

# BIOLOGICAL SCIENCE (BIOL)

## Course Descriptions

### **BIOL 500 Graduate Seminar in Natural Sciences 3 Credit Hours**

In this course, the students will gain experience in the various forms of science communication within the broad field of natural sciences, which comprises a spectrum of disciplines within it. In addition to gaining knowledge in communicating both basic and applied biology, students will also learn about the variety of techniques used in the various disciplines within the field. Through attendance of weekly seminars, students will be exposed to research talks from senior faculty in different fields of study. Additionally, through weekly evaluation and presentations of scientific journal articles, students will hone their critical analysis and scientific communication skills. (F).

#### **Restriction(s):**

Can enroll if Class is Graduate

### **BIOL 501 Discoveries in Current Biology 3 Credit Hours**

Current issues in biology based on an inquiry approach to learning with a primary emphasis on laboratory, field observations, and discussion. Students will help to develop the specific topics within the subject areas that include the environment, heredity, and health. Projects will have direct applications for classroom teaching. Lecture and laboratory. Permission of College of Education, Health, and Human Services advisor. Teacher experience. (S).

### **BIOL 502 Physiology of Excitable Cells 3 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 Graduate

### **BIOL 504 Mechanisms of Chronic Human Disease 3 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. Three hours 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 Graduate

### **BIOL 508 Invasive Species Ecology 3 Credit Hours**

This course will examine the biological, ecological and societal impacts of invasive species. Major issues including characteristics of invasive species, invaded communities, origins and success rates of invaders, economic and health effects, methodologies and regulatory strategies for dealing with invasive species will be discussed. Students will investigate an invasive species and make oral and written reports.

**Prerequisite(s):** BIOL 304 or BIOL 320

### **BIOL 512 Vertebrates 3 Credit Hours**

A comparative study of the functional anatomy of vertebrates, including an analysis of structural and functional features, diversity, history, and macroevolution. Three 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 Graduate

### **BIOL 515 Aquatic Ecosystems 3 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. Some weeks instruction will take place in the field. Some local travel may be required. (AY).

**Prerequisite(s):** BIOL 130 and (CHEM 124 or GEOL 118 or ESCI 118)

#### **Restriction(s):**

Can enroll if Class is Graduate

### **BIOL 519 Behavior and Evolution 3 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. Additional assignments will distinguish this course from the undergraduate version.

#### **Restriction(s):**

Can enroll if Class is Graduate

### **BIOL 520 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 Graduate

### **BIOL 522 Conservation Biology 3 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. A student may not receive credit for both BIOL/ESCI 422 and BIOL 522. (W, AY)

#### **Restriction(s):**

Can enroll if Class is Graduate

### **BIOL 524 Integrative and Comparative Zoology 3 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):**

Can enroll if Class is Graduate

**BIOL 545 Restoration Ecology 3 Credit Hours**

Restoration Ecology is an interdisciplinary course that develops theories and practices that help rehabilitate impaired ecosystems towards a sustainable state. Bioremediation and phytoremediation are some approaches to be discussed. Short-term site management is discussed, often including continued resource or recreational use, with the eventual site sustainability in mind. (F, AY)

**Restriction(s):**

Can enroll if Class is Graduate

**BIOL 550 Virology 3 Credit Hours**

This course will focus on human and animal viruses that represent significant public health challenges. This course is beneficial for pre-health students and those interested in pandemics and infectious diseases. Students will learn molecular virology and diseases caused by Influenza, Ebola, and HIV plus many others. Additional content will include clinical case studies and epidemiology problems. Zoonotic viruses and spillover events will also be considered. (W, AY).

**Restriction(s):**

Can enroll if Class is Graduate

**BIOL 552 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.

**Prerequisite(s):** BIOL 140 and CHEM 225 and (BIOL 301 or BIOL 303 or BIOL 385 or BIOL 370 or BIOL 455 or BIOL 470)

**Restriction(s):**

Can enroll if Level is Rackham or Graduate

**BIOL 555 Immunology 3 Credit Hours**

This course provides an understanding of basic concepts in 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. Emphasis will be placed on characterizing the innate and adaptive immune responses and understanding the dynamics between innate and adaptive responses. The molecular details governing immune system development will also be covered. Consideration will be given to allergies, autoimmunity, and host defense against infection. Topics introduced in this course will include vaccines, manipulation of immune responses, and advances in immunotherapies. (F, AY).

**Restriction(s):**

Can enroll if Class is Graduate

**BIOL 556 Behavioral Ecology 3 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 undergraduate credit should elect BIOL 456. (YR).

**Restriction(s):**

Cannot enroll if Class is Undergraduate NCFD or Freshman or Sophomore or Junior or Senior

**BIOL 557 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 556\*

**BIOL 559 Pathogenic Microbiology 3 Credit Hours**

This course provides an understanding of basic concepts of pathogenic microbiology. This course serves as an introduction to pathogenic microorganisms and mechanisms of microbial pathogenicity.

Disease-causing bacteria, fungi, and protozoa will be considered. This course will also include clinical case studies, medical microbiology, superbugs and antibiotic resistance, and vaccines to prevent infectious diseases. Additional topics considered are various aspects of microbial pathogenesis, such as mechanisms to subvert host defenses, host-microbe interactions, and molecular genetics as related to the causes of infectious diseases. (F, AY).

**BIOL 560 Sequence Analysis and Bioinformatics 3 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. Three hour meetings per week. (YR).

**Prerequisite(s):** BIOL 306 or BIOL 360

**Restriction(s):**

Can enroll if Class is Graduate

**BIOL 561 Advances in Molecular, Cellular, and Developmental Biology 3 Credit Hours**

This course will introduce the fundamentals of molecular cellular biology and their fundamental roles in the development of multicellular organisms. These areas are the focus of a great deal of fascinating research with far-reaching biomedical, ethical, and social implications. The structure and function of cellular components will be discussed in the context of their contribution to the functioning of organisms, highlighting the importance of organelles in the function of eukaryotic cells and ultimately higher tissue assemblies. Textbook readings will be used to develop a foundation of basic facts and concepts. Lectures will build on this foundation to dive into key concepts, explore the experimental logic and techniques used to study molecular, cellular and developmental biology, and develop a deep understanding of the application of these ideas. Although some review level introductory information will be presented, it is important to note that this is a graduate course and students will be expected to know fundamental of the topics presented. Emphasis will be placed on human physiology and disease. Lectures are also complemented by a graduate wet lab course BIOL 562- Techniques in Molecular, Cellular, and Developmental Biology, which can be taken concurrently or following BIOL 561 (OC).

**Restriction(s):**

Can enroll if Class is Senior or Graduate

Can enroll if Level is Rackham or Graduate

**BIOL 562 Methods in Molecular, Cellular, and Developmental Biology 3 Credit Hours**

This course is designed to introduce students to general methods used in molecular, cellular and developmental biology as well as their application in research and industry. Each laboratory section will include a short lecture and accompanying text that will be used to orient you to the upcoming laboratory, teach the theory behind the methods you will be using, and acquaint you with additional methodologies and their applications that we do not have time to cover in lab. In this course you will learn techniques such as RNA and DNA extraction, cloning and sequencing of DNA, CRISPR gene editing, polymerase chain reaction (PCR), as well as determining how experimental treatments regulate mRNA and protein levels using quantitative RT-PCR and western immunoblotting, respectively. In addition to "wet lab" techniques, you will also learn about in silico analysis of genomic data through mining of databases such as NCBI and UCSC as well as BLAST and basics of next-generation sequence analysis. Lab is designed to complement the graduate lecture course BIOL 561- Advances in Molecular, Cellular, and Developmental Biology, which can be taken concurrently or prior to BIOL 562 (OC).

**Restriction(s):**

Can enroll if Class is Graduate

**BIOL 574 Molecular Biology 3 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

**Restriction(s):**

Can enroll if Class is Graduate

**BIOL 576 Cancer Cell Biology 3 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. (OC).

**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 Graduate

**BIOL 580 Neurobiology of Brain Disorders 3 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).

**BIOL 590 Topics in Biology 1 to 4 Credit Hours**

Current topics in Biology. One to four credit hours. (OC)

**Restriction(s):**

Can enroll if Class is Graduate

**BIOL 599 Graduate Independent Research 3 Credit Hours**

Provides graduate students the opportunity to participate in individual research projects with faculty support and supervision. (F).

**Restriction(s):**

Can enroll if Class is Graduate

**BIOL 699 Master's Thesis 3 Credit Hours**

Graduate students electing this course, are expected to plan and conduct a research project themselves, to submit a thesis for review and approval, and to present an oral defense of the thesis. (F).

**Restriction(s):**

Can enroll if Class is Graduate

\*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