BIO - BIOLOGICAL SCIENCES

BIO 1030 Biology Today Cr. 3
Satisfies General Education Requirement: Life Sciences, 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. Not for biology major credit. 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)

BIO 1040 Exploring Life Cr. 1
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 course is geared towards students who are not majoring in Biology. 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)

BIO 1050 An Introduction to Life Cr. 3
Satisfies General Education Requirement: Life Sciences, Natural Scientific Inquiry
A factual and conceptual treatment of modern biology at the cell, organismal, and population levels of organization. No credit after BIO 1500 or BIO 1510. Offered Every Term.

Course Material Fees: $20

BIO 1500 Basic Life Diversity Cr. 4
Satisfies General Education Requirement: Natural Scientific Inquiry
Physiology, ecology, evolution, and systematics, their principles, strategies and outcomes in both structure and function. 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-

Course Material Fees: $25

BIO 1510 Basic Life Mechanisms Cr. 4
Satisfies General Education Requirement: Life Sciences, Natural Scientific Inquiry
Factual and conceptual treatment of cell molecules, cell structure, metabolism, genetics, and development. For the science major and certain pre-professional programs. Meets General Education laboratory requirement. BIO 1500 and BIO 1510 required of all biological sciences majors. Only Engineering students may elect for three credits. 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-

Course Material Fees: $25

BIO 2200 Introductory Microbiology Cr. 5
Satisfies General Education Requirement: Life Sciences, Natural Scientific Inquiry
Bacteria and their basic biology; the relationship of microorganisms to man and other living forms, including their ecological importance and their role in the causation of disease; laboratory exercises paralleling the above principles. Offered Every Term.

Prerequisites: BIO 1510 with a minimum grade of C-

Course Material Fees: $60

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 Every Term.

Prerequisites: BIO 1510 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-correctioning 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 Every Term.

Corequisite: BIO 2270

Course Material Fees: $90

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-

Course Material 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-
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 3110 Biomolecules to Cell Biology: Mastering Concepts Through Teaching Cr. 2
Provide Honors students with a service learning opportunity (peer mentor/assistant in BIO 1510) that will enhance their knowledge of biology while engaging them with experiences in teaching and interacting with students. Offered Fall, Winter.
Prerequisites: BIO 1510 with a minimum grade of B and BIO 2600 with a minimum grade of B
Corequisite: HON 3000
Repeatable for 4 Credits

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 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.

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.
Course Material Fees: $40

BIO 3990 Directed Study Cr. 1-4
Primarily for biology majors who wish to continue in a field beyond that covered in regular courses; to be taken under direction of Biological Sciences faculty. Offered Every Term.
Repeatable for 8 Credits

BIO 4110 Biomedical Technology and Molecular Biology Cr. 4
Satisfies General Education Requirement: Writing Intensive Competency
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
Satisfies General Education Requirement: Writing Intensive Competency
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-
Course Material Fees: $20

BIO 4130 General Ecology Cr. 4
Satisfies General Education Requirement: Writing Intensive Competency
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-
Course Material 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 Winter.
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 4200 Evolution Cr. 3
Evidence for mechanisms of evolution at the molecular, organismal and population level. Offered Every Term.
Prerequisites: BIO 3070 with a minimum grade of C- and (BIO 3100 with a minimum grade of C-, BIO 3200 with a minimum grade of C-, or BIO 3500 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 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-
Course Material 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- 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
Prerequisites: BIO 2600 with a minimum grade of C- or BIO 2870 with a minimum grade of C-
Course Material 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 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)

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)

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)

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)

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)

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 2200 with a minimum grade of C-, BIO 2600 with a minimum grade of C-, and BIO 3070 with a minimum grade of C-

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 3070 with a minimum grade of C- or BIO 4130 with a minimum grade of C- and MAT 1800-6XXX with a minimum grade of C-
Course Material Fees: $15

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.
Prerequisites: BIO 2600 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.
Course Material Fees: $67

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, MNP, 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-
Course Material 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 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.
Prerequisite: BIO 3070 with a minimum grade of C-

BIO 5310 Infectious and In innate Immunity Cr. 3
There is a constant arms race between pathogens and their hosts. The hosts equip multiple lines of defense to prevent the invading pathogens, and the pathogens uses a wide variety of arsenals to counteract host defense. This course is designed to introduce the infection strategies used by bacterial pathogens and the anti-microbial responses in the host cells at cellular and molecular levels. The course will cover small molecules, post-translational modifications, protein interactions, and molecular machineries that are involved in the host-pathogen interactions. Offered Fall.
Prerequisite: BIO 2200 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 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.
Course Material Fees: $110

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 1500 with a minimum grade of C- and BIO 4130 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)
Course Material 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-
Course Material 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.
Prerequisite: BIO 3070 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.

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 seminar research articles from a variety of animal models, and run simulations. Offered Winter.
Prerequisite: BIO 4690 with a minimum grade of C-

BIO 5996 Senior Research Cr. 1-2
Original research. To be taken under direction of Biological Sciences faculty. Offered for undergraduate credit only. Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Senior; enrollment is limited to Undergraduate level students.
Repeatable for 3 Credits

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.
Prerequisite: BIO 2600 (may be taken concurrently) with a minimum grade of C and BIO 3100 (may be taken concurrently) with a minimum grade of C

BIO 6010 Molecular Cell Biology II Cr. 3
Prerequisite: BIO 6000 with a minimum grade of C-

BIO 6020 Methods of Analyses Cr. 4
Design and execution of experiments in molecular biology. Topics include: laboratory safety, scientific documentation, database searching, development of experimental protocols, error analysis, solutions and buffers, electrophoretic separation of proteins and nucleic acids, basic immunohistochemistry, bioimaging, and scientific ethics. Offered Fall.
Prerequisites: BIO 4110 with a minimum grade of C- (may be taken concurrently) (must be taken at WSU) or BIO 5330 with a minimum grade of C- (may be taken concurrently) (must be taken at WSU)
Course Material Fees: $50

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.
Prerequisite: BIO 2600 with a minimum grade of C- and BIO 3100 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
Course Material Fees: $25
Equivalent: ANA 6050, PYC 6050

BIO 6060 Molecular Evolution Cr. 3
Patterns and processes of evolutionary change on the DNA sequence level. Emphasis on models of nucleotide substitutions, and genic evolution. Methods of phylogenetic inference. Offered Intermittently.
Prerequisite: BIO 3070 with a minimum grade of C- and (BIO 4200 (may be taken concurrently) 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 6120 Molecular Biology Laboratory I Cr. 3
Laboratory exercises illustrate methods and concepts of molecular biology and recombinant DNA analysis. Offered Winter.
Course Material Fees: $30

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 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

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 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 6510 Molecular Interactions Cr. 1
Introduces 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, fluorescence polarization and FRET, SPR, isothermal calorimetry 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 4690 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 corequisite 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)

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)

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)

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)

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; enrollment is limited to Undergraduate level students.
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 6997 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.
Prerequisites: BIO 6890 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.
Repeatable for 6 Credits

BIO 7000 Recent Advances in Cellular and Developmental Biology Cr. 3
Formalized and in-depth treatment of the current state of knowledge in a significant area of cell and molecular biology. Topics to be announced in Schedule of Classes. Offered Intermittently.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 7011 Principles of Toxicology Cr. 3
Basic concepts and principles of toxicology, including toxicity of major classes of chemicals (pesticides, solvents, metals) and organ systems (renal, immune, digestive, neuro and respiratory) affected. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.
Equivalent: PHC 7410

BIO 7020 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 Fall.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 7040 Signaling Transduction Mechanisms Cr. 3
Overview of signaling strategies and mechanisms used by prokaryotes and eukaryotes (including plants) to sense and respond to extracellular or intracellular stimuli. Additional study of bioinformatic, biochemical, and genetics approaches to characterization of signaling proteins, systems and networks. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 7045 Biometry Cr. 4
Provides practical tools for the design of experiments, data exploration and statistical analysis of data. Prepares students to begin to design scientific studies and experiments, critically evaluate data and test hypotheses via data analysis. While the course will delve into some underlying statistical theory, a major emphasis will be providing exposure to and hands-on experience with basic approaches to the analysis of univariate and multivariate data. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.
**BIO 7055 Biology of the Eye Cr. 3**
Integrated introduction to basic biological structure/function of the eye; causes and clinical treatments of eye-related disorders and diseases. Offered Fall.

*Restriction(s):* Enrollment is limited to Graduate level students.

*Equivalent:* ANA 7055

**BIO 7060 Evolutionary and Developmental Biology Cr. 3**
Introduction to animal diversity. Genetic pathways and networks in development; focus on limb and organ formation. Evolving developmental pathways: case studies. Genetic source materials for developmental evolution. Speciation and developmental evolution. Offered Every Other Year.

*Prerequisite:* BIO 5620 with a minimum grade of C-

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7090 Molecular Genetics of Development Cr. 3**
An examination of the current and classical research literature dealing with the role of gene action in development. Offered Intermittently.

*Prerequisite:* BIO 5620 with a minimum grade of C-

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7110 Aquatic Ecology Cr. 4**
Physical, chemical and biological processes occurring in lakes, streams, and wetlands. Offered Every Other Fall.

*Restriction(s):* Enrollment is limited to Graduate level students.

**Course Material Fees:** $67

**BIO 7150 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 Fall.

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7180 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 Winter.

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7240 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

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7280 Bioinformatics Cr. 3**
Basic Linux commands and PERL programming skills, sequence comparison, phylogenetic analysis, gene/genome patterns. Offered Winter.

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7300 Communication of Research Cr. 2**
During this course, students will learn to present scientific results and make compelling scientific arguments orally, visually and in written form. In addition, students will learn to professionally and constructively critique the work of others. Students will also prepare a professional resume/CV and cover letter for job applications. Offered Winter.

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7310 Sustainability of Urban Environmental Systems Cr. 2**
Students will be introduced to topics in urban sustainability from multiple disciplinary perspectives such as: ecology, anthropology, communication, engineering, economics and urban planning. Questions in fostering a more sustainable urbanism will be introduced and evaluated. Offered Fall.

*Restriction(s):* Enrollment is limited to Graduate level students.

*Equivalent:* CE 7311

**BIO 7440 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 Every Other Year.

*Prerequisite:* BIO 1500 with a minimum grade of C- and BIO 4130 with a minimum grade of C-

*Restriction(s):* Enrollment is limited to Graduate level students.

**Course Material Fees:** $110

**BIO 7490 Population and Community Ecology Cr. 3**
Population dynamics of animals and plants. Life history theory. Species interactions. Structure and dynamics of communities. Offered Every Other Year.

*Prerequisite:* BIO 1500 with a minimum grade of C- and BIO 4130 with a minimum grade of C-

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7510 Eukaryotic Gene Structure and Function Cr. 4**
Experimental approaches to study eukaryotic gene expression, critical comprehension of current research, design of experiments in gene expression. Offered Every Other Year.

*Prerequisite:* BIO 6330 with a minimum grade of C- or BIO 7780 with a minimum grade of C

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7520 Nucleic Acid Laboratory Cr. 2**
The objective of the course is to provide students an in-depth understanding of nucleic acid related techniques, and their practical application in a research lab. Offered Fall.

*Restriction(s):* Enrollment is limited to Graduate level students.

**Course Material Fees:** $125

**BIO 7530 Proteins Laboratory Cr. 2**
The objective of the course is to provide students an in-depth understanding of protein purification and related techniques, and their practical application in a research lab with emphasis on: Cell lysis procedures, selection of buffer ingredients for purification, an understanding of different chromatographic procedures, and the analysis of proteins by different type of electrophoretic procedures and Western blot. Offered Winter.

*Restriction(s):* Enrollment is limited to Graduate level students.

**Course Material Fees:** $125

**BIO 7540 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.

*Restriction(s):* Enrollment is limited to Graduate level students.

**BIO 7560 Light Microscopy and Imaging Cr. 2**
The objective of the course is to provide students an in-depth understanding of current microscopy and imaging technology. Offered Winter.

*Restriction(s):* Enrollment is limited to Graduate level students.

**Course Material Fees:** $125
BIO 7610 Infections and Innate Immunity Cr. 3
There is a constant arms race between pathogens and their hosts. The hosts equip multiple lines of defense to prevent the invading pathogens, and the pathogens use a wide variety of arsenals to counteract host defense. This course is designed to introduce the infection strategies used by bacterial pathogens and the anti-microbial responses in the host cells at cellular and molecular levels. Topics include: small molecules, post-translational modifications, protein interactions, and molecular machineries that are involved in the host-pathogen interactions. Offered Intermittently.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 7660 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.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 7740 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. Students cannot earn credit for both BIO 5740 and BIO 7740. Offered Intermittently.
Restriction(s): Enrollment is limited to Graduate level students.
Course Material Fees: $60

BIO 7750 Biology of Longevity 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 graduate credit only. Offered Winter.
Prerequisite: BIO 3070 with a minimum grade of C-
Restriction(s): Enrollment is limited to Graduate level students.

BIO 7890 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. No credit after BIO 5890. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 7996 Research Problems Cr. 1-8
Original investigation. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 998.99 Credits

BIO 8000 Special Topics Cr. 1-6
Various frontier aspects of biology. Work may include lectures, laboratories or discussion. Topics to be announced in Schedule of Classes. Offered Yearly.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 6 Credits

BIO 8895 Graduate Seminar in Biology Cr. 2
Presentations by graduate staff, advanced students, visiting lecturers. Offered Yearly.
Restriction(s): Enrollment is limited to students with a major in Biological Sciences; enrollment is limited to Graduate level students; enrollment limited to students in a Doctor of Philosophy or Master of Science degrees.
Repeatable for 4 Credits

BIO 8896 Research in Molecular Biotechnology Cr. 1-4
Students spend two semesters doing research under the guidance of faculty associated with the Molecular Biotechnology Program and in other laboratories. Offered Winter, Spring/Summer.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 8 Credits

BIO 8999 Master's Thesis Research and Direction Cr. 1-8
Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Candidate Masters; enrollment is limited to Graduate level students.
Repeatable for 8 Credits

BIO 9990 Pre-Doctoral Candidacy Research Cr. 1-8
Research in preparation for doctoral dissertation. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 12 Credits

BIO 9991 Doctoral Candidate Status I: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

BIO 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: BIO 9991 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

BIO 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: BIO 9992 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

BIO 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: BIO 9993 with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

BIO 9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction Cr. 0
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Course Material Fees: $384.7
Repeatable for 0 Credits
BIO 9996 Lab Rotation Cr. 2
Research training in faculty laboratories on a rotating basis, up to two labs per semester. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 4 Credits