**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 coursework must be completed in accordance with the regulations of the University (http://bulletins.wayne.edu/undergraduate/general-information/academic-regulations) and the College (http://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 coursework 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 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** 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 1510 (eight credits). Students are eligible to enroll in subsequent courses providing the prerequisites for them have been met.

**Score of 3 or 4:** Credit is awarded for BIO 1510 (four credits). Students with a score of 3 or 4 are eligible to register in BIO 1500.

**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.

**ALCEDO, JOY A.:** Ph.D., University of Zurich; M.S., Dartmouth University; B.A., College of Saint Rose; Associate Professor

**ANSARI, ATHAR:** Ph.D., M.Sc., B.Sc., University of Delhi; Associate Professor

**ARKING, ROBERT:** Ph.D., Temple University; B.S., Dickinson College; Professor

**BENINGO, KAREN A.:** Ph.D., University of Michigan; B.Sc., Michigan State University; Associate Professor

**CROZIER, MARTIN:** Ph.D., University of Windsor; Lecturer

**CUNNINGHAM, PHILIP R.:** Ph.D., Southern Illinois University; B.A., Murray State University; Associate Professor

**DOWLING, THOMAS E.:** Ph.D., Wayne State University; B.S., University of Michigan; Professor
FAN, CHUANZHU: Ph.D., North Carolina State University; M.S., Chinese Academy of Agricultural Sciences; B.S., Northeast Normal University; Associate Professor

FREEMAN, D. CARL: Ph.D., M.S., Brigham Young University; B.S., University of Utah; Professor Emeritus

FRIEDRICH, MARKUS: Ph.D., B.S., Ludwig-Maximilians-Universitaet; Professor

GANGWERE, STANLEY K.: Ph.D., M.S., B.A., University of Michigan; Professor Emeritus

GOLENBERG, EDWARD M.: Ph.D., State University of New York at Stony Brook; B.A., Johns Hopkins University; Professor

GREENBERG, MIRIAM L.: Ph.D., Albert Einstein College of Medicine; M.S., Loyola University; B.A., Reed College; Professor

GU, HAIDONG: Ph.D., Ohio State University; M.S., Chinese Academy of Medical Sciences; B.S., Fudan University; Associate Professor

HAO, WEILONG: Ph.D., McMaster University; M.S., B.S., Nankai University; Assistant Professor

HARI, V.: Ph.D., M.S., University of Madras; B.S., Annamalai University; Associate Professor Emeritus

HEBERLEIN, GARRETT: Ph.D., M.S., Northwestern University; B.A., Ohio Wesleyan University; Professor Emeritus

HIGGS, PENELLOPE I.: Ph.D., B.S., Washington State University; Assistant Professor

HOOD, GLEN: Ph.D., University of Notre Dame; M.S., Texas State University; B.S., Texas State University; Assistant Professor (Research)

KASHIAN, DANIEL M.: Ph.D., University of Wisconsin, Madison; M.S., B.S., University of Michigan; Professor and Associate Chair

KASHIAN, DONNA R.: Ph.D., University of Wisconsin; M.S., Michigan State University; B.S., Eastern Michigan University; Associate Professor

KENNEY, JUSTIN: Ph.D., Temple University; B.S., B.A., Case Western Reserve University; Assistant Professor

MELLER, VICTORIA H.: Ph.D., University of North Carolina-Chapel Hill; B.S., Cornell University; Professor and Chair

MIZUKAMI, HIROSHI: Ph.D., University of Illinois; B.A., International Christian University of Tokyo; Professor Emeritus

MOORE, WILLIAM S.: Ph.D., University of Connecticut; B.S., Michigan State University; Professor Emeritus

MYHR, KAREN L.: Ph.D., B.S., University of Michigan; Assistant Professor (Research)

NJUS, DAVID L.: Ph.D., Harvard University; B.S., Massachusetts Institute of Technology; Professor

PILE, LORI A.: Ph.D., University of Cincinnati; B.Sc., University of Toledo; Associate Professor

POPADIC, ALEKSANDAR: Ph.D., University of Georgia; B.S., University of Belgrade; Associate Professor

SADAGURSKI, MARIANNA: Ph.D., B.Sc., Tel Aviv University; Assistant Professor

SCHRADER, JARED: Ph.D., Northwestern University; B.S., Colorado State University; Assistant Professor

SODJA, ANN: Ph.D., University of California; M.S., Ohio State University; A.B., Ursuline College; Associate Professor

STEINER, CHRISTOPHER: Ph.D., Michigan State University; B.S., University of California-Los Angeles; Associate Professor

THOMAS, ROBERT A.: Ph.D., M.S., Wayne State University; B.S., City University of New York; Lecturer

TUCKER, JAMES D.: Ph.D., Oregon Health Sciences University; B.S., University of California-Davis; Professor Emeritus

TURCHYN, NATALIYA: Ph.D., B.S., Wayne State University; Senior Lecturer

VANBERKUM, MARK: Ph.D., Baylor College of Medicine; M.Sc., B.Sc., University of Toronto; Professor

• Biological Sciences (B.A.) (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/biological-sciences/biological-science-ba)
• Biological Sciences (B.S.) (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/biological-sciences/biological-sciences-bs)
• Biological Sciences Minor (http://bulletins.wayne.edu/undergraduate/college-liberal-arts-sciences/biological-sciences/biological-sciences-minor)

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.
**BIO 1050 An Introduction to Life Cr. 4**

**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. Meets General Education Laboratory Requirement when elected for 4 credits. 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 1500 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 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. 3**

An advanced introduction to the structural and functional biology of the eucaryotic cell. Molecular, biochemical, and functional material learned in other courses reviewed and synthesized as it related to the cell. Offered Every Term.

**Prerequisites:** BIO 1500 with a minimum grade of C- and BIO 1510 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 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- and CHM 1250 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- and (BIO 2600 with a minimum grade of C- or EVS 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.
Prerequisite: PSY 1010 with a minimum grade of C- or BIO 1020 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-
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 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. 6
Formalized treatment of the current state of knowledge in a significant area of biology. Topics to be announced in Schedule of Classes. Offered for undergraduate credit only. Offered Intermittently.
Prerequisites: BIO 1500 with a minimum grade of C- and BIO 1510 with a minimum grade of C-
Restriction(s): Enrollment is limited to Undergraduate level students.
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, 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-
Course Material Fees: $10
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 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 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- and BIO 2600 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 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 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.
**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 6070 Human Genetics Cr. 3
Principles of genetics as applied to humans. Topics include pedigree analysis, simple and complex inheritance patterns, cytogenetics, development and sex determination, role of mutations in disease, genes and cancer, genetic testing and forensics, genomics, linkage, genetics of behavior, and human evolution. Offered Intermittently.
Prerequisite: 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 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
Restriction(s): Enrollment is limited to Undergraduate level students.

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 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, 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

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 6620 Advanced Evolution Cr. 3
Continuation of BIO 4130; emphasis on evolutionary biology. Topics include: history of evolutionary thought, origins of life, evolution of the cell, evolution of genes, evolution and behavior, evolution of life history traits, phylogentic, historical biogeography, tempo and mode of evolution, species concepts and speciation, nature of adaptation and adaptive radiations. Offered Intermittently.

Prerequisite: BIO 4200 with a minimum grade of C-

BIO 6690 Neurobiology I Cr. 3
Electrical and chemical signal transmission and signal processing in the nervous system. Integration of these functions into complex sensory and control mechanisms. Molecular mechanisms of electrical excitability and ion channels, neurotransmitters and receptors, second messengers, and feedback circuits. Neurobiology of motor control, sensory and regulatory systems. Offered Winter.

Prerequisite: BIO 3100 with a minimum grade of C- and (BIO 4120 (may be taken concurrently) 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 6890-6894 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 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.