.
Prerequisites: PSY 1010 with a minimum grade of C and (PSY 3120 with a minimum grade of C or PSY 3330 with a minimum grade of C)
Equivalent: PSY 4140

BIO 4150 Neuronal Circuits Cr. 3
The course explores neuronal circuits (NCs) as functional units of the nervous system and highlights the importance of NCs as an intermediate level of organization, as they bridge the function of individual neurons with the performance of the nervous system as a whole. We will explore NCs through the use of invertebrate and small vertebrate models, and state-of-the-art experimental and theoretical methods. The course includes lectures, reading and discussing scientific articles, written assignments, and oral presentations. Offered Intermittently.
Prerequisite: BIO 3200 with a minimum grade of C-

BIO 4220 Biological Dimensions of Evolutionary Psychology Cr. 3
This course introduces the genetic and comparative tools used in evolutionary psychology and the major insights that have accumulated through these approaches. In the process, the course also discusses how these outcomes impact a wide range of research areas including philosophy, social sciences, political sciences, and economics. Offered Fall.
Prerequisite: BIO 1510 with a minimum grade of C- and (BIO 1500 with a minimum grade of C- or BIO 2700 with a minimum grade of C- or PSY 1010 with a minimum grade of C- or PSY 1020 with a minimum grade of C-)

BIO 4340 Regenerative Biology and Medicine Cr. 4
Introduces students specializing in biomedical engineering and premedical students to the conceptual and methodological principles of modern regenerative biology and medicine. Includes a review of research methods and achievements in this field and the translational applications of regenerative biology to tissue engineering and the development of regenerative therapies. Offered Winter, Spring/Summer.
Prerequisite: BIO 2600 with a minimum grade of C-

BIO 4350 Laboratory Research Experience in Molecular Bacterial Genetics Cr. 3
Discovery-based laboratory research experience centered on identification of genes controlling bacterial behavior. Students will identify genes that control the developmental life cycle of a soil bacterium, design experiments to characterize any genes identified, and characterize their role in regulating bacterial behavior. Students will employ a series of common bacteriology and molecular biology techniques including bacterial transformation, phenotypic assays, PCR amplification, cloning, plasmid isolation, immunoblot, and web-based bioinformatic analyses. Offered Intermittently.
Prerequisite: BIO 2200 with a minimum grade of C- and BIO 3070 with a minimum grade of C-
Fees: $60

BIO 4370 Microbial Communities Cr. 3
An introduction to the concept of microbial communities and their roles in health and the environment. The study of biofilms in disease, microbial communities in the environment, and human/animal microbiota will be covered. Offered Every Other Year.
Prerequisite: (BIO 2200 with a minimum grade of C- or BIO 3250 with a minimum grade of C-) and BIO 3070 with a minimum grade of C-

BIO 4420 Biogeography Cr. 3
An examination of current and past spatial distributions of biological diversity with an emphasis on the ecological, evolutionary, geological, and climatological processes underlying biogeographic variation. Offered Every Other Year.
Prerequisites: BIO 3500 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 4630 Histology Cr. 4
Characteristics and identification of normal mammalian tissues. Micro-anatomy of the mammal. Functional interpretation of microstructure and fine structure. Offered Winter, Spring/Summer.
Prerequisites: BIO 2600 with a minimum grade of C- or BIO 2870 with a minimum grade of C-
Fees: $20

BIO 4690 Molecular and Cellular Neurobiology Cr. 3
Focuses on the molecular and cellular aspects of neuronal function, from cellular signaling to sensory and motor function as well as behavior, learning and memory. Also covers the biological aspects of neuronal function, from molecules to cells to systems. Offered Fall.
Prerequisite: BIO 3200 with a minimum grade of C-

BIO 4795 Special Topics in Behavioral and Cognitive Neuroscience Cr. 3
This is an undergraduate course that is designed to be a participatory exploration with a faculty expert on an advanced, emergent, and/or stimulating topic within Neuroscience. This course will provide students with a detailed understanding of contemporary research topics in the broad interdisciplinary field of Behavioral and Cognitive Neuroscience, encompassing behavioral, clinical, cognitive, developmental, and systems neuroscience. Offered Intermittently.
Prerequisites: BIO 2600 with a minimum grade of C- and (PSY 1010 with a minimum grade of C- and PSY 1020 with a minimum grade of C-)
Repeatable for 6 Credits

BIO 4895 Special Topics in Cellular and Molecular Neuroscience Cr. 3
This is an undergraduate course that is designed to be a participatory exploration with a faculty expert on an advanced, emergent, and/or stimulating topic within Neuroscience. This course will provide students with a detailed understanding of contemporary research topics in the broad interdisciplinary field of Cellular and Molecular Neuroscience. Offered Intermittently.
Prerequisites: BIO 3200 with a minimum grade of C-
Repeatable for 6 Credits

BIO 4990 Introduction to Research Practice Cr. 1
Introduces laboratory safety, research practice and scientific integrity for undergraduate students engaged in independent research. It is a co-requisite for students enrolling in BIO 4991-4994 for the first time. Students must complete online CITI training modules in basic laboratory safety before the conclusion of first two weeks of class. Offered Every Term.
Prerequisites: BIO 4991-4994 with a minimum grade of C- (may be taken concurrently)
Restriction(s): Enrollment is limited to students in the Department of Biological Sciences.

BIO 4991 Undergraduate Research in Biological Sciences Cr. 1
Original research performed under the guidance of a faculty member. Registration is by permission only. Offered Every Term.
Prerequisites: BIO 4990 (may be taken concurrently)
Repeatable for 5 Credits

BIO 4992 Undergraduate Research in Biological Sciences Cr. 2
Original research performed under the guidance of a faculty member. Registration is by permission only. Offered Every Term.
Prerequisites: BIO 4990 (may be taken concurrently)
Repeatable for 6 Credits

BIO 4993 Undergraduate Research in Biological Sciences Cr. 3
Original research performed under the guidance of a faculty member. Registration is by permission only. Offered Every Term.
Prerequisites: BIO 4990 (may be taken concurrently)
Repeatable for 6 Credits

BIO 4994 Undergraduate Research in Biological Sciences Cr. 4
Original research performed under the guidance of a faculty member. Registration is by permission only. Offered Every Term.
Prerequisites: BIO 4990 (may be taken concurrently)
Repeatable for 8 Credits

BIO 5001 Molecular Biology Cr. 3
This course provides an in-depth introduction to genetic mechanisms and molecular biology. The course will cover DNA replication and repair as well as mechanisms of gene expression and protein production in prokaryotic and eukaryotic systems. Offered Winter.
Prerequisites: BIO 3070 with a minimum grade of C- and BIO 3100 with a minimum grade of C-

BIO 5020 Comprehensive Virology Cr. 3
Course provides students with a comprehensive knowledge of molecular virology, from viral classification, vital structures and life cycles, to host response and global health. Offered for undergraduate credit only. Offered Fall.
Prerequisites: BIO 2270 with a minimum grade of C-, BIO 3250 with a minimum grade of C-, or BIO 3270 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 5040 Biometry Cr. 4
Quantitative methods in biology. Statistical approach to data analysis and the design of experiments. Laboratory section permits actual analysis of selected statistical problems. Offered Intermittently.
Prerequisites: BIO 2600 with a minimum grade of C- and (STA 1020 with a minimum grade of C-, STA 2210 with a minimum grade of C-, or MAT 2020 with a minimum grade of C-)

BIO 5060 Special Topics Cr. 1-6
Formalized treatment of the current state of knowledge in a significant area of biology. Topics to be announced in Schedule of Classes. Offered Intermittently.
Prerequisites: BIO 2600 with a minimum grade of C-
Repeatable for 6 Credits

BIO 5080 Cellular Basis of Animal Behavior Cr. 3
Relationship between behavior and neuroscience using a variety of animal models, each examined from the level of natural behavior progressively to the cellular level. Topics include: sensory systems, motor behavior, and learning. Offered Winter.
Prerequisite: BIO 2550 with a minimum grade of C- or BIO 2600 with a minimum grade of C- or PSY 3120 with a minimum grade of C- or PSY 3330 with a minimum grade of C-
Equivalent: PSY 5080

BIO 5100 Aquatic Ecology Cr. 4
Physical, chemical and biological processes occurring in lakes, streams and wetlands. Offered for undergraduate credit only. Offered Every Other Year.
Prerequisites: BIO 1500 with a minimum grade of C- and BIO 3500 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Fees: $95

BIO 5145 Principles of Genetic Analysis Cr. 3
This course emphasizes the theory and applications of modern methods of genetic analysis and gene manipulation. Practical and theoretical aspects of methods will be considered. Offered Fall.
Prerequisites: BIO 3070 with a minimum grade of C-, BIO 3100 with a minimum grade of C-, and BIO 4110 with a minimum grade of C-

BIO 5150 Genomics Cr. 3
Introduction to the theory and practice of genomics. Topics include sequencing and mapping, overview of genomes, comparative genomics, transcriptomes, population genetics and genomics, basic bioinformatics and statistics, population-level variation (SNPs, MNPs, indels), ethics, evolutionary genomics, and functional genomics. Offered for undergraduate credit only. Offered Fall.
Prerequisites: BIO 3070 with a minimum grade of C- and BIO 3100 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 5180 Field Investigations in Biological Sciences Cr. 12
Field studies of one to fifteen weeks, emphasizing biological principles and techniques demonstrated in the field. Offered Intermittently.
Prerequisites: (BIO 2200 with a minimum grade of C- or BIO 2600 with a minimum grade of C-), BIO 1500 with a minimum grade of C-, and BIO 1510 with a minimum grade of C-
Fees: $125
Repeatable for 20 Credits

BIO 5240 Molecular Systems Biology Cr. 3
Introduces the basic design principles of biological circuits and networks and their functional designs at the molecular, pathway, whole cell, and population levels. Students will perform a comprehensive group project to build a computational model of a simple biological network. Offered Every Other Year.
Prerequisites: BIO 3070 and PHY 2140

BIO 5260 Evolution of Pathogen Genomes of Modern Disease Cr. 3
Understanding the evolutionary processes that shape pathogen genomes is critical to our understanding of infectious disease biology. This course will introduce fundamental concepts in genome evolution, and use common pathogens as examples to discuss the uniqueness of different evolutionary processes and genomic changes in each pathogen, with special emphasis on microbes. Much of the answers lie in the genomes of these pathogens and how their genomes change over time. Offered Intermittently.
Prerequisites: BIO 2700 with a minimum grade of C- or BIO 4200 with a minimum grade of C-

BIO 5280 Bioinformatics Cr. 3
Basic Linux commands and PERL programming skills, sequence comparison, phylogenetic analysis, gene/genome patterns. Offered for undergraduate credit only. Offered Winter.
Prerequisites: BIO 3070 with a minimum grade of C- and BIO 3100 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 5290 Evolutionary Medicine Cr. 3
Examines the recent trend in applying fundamental evolutionary concepts to medical field and how this trend can lead to better treatment and therapy development. Students will explore a range of topics, from what is a disease to body defenses and reproductive medicine, by reading and discussing assigned material from their textbooks and selected research articles. Offered Winter.
Prerequisites: BIO 2550 with a minimum grade of C-, BIO 2600 with a minimum grade of C-, or BIO 2700 with a minimum grade of C-

BIO 5310 Infections and Innate Immunity Cr. 3
There is a constant arms race between pathogens and their hosts. Tipping the balance decides outcomes and severity of infections. The hosts equip multiple lines of defense against the invading pathogens, meanwhile, the pathogens use a wide variety of arsenals to counteract host defense. This course is designed to introduce infection strategies used by pathogens and anti-microbial responses in the host cells at cellular and molecular levels. The course covers the interactions between hosts and microbes, including small molecules, post-translational modifications, protein interactions, signaling transduction and molecular machineries. Understanding these mechanisms during host-microbe interactions will provide important foundation for developing potential therapeutics. Offered Fall.
Prerequisite: BIO 2200 with a minimum grade of C- or BIO 2270 with a minimum grade of C- or BIO 3250 with a minimum grade of C- or BIO 2600 with a minimum grade of C- or BIO 2550 with a minimum grade of C-

BIO 5330 Principles and Applications of Biotechnology I Cr. 3
Review of origins of molecular biotechnology and its characteristic technologies; survey of applications of biotechnology to problems in industries. Offered Fall.
Prerequisites: BIO 2200 with a minimum grade of C-, BIO 3070 with a minimum grade of C-, and BIO 3100 with a minimum grade of C-

BIO 5350 Microbial Biofilms Cr. 3
The objective of the course is understand the features, and molecular mechanisms used by bacteria to build or disperse microbial biofilms. Students will learn the techniques and tools used to research microbial biofilms. Offered Intermittently.
Prerequisites: BIO 3250 with a minimum grade of C-

BIO 5440 Terrestrial Ecology Cr. 4
Ecology of forests and grasslands. Field study and interpretation of ecological processes. Importance of species-site relationships and disturbance history. Offered for undergraduate credit only. Offered Every Other Year.
Prerequisites: BIO 1500 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Fees: $250

BIO 5490 Population and Community Ecology Cr. 3
Population dynamics of animals and plants. Life history theory. Species interactions. Structure and dynamics of communities. Offered for undergraduate credit only. Offered Every Other Year.
Prerequisites: BIO 3500 with a minimum grade of C- and (STA 1020 with a minimum grade of C-, MAT 2020 with a minimum grade of C-, or STA 2210 with a minimum grade of C-)
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 5540 Landscape Ecology Cr. 3
Concepts, methods, and applications of landscape ecology; causes and implications of ecological patterns and heterogeneity on landscapes; interrelationships of patterns and ecological processes. Offered Every Other Year.
Prerequisites: BIO 1500 with a minimum grade of C- and BIO 3500 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 5610 Developmental Biology Lab Cr. 1
Slides, models, and 4-D computer programs used to enable the student to know and recognize the cascade of structural changes that take place during the embryological developmental pathways. Offered Winter.
Prerequisites: BIO 5620 with a minimum grade of C- (may be taken concurrently)
Fees: $55

BIO 5620 Developmental Biology Cr. 3
An analytical and comparative study of genetic and cellular mechanisms and their interaction with environmental factors to effect the developmental mechanisms which produce the adult organism. Origin and unfolding of structural patterns characteristic of different species; their evolutionary origins. Offered Winter.
Prerequisites: BIO 3070 with a minimum grade of C-

BIO 5640 Cancer Biology Cr. 3
Introduction to integrated analysis of cancer and cell biology, pathology, etiology and therapy. Offered Intermittently.
Prerequisites: BIO 2600 with a minimum grade of C-, BIO 3070 with a minimum grade of C-, and BIO 3100 with a minimum grade of C-

BIO 5660 Neural Signaling in Health and Disease Cr. 3
Addresses major principles of how various brain systems regulate physiological processes of the body function, both individually and as an integrated unit. Includes principles of physiological communication as it relates to homeostasis, metabolism, and both neural and endocrine communication; emphasis is given not only to major principles but also to how these principles were developed. Topics include (but are not limited to) dysfunction and disorders of the central nervous system (CNS) in the context of signaling pathways and hormonal systems, neurodegeneration, interaction between neurons and glia cells and neuroinflammation. Offered Fall.
Prerequisite: BIO 3200 with a minimum grade of C-

BIO 5680 Basic Endocrinology Cr. 3
Basic description of the human endocrine system, the endocrine control of several physiologic processes (growth, development, metabolism and reproduction), and a description of common endocrine disorders. Offered Fall.
Prerequisites: BIO 3200 with a minimum grade of C- or BIO 4120 with a minimum grade of C-
Equivalent: PSL 5680

BIO 5740 General Entomology Cr. 4
This course will focus on introducing students to the taxonomy (identification), natural history, ecology, and evolutionary biology of the Class Insecta and related taxa. Through in-class lectures and inside and outside the classroom lab-based activities, students will have the opportunity to apply the process of science to tap into the interdisciplinary nature of entomology. More specifically, after successfully completing this course, you should be able to sight-identify the major insect orders and species that exist in urban and suburban Detroit, and have a thorough understanding of the biology and evolution of insects, their diversity, their role in natural ecosystems, the basics of their physiology, development, and behavior, and the many important ways they affect human life. Offered Intermittently.
Prerequisite: BIO 2700 with a minimum grade of C-
Fees: $60

BIO 5750 Biology of Longevity and Aging Cr. 3
Longevity, aging and senescence viewed as fundamental biological processes common to most organisms. Data-based discussion of investigative methods and accepted facts regarding the mechanisms underlying longevity and aging, coupled with critical discussion of behavioral and biological interventions known to retard or reverse the aging processes. Systems biology overview of the process, including societal parameters necessary to the maintenance of longevity. Offered for undergraduate credit only. Offered Winter.
Prerequisites: BIO 3070 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 5760 Proteins and Proteomics Cr. 3
The course gives students a solid understanding of the structure of proteins, functions of proteins including folding of proteins into native conformation and dynamic nature of protein structure; post-translational modification of proteins; protein degradation; approaches and techniques of protein purification and analyses; methods and analysis of proteome using proteomic approaches. Offered Intermittently.
Prerequisites: BIO 3100 with a minimum grade of C- and BIO 5600 with a minimum grade of C-

BIO 5890 Neuroplasticity Cr. 3
Neuroplasticity is the study of the ways the brain changes in response to genetic controls, and to the internal and external environments. Neuroplasticity includes neural development (neurogenesis and migration, neural differentiation, axon pathway formation, and synapse formation and maturation), mechanisms of learning and memory, homeostasis of excitability, aging, diseases, and responses to injury. To explore these topics, students will read and discuss readings from their textbook and seminal research articles from a variety of animal models, and run simulations. Offered Winter.
Prerequisites: BIO 3200 with a minimum grade of C-

BIO 6000 Molecular Cell Biology I Cr. 3
Analysis of cell structure at the molecular and cellular levels and the physiological consequences of these structures: isolation, physico-chemical properties, and biological attributes of cells, organelles, and biopolymers including nucleic acids, proteins, and lipids. Offered Fall.
Prerequisites: BIO 2600 with a minimum grade of C (may be taken concurrently) and BIO 3100 with a minimum grade of C (may be taken concurrently)

BIO 6010 Molecular Cell Biology II Cr. 4
Analysis of cell regulation at the molecular level. Cell development and differentiation. Genetic mechanisms including: DNA synthesis and repair, mechanism of gene expression and control. Offered Winter.
Prerequisite: BIO 6000 with a minimum grade of C-

BIO 6055 Biology of the Eye Cr. 3
Introduction to biology of eye structure/function, and to causes and clinical treatments of eye-related disorders and diseases. Offered for undergraduate credit only. Offered Fall.
Prerequisites: BIO 3200 with a minimum grade of C- and (BIO 3100 with a minimum grade of C- or CHM 5600 with a minimum grade of C-)
Restriction(s): Enrollment is limited to Undergraduate level students.
Equivalent: ANA 6050, PYC 6050

BIO 6060 Molecular Evolution Cr. 3
This course introduces the theory and practice of molecular sequence evolution analysis. It examines the pattern and process of evolutionary change at the DNA and protein level. The course covers relevant models of population genetics, nucleotide substitutions, and gene evolution, methods of multiple sequence alignments and phylogenetic inference, and their significance in current applications of protein structure prediction and genetic ancestry analyses. Offered Every Other Year.
Prerequisites: BIO 2700 with a minimum grade of C- or BIO 3070 with a minimum grade of C-

BIO 6090 Population Genetics Cr. 3
Theoretical bases for microevolutionary change in natural populations of organisms; basic to study of evolutionary genetics and evolutionary ecology. Offered Intermittently.
Prerequisite: BIO 3070 with a minimum grade of C-

BIO 6150 Neuronal Circuits Cr. 3
In this course we will discuss neuronal circuits (NCs) as functional units of the nervous system. The course aims to highlight the importance of NCs as an intermediate level of organization, that bridges the role of individual neurons with the performance of the nervous system as a whole. We will explore the structure and function of neuronal circuits, how they are studied through the use of informative model organisms (emphasis on invertebrate and small vertebrate models) and state-of-the-art experimental and theoretical methods, the role of neuronal circuits in learning, decision making, and locomotion, the evolution of neuronal circuits, neuromodulation and neuronal control, the impact of aging, and the concept of internal state. Finally, we will discuss how circuits form bigger networks, see connectomes, and we will touch on key interdisciplinary methods for the study of NCs. Offered Intermittently.
Restriction(s): Enrollment limited to students in a Doctor of Philosophy, Master of Arts or Master of Science degrees.

BIO 6160 Proteins and Proteomics Cr. 3
Structure and dynamics of proteins at the molecular level. Strategies used to biochemically purify, analyze, and characterize proteins. Offered Winter.
Prerequisite: BIO 3100 with a minimum grade of C- or CHM 5600 with a minimum grade of C- or CHM 6620 with a minimum grade of C-

BIO 6165 Biodiversity Changes in the Anthropocene Cr. 4
This course is a study of the Anthropocene—what scientists argue is our current epoch in geologic time—emphasizing changes in Earth's biodiversity as a result of human activities. Following an introduction to the Anthropocene, how it can be defined, and key ecological principles of biodiversity, we will explore the history and context for various types of human-influenced change. We will then survey seven human drivers of biodiversity change—from climate and chemical changes to habitat alteration and resource use and finally species transport (including modern pandemics) and invasion. We will wrap up the course examining past, present, and future tipping points, shifting baselines, goals and targets for management, and attitudes. Through this course, you will be challenged to consider both domestic and global (indigenous and western) perspectives of biodiversity change and issues concerning environmental justice. Emphasis will be placed on biodiversity shifts as influenced by humans. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: ESG 6165

BIO 6180 Membrane Biology Cr. 3
Comprehensive analysis of cellular and model membranes integrating molecular structure and physiological properties. Structural, dynamic, and physiological properties examined, including molecular and macromolecular assemblies, physical and chemical analysis of molecular motion, functional aspects including trans-membrane signaling. Offered Intermittently.
Prerequisite: BIO 6000 with a minimum grade of C
Restriction(s): Enrollment is limited to Undergraduate level students.

BIO 6185 Environmental DNA for Ecosystem Monitoring and Conservation Cr. 4
This course is a study of environmental DNA principles, approaches, and applications to study anthropogenic change in the environment. Following an introduction to the field of eDNA, challenges and limitations, early landmark studies, and applications in a variety of ecosystems and types of research questions, we will shift our focus to the technical background for designing an eDNA study—including how eDNA samples are collected, processed, and analyzed— and wrap up with considerations of the future of DNA metabarcoding. Emphasis will be placed on eDNA as a tool for studying environmental changes caused by humans. Offered Yearly.
Prerequisites: BIO 3070 with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: ESG 6180

BIO 6190 Advanced Special Topics Cr. 6
Formalized treatment of current state of knowledge in a significant area of biology. Topics to be announced in Schedule of Classes. Offered Intermittently.
Repeatable for 6 Credits

BIO 6195 Environmental Microbiology Cr. 4
This course is a study of microbial diversity, approaches, and anthropogenic change in the environment. Following an introduction to the field of environmental microbiology, emerging global issues, and exploration of microorganisms in various habitats, we will focus on recent advances in characterization of microorganisms, pathogen transmission (including modern day pandemics), indicators of ecosystem health, and risk assessment. Through this course, you will also develop an understanding of how environmental microbiological samples are collected and processed, analyze how to track microbial sources and transport, and evaluate how microbiota interact with pollutants and ecosystems. Emphasis will be placed on microbiotic changes in the environment as influenced by humans. Offered Yearly.
Equivalent: ESG 6190

BIO 6330 Principles and Applications of Biotechnology II Cr. 3
Application of molecular biology and recombinant DNA technology of contemporary eukaryotic systems. Topics include: specialized application of PCR for cloning, generation of antibodies, the expression of recombinant proteins in cultured cells and transgenic animal models. Offered Winter.
Prerequisite: BIO 5330 with a minimum grade of C-

BIO 6420 Ecotoxicology and Risk Assessment Cr. 3
Provides students with an overview of ecological and environmental aspects of toxicology and pollution biology. The course will emphasize population, community, and ecosystem responses to contaminants. General understanding of ecology, chemistry, and basic statistics is essential. Offered Every Other Winter.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 6490 Molecular and Cellular Neurobiology Cr. 3
The brain is the most complex object known to man and is the storehouse of our lives. In the past century, humanity has made great strides in our understanding of the brain. In this class, we take a reductionist approach to understanding how the brain works. We start with exploring the basic mechanisms by which neurons process information by studying electrical signaling (Unit I) and chemical signaling (Unit II). These then serve as a foundation for building up an integrated appreciation for how the nervous system interacts with the outside world (Unit III). Taken together, this class provides the foundation for understanding how neurons work individually, an in concert, to from the nervous system. This class will also prepare students for approaching more advanced topics in neuroscience. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 6510 Molecular Interactions Cr. 1
Introduces to methods to study biomolecular interactions. Topics covered will include yeast two-hybrid, protein tagging, protein chips, DNA/RNA footprinting, DNase,MNase, hypersensitivity, ATAC-seq, ChIP-PCR, ChIP-chip, ChIP-seq, HITS-CLIP, PAR-CLIP, three hybrid, Co-immunoprecipitation, EMSA, flourescence polarization and FRET, SPR, isothermal calorimtery and microscale thermophoresis, proximity labeling and lipid: protein interactions. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 6520 Gene Expression Manipulation Systems Cr. 1
Introduces methods to manipulate gene expression. Topics include: Bacterial transformation methods - natural vs artificial competency, conjugation, phage transduction. Eukaryotic cell culture transfection methods - transient and stable. Transgenic organism manipulation: methods for gene knock-out and inducible expression including - homologous recombination, site specific recombination, Lambda red recombination, markerless in-frame deletion, Cre-Lox, transposons, RNAi, CRISPR, TALENS, P-element mutagenesis, inducible/repressible promoters, expression reporters. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 6530 Protein Structure and Dynamics Cr. 1
Provides a solid understanding of the structure of proteins, their physiological functions, and an understanding that the molecular basis of a number of diseases is associated with protein abnormalities. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 6540 Principles of Genetic Analysis Cr. 1
Emphasizes the theory and applications of modern genetic methods of analysis. Practical and theoretical aspects of methods will be considered. Exams and quizzes will focus on concepts, experimental design and strategy. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 6690 Special Topics in Neurobiology Cr. 3
This course will enable students to apply their knowledge of neurobiology to explore a current research area in depth. The course will involve reading and discussing articles from the scientific literature. Offered Winter.
Prerequisites: BIO 3200 with a minimum grade of C-

BIO 6700 Responsible Conduct of Research Cr. 1
Fulfills federal requirements for in person faculty-led training in scientific ethics and responsible conduct of research. Offered Fall.

BIO 6890 Introduction to Research Practice - Honors Cr. 1
Provides instruction in basic laboratory safety and accepted standards for research conduct. It will provide professional development and networking opportunities for students interested in careers in research and the biomedical sciences. Instruction may be provided in the form of reading assignments, discussions, lectures and case studies. It is a co-requisite for students enrolling in BIO 6891-6894 for the first time. Offered Every Term.
Prerequisites: BIO 6891-6894 with a minimum grade of C- (may be taken concurrently)

BIO 6891 Honors Undergraduate Research in Biological Sciences Cr. 1
Original research performed under the guidance of a faculty member. Registration is by permission only. Offered Every Term.
Prerequisites: BIO 6890 with a minimum grade of C- (may be taken concurrently)
Repeatable for 5 Credits

BIO 6892 Honors Undergraduate Research in Biological Sciences Cr. 2
Original research performed under the guidance of a faculty member. Registration is by permission only. Offered Every Term.
Prerequisites: BIO 6890 with a minimum grade of C- (may be taken concurrently)
Repeatable for 6 Credits

BIO 6893 Honors Undergraduate Research in Biological Sciences Cr. 3
Original research performed under the guidance of a faculty member. Registration is by permission only. Offered Every Term.
Prerequisites: BIO 6890 with a minimum grade of C- (may be taken concurrently)
Repeatable for 6 Credits

BIO 6894 Honors Undergraduate Research in Biological Sciences Cr. 4
Original research performed under the guidance of a faculty member. Registration is by permission only. Offered Every Term.
Prerequisites: BIO 6890 with a minimum grade of C- (may be taken concurrently)
Repeatable for 8 Credits

BIO 6990 Honors Directed Study in Biology Cr. 1-4
To be taken under direction of Biological Sciences faculty. Offered for undergraduate credit only Offered Every Term.
Restriction(s): Enrollment is limited to students with a major in Biological Sciences Honors or Biological Sciences; enrollment is limited to Undergraduate level students; enrollment limited to students in a BS in Biological Science or Bachelor of Arts degrees.
Repeatable for 99 Credits

BIO 6994 Technical Communication in Molecular Biotechnology Cr. 3
Methods of written and oral communication in the biotechnology field. Offered Winter.

BIO 6999 Honors Undergraduate Research Thesis Cr. 2
Preparation of a thesis, satisfactory completion of which assures Honors graduation, providing performance in preceding Honors courses has been at Honors level; to be taken under direction of Biological Sciences faculty. Offered for undergraduate credit only. Offered Every Term.
Prerequisite: BIO 6891 with a minimum grade of C- or BIO 6892 with a minimum grade of C- or BIO 6893 with a minimum grade of C- or BIO 6894 with a minimum grade of C- or BIO 6990 with a minimum grade of C-
Restriction(s): Enrollment is limited to students with a major in Biological Sciences Honors; enrollment is limited to Undergraduate level students.

Departmental Academic Policies

Student's Responsibility

It is each student's responsibility to learn the major requirements, policies, and procedures governing the program they are following and to act accordingly. All course work must be completed in accordance with the regulations of the University (https://bulletins.wayne.edu/undergraduate/general-information/academic-regulations/) and the College (https://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/academic-regulations/) governing undergraduate scholarship and degrees. Students should consult a Biological Sciences Department Advisor regularly in order to verify that their Biology requirements are being met in a timely fashion. Although the advisor will provide assistance, the responsibility for fulfilling degree requirements remains with the student.

Declaration of Major

Students should declare their major after completing BIO 1500 and BIO 1510 with a 'C-minus' or better. Major requirements are established by the declaration of major date. Students who do not formally declare their major are susceptible to program changes made by the Department. Recent program changes may not be

reflected in the University Bulletin if they are established after the printing of the Bulletin.

Prerequisites/Corequisites

Students are required to follow all prerequisites and corequisites listed for each Biology course. Please refer to the Biological Sciences Department Advisor and the Class Schedule for accurate listings of prerequisite requirements.

Grade Requirements

All students are required to complete BIO courses with a 'C-minus' or better to satisfy the prerequisite requirements. Students with grades below a 'C-minus' in prerequisite coursework are required to retake the course before proceeding to the subsequent courses in the program.

Residency Requirement

Students must complete a minimum of twenty-one credits *in residence* in biological sciences (BIO). Of the twenty-one in residence credits, fifteen of those credits must be at the 3000 level or higher.

Combined Degree with Dentistry and Medicine

Students who were majoring in biological sciences and are candidates for a combined degree must have made reasonable progress towards the requirements listed for biological sciences majors. A minimum of twenty-five credits in residence are required in biological sciences (BIO). See also the College of Liberal Arts and Sciences policy on combined degrees.

Over-Age Credits

A student attempting to complete a biological sciences major after a prolonged interruption of his/her education may find that some of the previous course work in biological sciences is out of date. In such cases, the record will be reviewed and the Department may require the student to fulfill biological sciences course requirements existing at the time of his/her return.

Transfer

Transfer Students should consult with a Departmental undergraduate advisor during the semester prior to their transfer (after a transfer evaluation has been completed by the Transfer Credit Office).

Determination of course equivalency will be made by the Departmental undergraduate advisor in conjunction with the Transfer Credit Evaluation Unit in the Office of Undergraduate Admissions. The Department reserves the right for the final determination of course equivalency.

Advanced Placement

Advanced Placement in Biological Sciences may be obtained by earning the following scores in the AP Qualifying Examination:

Score of 5: Credit is awarded
for BIO 1500 and BIO 1501 and BIO 1510 (seven credits). Students are eligible to enroll in subsequent courses providing the prerequisites for them have been met. Students will need to complete BIO 1511.

Score of 3 or 4: Credit is awarded for BIO 1510 (three credits). Students with a score of 3 or 4 are eligible to register in BIO 1500 and BIO 1501. Students will also need to complete BIO 1511.

AGRADE (Accelerated Graduate Enrollment)

Accelerated Graduate Enrollment: The 'AGRADE' Program is designed for outstanding seniors who wish to complete bachelor's and master's degrees. For further details and eligibility requirements regarding the 'AGRADE' Program and Biological Sciences, contact the Department Advising Office, 1360 Biological Sciences Building.