BIOLOGICAL SCIENCE (BIOL)

BIOL 100 Principles of Biology 3 Credit Hours
A lecture course introducing non-science concentrators to major areas of biology, including cell biology, genetics, human physiology, plant biology, ecology, and evolution. Topics of current interest are discussed. Students cannot use both BIOL 100 and NSCI 120 to satisfy the Natural Sciences distribution requirements. Three hours lecture. (F,W).

BIOL 103 Anatomy and Physiology I 4 Credit Hours
The structural and functional relationships of the human body at the cellular, tissue, organ, and system levels are analyzed. Students identify the major anatomical parts and relate these to the physiological activities of the circulatory, skeletal, nervous, muscular, and digestive systems. The homeostatic effects of fluids, electrolytes, and acids and bases throughout the integrated human body are analyzed. Four hours lecture, three hours laboratory. (F).
Corequisite(s): BIOL 103L

BIOL 105 Anatomy and Physiology IIA 4 Credit Hours
The major anatomical parts of the cardiovascular, respiratory, reproductive, endocrine, nervous, and urinary systems of the human body are identified and related to the physiological activities of these systems. Emphasis is placed on the homeostatic effects of fluids, electrolytes, acids, and bases throughout the integrated human body. Four hours lecture, three hours laboratory. (W)
Prerequisite(s): BIOL 103
Corequisite(s): BIOL 105L

BIOL 120 The Science of Life 4 Credit Hours
BIOL/NSCI 120 allows students to develop the skills, understanding and knowledge necessary to become citizen scientists. The course emphasis is on basic life processes, ecology, environmental issues, genetics and health. BIOL/NSCI 120 is complementary to but not a requirement for NSCI 121. This course fulfills DDC Natural Science requirements. Students cannot receive credit for both BIOL 120 and NSCI 120. (F, S).
Corequisite(s): BIOL 120L

BIOL 130 Intro Org and Environ Biology 4 Credit Hours
An introduction to organismal and environmental biology, with emphasis on plant and animal diversity, structure, physiology, and development; ecology; and evolution. This course complements BIOL 140, which need not be taken as a prerequisite; together they constitute an introduction to biology. This course is intended for science concentrators. Three hours lecture, four hours laboratory/ recitation. (F,W,S).
Corequisite(s): BIOL 130L

BIOL 140 Intro Molec & Cellular Biology 4 Credit Hours
An introduction to molecular and cellular aspects of biology with emphasis on cell structure and function, biochemistry, genetics, cell growth, and the origin of life. This course complements BIOL 130; together they constitute an introduction to biology. This course is intended for science concentrators. Three hours lecture, four hours laboratory/recitation.
Prerequisite(s): CHEM 134* or CHEM 144*
Corequisite(s): BIOL 140L

BIOL 285 Microbiology 4 Credit Hours
The biology of microorganisms is considered through study of the properties of bacteria, fungi, algae, protozoa, and viruses. Microbial structures are discussed and correlated with their function. Aspects of cellular metabolism pertinent to microorganisms are emphasized. The interaction of microorganisms and their environment, animate and inanimate, is discussed with respect to the beneficial or harmful effects of the different microbial groups. Laboratory exercises introduce the student to basic, practical microbiological techniques and illustrate various principles of microbial life. Three hours lecture, three hours laboratory. (F, W, S).
Prerequisite(s): BIOL 140 and (CHEM 134* or CHEM 144*)
Corequisite(s): BIOL 285L

BIOL 301 Cell Biology 4 Credit Hours
Functional and structural features of cells, organelles, and macromolecules. Topics in biochemistry, and physical chemistry of cellular processes are considered. Four hours lecture. (F, W).
Prerequisite(s): BIOL 140

BIOL 302 Cell Biology and Cellular Physiology laboratory 2 Credit Hours
This course provides comprehensive training in the cell biology laboratory, equipping students with the skills to address emerging questions in the biomedical field. Students will gain practical experience in experimental techniques employed to investigate biology of the cell. Through real-world research projects, they will develop practical skills relevant to academic research and industry. Additionally, this course reinforces concepts from cellular and molecular biology theory courses and prepares students for entry-level positions in biotech or related industries. This course will meet for 4 hours per week (1hr lecture + 3hr lab) (F, W).
Prerequisite(s): BIOL 140 or BIOL 301*

BIOL 303 Comparative Animal Physiology 4 Credit Hours
Physiological processes and their control in animals, particularly vertebrates. Emphasis ranges from the cellular mechanisms and systemic patterns of regulation of body functions to the evolutionary and environmental adaptations determining body form and function in diverse animal types. Four hours lecture. MATH 114 is recommended. (YR).
Prerequisite(s): BIOL 130 and BIOL 140 and (CHEM 124 or CHEM 134 or CHEM 144)

BIOL 304 Ecology 4 Credit Hours
Relationships between organisms and their environments. Patterns in the physical environment, physiological and behavioral adaptations, population dynamics, energy flow, nutrient cycling; succession. Three hours lecture, four hours laboratory (with field trips). (F, S).
Prerequisite(s): BIOL 130 and (MATH 104 or MATH 105 or MATH 113 or MATH 115 or Math Placement with a score of 116)

BIOL 306 General Genetics 4 Credit Hours
An intermediate course in classical, molecular and evolutionary genetics. The structure, function, and inheritance of genetic material in prokaryotes, eukaryotes and viruses are discussed. Topics include DNA and chromosome structure, genetic linkage and mapping, gene expression and its regulation, human genetic disease, and population genetics. Three hours lecture, one hour recitation. (F, W).
Prerequisite(s): BIOL 140

BIOL 307 Genetics Laboratory Techniques 1 Credit Hour
A semester-long independent study course dealing with investigation and analysis in genetics. Laboratory work will include investigation of patterns of inheritance and genetic mapping in plant, animal, or microbial models in a project-based format. Computer work will also be used to apply genetic tools for modern molecular analysis. Four hours laboratory under supervision of a qualified faculty member. (F, W, S).
Prerequisite(s): BIOL 306*

BIOL 308 Principles of Ecology Laboratory 2 Credit Hours
A stand-alone laboratory experience designed to give student hands-on practice with ecological field methods and scientific communication using project-based learning as a theme. Students will use the campus natural area to gain experience with ecological research. Each lab applies different ecological research techniques. Students will complete a semester long project using ecological knowledge to develop solutions to real-world problems and to communicate those solutions and the science behind them to a wide-variety of audiences. (F, S).
Prerequisite(s): BIOL 304* or BIOL 315* or BIOL 320* or BIOL 456*

BIOL 310 Histology 4 Credit Hours
Histology is a 4 hour lecture course. In this course, students learn to identify the structure and function of cells, tissues, and organs at a microscopic level. This course covers imaging, microscopy and staining/processing of tissues for histological analyses. Students learn pattern recognition in a variety of normal tissues of the body including epithelial, connective, skeletal, blood/vascular, muscular, and neurological tissues as well as the various organ systems including cardiovascular, lymphatic, integumentary (skin), endocrine and digestive. Students are also introduced to the field of histopathology. A strong emphasis is placed on the correlation between tissue architecture and normal physiological function of organs and tissues, in order to provide context to the observations. (W).
Prerequisite(s): BIOL 130 and BIOL 140

BIOL 311 Embryology 4 Credit Hours
Embryology is a 4-hour lecture course. This course addresses the cellular and molecular events during all stages of prenatal development beginning from the germ cells and ending in the fully formed organism. Students will learn about the basic processes that underlie the formation of the embryo on genetic, cellular and morphological levels. Diverse topics will be covered ranging from how chromosomes behave during cell replication to the evolutionary homology and structure of the wing and the arm in a bird, a human and a bat. Additionally, students will be exposed to a wide variety of embryonic systems including well-established and intensively studied models, both genetic (e.g., C. elegans, Drosophila, zebrafish, mouse) and experimental (e.g. chick, sea urchins, frogs). With each topic, discussion of pathological conditions/ birth defects that may arise in association with that developmental process will familiarize students with the medical applications of the topics covered. (F).
Prerequisite(s): BIOL 130 and BIOL 140

BIOL 314 Laboratory in Embryology and Histology 2 Credit Hours
The aim of this course is to provide students with the skills and knowledge required to accurately identify the primary tissues in the animal body and understand how they arise in the developing embryo. This course will familiarize students with microscopy, experimental techniques in developmental biology, and identification of diagnostic characteristics in a histological context. Students will learn pattern recognition in normal tissues and organ structure (histology) as well as comparison to disease state (histopathology). To complement these exercises, a strong emphasis will also be placed on the correlation between tissue architecture and normal physiological function of organs and tissues during developing and adult animals in order to provide context to the observations. The course will cover diverse topics ranging from how chromosomes behave during cell replication to the evolutionary homology and structure of the wing and the arm in a bird, a human and a bat. To succeed in this course, students will be expected to commit to memory the diagnostic characteristics required to identify tissue types and the embryonic stage when they develop. However, this course will not simply rely on rote memorization, as students will be expected to apply their knowledge in practice-based, hands on experiments on vertebrate and invertebrate embryos. This course will meet for 4 hours per week (1hr lecture + 3hr lab) (F, W).
Prerequisite(s): BIOL 310* or BIOL 311*

BIOL 315 Aquatic Ecosystems 4 Credit Hours
An introduction to aquatic ecosystem ecology. Course topics include physical and chemical properties of water and how this contributes to a unique ecological environment, freshwater and marine biomes and their ecology, and threats that face these systems. Four hours lecture. Some weeks instruction will take place in the field. Some local travel may be required. (AY).
Prerequisite(s): BIOL 130 and (CHEM 134 or GEOL 118 or ESCI 118)

BIOL 317 Advanced Human Anatomy & Physiology 4 Credit Hours
This course explores the fundamental concepts of human anatomy and physiology in depth, with a strong focus on their applications in health sciences. Adopting a body systems approach, the course highlights the interconnectedness between structure and function, spanning both macroscopic and microscopic levels of cellular organization. Students explore the complexities of the skeletal, muscular, nervous, cardiovascular, respiratory, digestive, and urinary systems, while also gaining exposure to emerging and relevant topics within scientific and medical fields. The course places emphasis on the explanation of cellular, tissue, and organ functionality, as well as the generation of various biological signals. Throughout the curriculum, students engage with clinical cases and medical applications, fostering a deeper understanding of how anatomical and physiological principles manifest in real-world scenarios. This dynamic approach enables learners to develop critical thinking skills, enabling them to comprehend the intricate functioning of the human body and its impact on health. (W).
Prerequisite(s): BIOL 103 and BIOL 140

BIOL 318 Advanced Human Anatomy & Physiology Lab 2 Credit Hours
This in-depth course explores the concepts of human anatomy and physiology in relation to health sciences. It adopts a body systems approach, emphasizing the intricate connections between structure and function at both macroscopic and microscopic levels. Students will learn research and clinical skills associated with various human systems including the cell, muscular, nervous, cardiovascular, respiratory, digestive, and urinary systems. Practical-based learning experiences are integrated, allowing students to engage in activities such as structure recognition through dissection and human model analysis, blood typing, measurement of electrical signals (EMG, EEG, ECG) and respiration volumes, and assessing reflexes through measuring reaction time of vision and hearing. Additionally, students will gain knowledge about proper biological sterile practices in biological sample preparation. (YR).
Prerequisite(s): BIOL 317*

BIOL 320 Field Biology 4 Credit Hours
Adaptations, taxonomy, systematics, ecology, and behavior of southeastern Michigan flora and fauna. Techniques of field observation and recording are emphasized. Skills in the use of identification keys and guides are developed. The campus Environmental Study Area is used intensively. Three hours lecture, four hours laboratory (with field trips). (S).
Prerequisite(s): NSCI 120 or NSCI 233 or BIOL 130

BIOL 333 Plant Biology 4 Credit Hours
A thorough survey of the evolutionary trends in plant reproduction and morphology will be considered. This survey will extend into the field of plant anatomy, but not plant physiology, which is covered in a separate course. Major groups to be studied include: bacteria, algae, fungi, liverworts, lichens, mosses, ferns, and seed plants. Certain less familiar groups will also be emphasized. Plant diversity will be examined from the perspective of its import to civilizations of the past and future. (W, YR).
Prerequisite(s): BIOL 130

BIOL 335 Plant Physiology 4 Credit Hours
Physiological principles as they apply to the major plant groups. Topics include cellular metabolism, water balance, translocation, photosynthesis, mineral nutrition, growth and development and production of secondary substances. Four hours lecture. (W).
Prerequisite(s): BIOL 130 and BIOL 140

BIOL 336 Plant Anatomy and Physiology Laboratory 2 Credit Hours
This course is a stand-alone laboratory experience designed to introduce students to the basic anatomical and physiological features of higher plants. Hands-on lab exercises will include examinations of plant propagation techniques, and the anatomy and classification of plant organ systems and methods of plant reproduction. Physiological experiments will evaluate aspects and principles of cellular metabolism, water balance, photosynthesis, and plant mineral nutrition. (F, W).
Prerequisite(s): BIOL 333* or BIOL 335*

BIOL 337 Plant Ecology 4 Credit Hours
This course focuses on different aspects of the relationship between plants and their environment. Topics include: a) interactions of plants with the physical environment; b) ways in which the environment acts to shape plant populations through evolution; c) intra- and interspecific interactions among individuals; and d) large-scale patterns and processes at the landscape-level. Four hours lecture. (W, AY).
Prerequisite(s): BIOL 130

BIOL 350 Principles of Neurobiology and Neuroendocrinology 4 Credit Hours
This course examines the nervous systems and endocrine systems in depth, seeking out general principles governing their functions. Students will learn 1) excitable properties of neurons and the function of synapses; neuroanatomy and functional properties of the nervous system, including sensory perception, motor control, motivation; dysfunction or disorders of nervous system. 2) The production and synthesis of various classes of hormones; mechanisms of hormone action and regulation; and endocrine disorders. 3) The interactions between the nervous systems and endocrine systems in health and disease, clinical case studies and differential diagnosis. (YR).
Prerequisite(s): BIOL 140

BIOL 355 Integrative Neurobiology, Physiology and Endocrinology Lab 2 Credit Hours
This project-based laboratory course will expose students to techniques used by neurobiologists, physiologists, and endocrinologists, including electrophysiology, imaging, and molecular biology. Research projects and exercises will focus on the mechanisms that facilitate the anatomical development and physiological activities of the nervous, muscular, cardiovascular, and endocrine systems. Students will also study human sensory physiology through non-invasive participatory lab exercises and examine tissue- and cell-physiology in non-neural tissues, including skeletal muscle and heart. (YR).
Prerequisite(s): BIOL 140

BIOL 357 Human Physiology 3 Credit Hours
Systems of the human body and their function are investigated individually and as part of an integrated natural living system. Topics include cell structure and function of nerves, muscles, the lungs, heart, blood vessels, kidneys, digestive tract, endocrine glands, brain, and reproductive organs.
Prerequisite(s): (BIOL 130 and BIOL 140) or (BIOL 103 and BIOL 105)

BIOL 360 Population Genetics & Evolution 4 Credit Hours
Processes which change the genetic composition of populations: mutation, gene flow, genetic drift, and natural selection. The origin of subspecies, species, and higher taxa. Evidence of evolution from the geological recors, comparative anatomy, comparative biochemistry and other sources. Three hours lecture. (F,W)
Prerequisite(s): BIOL 130 and BIOL 140 and (MATH 104 or MATH 105 or MATH 113 or MATH 115 or Math Placement with a score of 116)

BIOL 370 Principles of Biochemistry 4 Credit Hours
A concise yet comprehensive survey of biochemistry designed for non-biochemistry majors. The structure of biological molecules and enzyme - catalyzed events are presented in a eukaryotic cellular context. Topics include the structure of macromolecules, enzymology, bioenergetics, regulation, intermediary metabolism, signaling, and the flow of cellular information from DNA to RNA to proteins. Homeostasis and evolution are overarching concepts. Students cannot take both BCHM 370 and 470 or 471 for any combination of concentration, cognate or minor requirement. Four hours lecture. (F).
Prerequisite(s): BIOL 140 and CHEM 226

BIOL 380 Epidemiology 3 Credit Hours
Introduces the methods for infectious disease epidemiology (occurence and spread in population) and case studies of important disease syndromes and entities. Methods include definitions and nomenclature, outbreak investigations, disease surveillance, case-control studies, cohort studies , laboratory diagnosis, molecular epidemiology, dynamics of transmission, and assessment of vaccine field effectiveness. Case-studies focus on acute respiratory infections, diarrheal diseases, hepatitis, HIV, tuberculosis, sexually transmitted diseases, malaria, and other vector-borne diseases. This course emphasizes methods of study that would contribute to understanding diseases etiology. This course will also cover important concepts in social epidemiology, including social inequalities and social capital in health, clinical studies and treatment of diseases. (S).
Prerequisite(s): BIOL 140

BIOL 385 Microbiology 4 Credit Hours
The biology of microorganisms is considered through study of the properties of bacteria, fungi, algae, protozoa, and viruses. Microbial structures are discussed and correlated with their function. Aspects of cellular metabolism pertinent to microorganisms are emphasized. The interaction of microorganisms and their environment, animate and inanimate, is discussed with respect to the beneficial or harmful effects of the different microbial groups. Laboratory exercises introduce the student to basic, practical microbiological techniques and illustrate various principles of microbial life. Three hours lecture, four hours laboratory. (F,S).
Prerequisite(s): BIOL 140 and (CHEM 134* or CHEM 144*)
Corequisite(s): BIOL 385L

BIOL 390 Topics in Biology 1 to 4 Credit Hours
Examination of problems and issues in selected areas of biology. Title in Schedule of Classes changes according to content. This course may be repeated for credit when specific topics differ. Permission of Instructor. (OC).

BIOL 402 Physiology of Excitable Cells 4 Credit Hours
An in-depth analysis of the mechanisms underlying electrical communication within and between mammalian cells. The major emphasis is on excitable cells in the brain, heart, and skeletal muscle and their functional integration. Fulfills the Biology major capstone requirement. (W).
Prerequisite(s): BIOL 130 and BIOL 140 and (BIOL 303 or BIOL 305 or BIOL 350 or BIOL 357)
Restriction(s):
Can enroll if Class is Junior or Senior

BIOL 404 Mechanisms of Chronic Human Disease 4 Credit Hours
This course focuses on the biochemical, molecular and cellular mechanisms underlying the progression of chronic diseases, such as diabetes mellitus and atherosclerosis. Techniques in epidemiology, pathology, genetics, molecular biology, and biochemistry are used to understand how relevant physiological processes become pathological. The examination of chronic diseases provides an opportunity to understand biological processes across many scales of life, from extracellular matrix proteins to cells in blood vessel walls to risk factors in patient populations to the pharmacology of treatments. Use of primary literature is emphasized. Four hour lecture. (AY).
Prerequisite(s): BIOL 301 or BIOL 306 or BIOL 357 or BCHM 370 or BIOL 370 or CHEM 370 or BCHM 471 or BIOL 471 or CHEM 471
Restriction(s):
Can enroll if Class is Junior or Senior

BIOL 405 Environmental and Public Health Microbiology 4 Credit Hours
This course provides an understanding of microorganisms within all habitats (soil, water, and air) and their beneficial and detrimental impacts on human health and welfare. Emphasis will be placed on soil/water microbiology (fungi, bacteria, archaea, microalgae, protozoa, and viruses); ecological processes (e.g., decomposition, bioremediation, nutrient cycling, biogeochemistry, and agroecosystems) and microbes of public health significance from environmental exposures and microbiological aspects of the environment as related to human health. (F).
Prerequisite(s): BIOL 140
Restriction(s):
Can enroll if Class is Senior

BIOL 407 Environmental and Public Health Microbiology Laboratory 2 Credit Hours
The Environmental and Public Health Microbiology Laboratory course provides students with hands-on experience in exploring the intricate relationships between microorganisms, the environment, and human health. Through a combination of experiments, analyses, and critical thinking, students will delve into the detection, identification, quantification, and assessment of health-related microorganisms within environmental samples. This immersive laboratory experience spans a broad spectrum of topics, encompassing the assessment of microbial diversity, water quality analysis, airborne microorganism monitoring, and bioremediation studies. Students will detect, identify, and quantify microorganisms within various environmental niches. (F).
Prerequisite(s): BIOL 140

BIOL 410 Diversity, Equity and Inclusion in Health Care: Research and Treatment 4 Credit Hours
This course will address the effect of race, age, gender, religion, and economic status on medical research and health care. Through an examination of clinical trials and case studies, students will learn how medical research is performed in the United States, and what health care treatments and options for patients are available. Medical treatment and disease topics will be selected and will be evaluated as to how they are influenced by the criteria listed. The examples will focus on both cultural differences and inequity, in national and global settings. (AY).
Prerequisite(s): BIOL 130 and BIOL 140
Restriction(s):
Can enroll if Class is Junior or Senior

BIOL 412 Vertebrates 4 Credit Hours
A comparative study of the functional anatomy of vertebrates, including an analysis of structural and functional features, diversity, history, and macroevolution. Four hours lecture. Fulfills the biology major capstone requirement. (AY).
Prerequisite(s): BIOL 303 or BIOL 317 or BIOL 360
Restriction(s):
Can enroll if Class is Senior

BIOL 413 Comparative Animal Anatomy and Physiology Lab 2 Credit Hours
A hands-on investigation of animal physiology and anatomy, with a focus on vertebrates. Activities include hypothesis-driven scientific experiments and dissection of representatives of the major vertebrate groups. One hour recitation, three hours laboratory. Animal dissection is required. (YR).
Prerequisite(s): BIOL 303* or BIOL 317* or BIOL 412*

BIOL 419 Behavior and Evolution 4 Credit Hours
An in depth examination of how evolutionary processes shape behavior, focusing on the influence of natural, sexual, and kin selection. Topics include behavioral genetics, natural selection, sexual selection, kin selection, optimality, game theory, evolutionary stable strategies, phylogenetics, and the comparative method.
Prerequisite(s): BIOL 140 and BIOL 130
Restriction(s):
Can enroll if Class is Senior
Can enroll if Level is Undergraduate

BIOL 420 Advanced Field Ecology 1 to 4 Credit Hours
An intense study of organisms and ecosystems at an advanced level, utilizing ecological habitats in a local or remote setting. Students will learn data collection and hypothesis testing as applied to investigations of behavior, biotic interactions, and biodiversity patterns in a focal ecosystem. The course may require travel. See current schedule of classes for destination and travel dates. Hours are variable depending on the field location. Repeats allowed if different location. (OC).
Restriction(s):
Can enroll if Class is Senior

BIOL 422 Conservation Biology 4 Credit Hours
This course is a study of the historical and current preservation of global biodiversity. The value of biodiversity, extinction, threats to biodiversity, and both ex situ and in situ conservation strategies are considered. (W, AY)
Prerequisite(s): BIOL 304 or ESCI 304
Restriction(s):
Can enroll if Class is Senior
Can enroll if Level is Undergraduate

BIOL 424 Integrative and Comparative Zoology 4 Credit Hours
Study of the organismal biology, evolution, and natural history of a representative focal animal group designated for the semester. Lecture topics include morphology, classification, diversity, evolutionary history, anatomy, physiology, movement, reproduction, behavior, communication, ecology, and conservation. Practical work includes species identification, collection study, field methods, and behavioral observation. Students develop individual projects. Three hours lecture plus local field trips. Course may be repeated for credit when focal animal group varies. See current schedule of courses for focal animal group. Students cannot receive credit for both Biology 424 and Biology 524. (AY).
Prerequisite(s): BIOL 130
Restriction(s):
Cannot enroll if Class is Graduate

BIOL 440 Microbial Genetics & Physiology Laboratory 2 Credit Hours
Microbial Genetics and Physiology Laboratory emphasizes the use of advanced microbiological techniques for understanding the genetics and physiology of microorganisms. Experiments focus on the understanding of general microbial phenomena, such as nutrition, metabolism, and biochemistry; protein and nucleic acid synthesis; energy generation, enzyme regulation, membrane transport, motility, differentiation, cellular communication, and the behavior of populations. The course involves laboratory work, data analysis of molecular data using bioinformatic tools, abstract writing, and poster presentation. (W).
Prerequisite(s): BIOL 140*
Restriction(s):
Cannot enroll if Class is Freshman
Can enroll if Level is Undergraduate

BIOL 450 Virology (BIOL) 4 Credit Hours
The first half of this course deals with bacterial viruses, with emphasis on classical events in this field. The second half surveys the field of animal viruses, with emphasis on recent discoveries, including replication, pathogenesis, and viral association with cancers. Three hours lecture, four hours laboratory. (AY,W).
Prerequisite(s): BIOL 140
Corequisite(s): BIOL 450L

BIOL 451 Virology Laboratory 2 Credit Hours
This course is a stand-alone laboratory experience designed to enhance the detailed study of virology. Hands-on lab exercises will include common methods used to study viruses including diagnostic techniques. Experiments will include a variety of modern antibody-based clinical approaches. This course is complementary to BIOL/MICR 450 but can be taken without BIOL/MICR 450 for students seeking a molecular and cellular biology laboratory course. (W, AY).
Prerequisite(s): BIOL 140

BIOL 452 Med & Env Toxicology 3 Credit Hours
Mechanistic concepts of toxicology at the cellular and molecular levels. THe course is taught from a human health perspective focusing on contemporary problems and environmental associations. Three hours lecture. (W, AY)
Prerequisite(s): BIOL 140 and CHEM 225 and (BIOL 370 or BIOL 470 or BIOL 301)
Restriction(s):
Can enroll if Class is Senior
Can enroll if Level is Undergraduate

BIOL 455 Immunology 4 Credit Hours
A detailed study of the field of immunology. Among the topics covered are various aspects of the immunological response, such as humoral or cell-mediated immunity, cell-cell interactions, and immunology as related to the cause and prevention of disease. Three hours lecture, four hours laboratory. (AY,F).
Prerequisite(s): BIOL 301

BIOL 456 Behavioral Ecology 4 Credit Hours
An in depth examination of what processes shape behavior, focusing on the influence of ecology and evolution. Topics include behavioral ecology and genetics, natural and sexual selection, kin selection, optimality modeling, game theory modeling, evolutionary stable strategies, life-history traits, demographics, ecological interactions (predator, prey, parasitism, mutualism, competition), phylogenetics, the comparative method and both parametric and non-parametric statistics. Students cannot receive credit for both BIOL 456 and BIOL 556. Students seeking graduate credit should elect BIOL 556. (YR).
Prerequisite(s): BIOL 130
Restriction(s):
Cannot enroll if Class is Specialist or Graduate or Doctorate

BIOL 457 Behavioral Ecology Lab 2 Credit Hours
An experimental approach to examining behavior in a scientific and objective way, focusing on the influence of ecology and evolution. Topics include experimental design, hypothesis testing, statistical analysis, ethological methods, behavioral ecology and genetics, natural and sexual selection, kin selection, optimality modeling, game theory modeling, evolutionary stable strategies, life-history traits, demographics, ecological interactions (predator, prey, parasitism, mutualism, competition), phylogenetics, the comparative method and both parametric and non-parametric statistics. (YR).
Prerequisite(s): BIOL 456*

BIOL 458 Pathogenic Microbiology and Immunology Laboratory 2 Credit Hours
This course is a stand-alone laboratory experience designed to enhance the detailed study of pathogenic microbiology and immunology. Hands-on lab exercises will include common techniques used to study bacterial pathogens, infectious diseases, and measuring immune responses. Experiments will include gene editing using CRISPR, quantifying pathogen sensitivity to antibiotics and immune defense mechanisms, and a variety of modern antibody-based clinical approaches. (F).
Prerequisite(s): BIOL 140

BIOL 459 Pathogenic Microbiology (BIOL) 4 Credit Hours
An introduction to pathogenic microorganisms and mechanisms of microbial pathogenicity. Disease-causing bacteria, fungi, viruses, and protozoa are studied. Laboratories emphasize clinical approaches to isolation, identification, and treatment. Three hours lecture, four hours laboratory. (AY,F).
Prerequisite(s): BIOL 140

BIOL 460 Sequence Analysis and Bioinformatics 4 Credit Hours
Use of computer resources to access and analyze nucleic acid and protein sequences. Emphasis is placed on practical approaches to visualize, analyze, and interpret the function and evolution of genes, genomes, and proteins, including database searches, sequence alignment and assembly, gene identification and annotation, and phylogenetic analysis. Students complete individual projects and develop research, writing, and presentation skills. Four hours meetings per week. (YR).
Prerequisite(s): BIOL 306 or BIOL 360

BIOL 470 Biochemistry I 4 Credit Hours
Biochemistry I explores the structure/function relationships of the four major types of biomolecules, including carbohydrates, nucleic acids, and lipids, with an emphasis on proteins and enzyme kinetics. (F).
Prerequisite(s): BIOL 130 and BIOL 140 and CHEM 226

BIOL 471 Biochemistry II 4 Credit Hours
BCHM 471 delves into advanced biochemical processes vital to life. Covering biomolecule structure and function, enzymatic reactions, metabolic pathways, and cellular signaling, the course starts with life's chemical basis and progresses to complex biochemical topics. It emphasizes practical skills like data analysis, problem-solving, and biochemical research techniques. Students undertake a research project on a biochemical disease and an oral presentation on recent biochemical research, enhancing their independent research and communication skills. This course prepares students for advanced academic or professional roles in biochemistry. (W).
Prerequisite(s): BCHM 470 or CHEM 470 or BIOL 470

BIOL 472 Biochemistry Lab I 2 Credit Hours
Biochemistry Laboratory I combines a blend of theoretical knowledge and hands-on experience. Students will explore advanced biochemical techniques including chromatography, gel electrophoresis, and spectroscopy. The course also includes molecular biology techniques such as site-directed mutagenesis. Aimed at fostering critical thinking, problem-solving, and scientific communication, BIOL 472 prepares students for advanced roles in biochemistry and medical research, emphasizing the application of laboratory skills to real-world challenges in personalized medicine. (F).
Prerequisite(s): (BIOL 470* or BCHM 470* or CHEM 470*) and BCHM 210

BIOL 473 Biochemistry Laboratory II 2 Credit Hours
This advanced laboratory class further develops experimental skills to examine receptors, ligands, and signal cascades. These cellular factors are critical to metabolic homeostasis, gene regulation and neurochemistry. This course will teach skills and techniques to understand drug development, signaling, biochemical assays, genomics, and ligand binding affinity, specificity, and competition. (W).
Prerequisite(s): (BCHM 471* or BIOL 471* or CHEM 471*) and (BCHM 472 or BIOL 472 or CHEM 472)

BIOL 474 Molecular Biology 4 Credit Hours
This course emphasizes the cellular mechanisms of information flow and regulation from DNA to RNA to proteins in eukaryotes. Topics will include chromatin structure, DNA replication, transcription, RNA modification, regulatory RNA, translation, DNA repair, genetic rearrangement, and genome organization. Experimental design, data interpretation and data analysis are emphasized. Four hours lecture (F). (F).
Prerequisite(s): (BCHM 470 or BIOL 470 or CHEM 470 or BCHM 370 or BIOL 370 or CHEM 370) and CHEM 227

BIOL 475 Molecular Biology Laboratory 2 Credit Hours
This laboratory provides instruction and experience in a variety of molecular biology techniques while performing a semester long project to address a question regarding molecular mechanism. Literature searching and creativity will guide students in designing experiments that together form the project. Skills addressed include experimental design, sample handling and manipulation, instrument use, data analysis, and scientific communication. One hour lecture, three hours laboratory (F).
Prerequisite(s): BCHM 210 or CHEM 227 and (BCHM 474* or BIOL 474*)

BIOL 476 Cancer Cell Biology 4 Credit Hours
Cancer is a disease of anti-social cell behavior. This course educates students on the genetics, molecular and cellular changes that normal cells undergo to become cancer cell. Major emphasis is on providing a mechanistic insight into fundamental questions in cancer cell biology. The course also discusses currently available therapeutic treatments and emerging issues in cancer therapy research. Fulfills capstone requirement for biology majors. Three hours lecture.
Prerequisite(s): BIOL 130 and BIOL 140 and (BIOL 301 or BIOL 306 or BIOL 370 or BCHM 370 or CHEM 370 or BIOL 385 or MICR 385)
Restriction(s):
Can enroll if Class is Senior

BIOL 480 Neurobiology of Brain Disorders 4 Credit Hours
This course aims to provide a foundation in the underlying mechanisms of neurological and psychiatric disorders. We will explore through lectures and readings of primary literature a number of important brain disorders, including autism spectrum disorder, traumatic brain injury, amyotrophic lateral sclerosis, Parkinson's disease, Huntington's disease, Alzheimer's disease and mental disorders. This course focuses on the fundamental molecular and cellular mechanisms that underlie brain disorders, clinical signs and symptoms, current therapeutics/treatments, and help students to better understand the brain dysfunctions or diseases through clinical case studies and differential diagnosis. (YR).
Prerequisite(s): BIOL 350 or BIOL 357 or BIOL 306 or BIOL 317
Restriction(s):
Can enroll if Class is Senior

BIOL 485 Physiology and Biochemistry of Microorganisms 4 Credit Hours
Physiology of Microorganisms (BIOL/MICR 485) is a lecture-based course that delves deeply into the intricacies of microbial physiology and biochemistry. This intensive course is specifically designed to foster an integrated understanding of the cellular functions of microorganisms, underpinned by the synergistic interaction of biochemistry and genetics. The course takes a holistic approach to unravel the diverse and robust nature of microbial life. The focal points covered within this course encompass various aspects, such as microorganism growth and nutritional patterns, the microbial breakdown of organic compounds, the control of degradation reactions, the production of distinct microbial compounds and secondary metabolites (including antibiotics and toxins), responses to microbial stress, and the phenomenon of bacterial differentiation. (W, YR).
Prerequisite(s): BIOL 140 and CHEM 225*

BIOL 490 Sem in Biology/Microbiology 1 to 6 Credit Hours
Directed research on a problem culminating in the preparation of a paper and presentation of a public seminar. Tutorials, lectures and student seminars are given on selection and formulation of research problems, experimental design, and statistical treatment of data. May be repeated for credit with permission of advisor. (OC).

BIOL 491 Capstone Course in Biology 4 Credit Hours
A culminating course for biology majors which focuses on an area of current biological research and integrates material from different subdisciplines of biology. Topic varies and is announced in the Schedule of Classes. Three hours lecture. (OC).
Restriction(s):
Can enroll if Class is Senior
Can enroll if Major is Biological Sciences

BIOL 492 Capstone Research Experience 3 Credit Hours
An approved research experience with a UM-D biology faculty member which integrates material from different sub disciplines of biology. Research results are reported in a poster or seminar presentation or in a manuscript submitted for publication.
Restriction(s):
Can enroll if Class is Senior
Can enroll if Major is Biological Sciences

BIOL 493 Capstone Teaching Experience 3 Credit Hours
An approved teaching experience which integrates material from different subdisciplines of biology. Students work as a student teaching assistant/student mentor in the laboratory portion of a biology course.
Restriction(s):
Can enroll if Class is Senior
Can enroll if Major is Biological Sciences

BIOL 494 Emergency Medicine Research Associates Program (EMRAP) 2 to 3 Credit Hours
Full Course Title: Emergency Medicine Research Associates Program (EMRAP) at St. Mary Mercy hospital. This course provides a unique research experience through a partnership with the University of Michigan-Dearborn Biology Discipline in the NSCI Department. Enrolled students will assist in ongoing clinical research programs, will learn the basic principles behind clinical research design, hypothesis testing, results interpretation, including discussions of issues involving human subjects in research, informed consent, and health information privacy. Students will gain knowledge in the aforementioned areas through lecture and through clinical shift work, including clinical provider shadowing, participant enrollment, and data collection for several ongoing trials. This course runs for a full academic year (3 credits Fall and 2 credits Winter). (F,W, YR) Registration is by permission of instructor only. (F, W, YR).

BIOL 495 Off-Campus Research Participat 1 to 3 Credit Hours
Participation in ongoing experimental research at an off-campus laboratory (or in the field). Arrangements made between the off-campus researcher, the student, and the Biology concentration advisor. No more than six credit hours combined from BIOL 490, 495, 498, and 499 may be counted toward the 120 hours required for a degree. Four to twelve hours laboratory. Permission of instructor. (F,S).

BIOL 497 Seminar in Biology 1 Credit Hour
Topics of current interest in Biology will be presented by guest lecturers, faculty members or students. Topics chosen will vary from term to term. Can be elected up to three times. One hour seminar. (W).

BIOL 498 Independent Study in Biology 1 to 3 Credit Hours
Library research and independent study performed under the guidance of a faculty member. Four to twelve hours readings. Permission of instructor. (F,S).

BIOL 499 Laboratory in Biological Resrh 1 to 3 Credit Hours
Directed laboratory research performed under the guidance of faculty member. Four to twelve hours laboratory. Permission of Instructor. (F,S).

*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally