

# BIOLOGY (BIOL)

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## **BIOL 1005 Perspectives-Veterinary Medicine (2 Credits)**

Introduction to career areas in veterinary medicine through lectures, guest speakers and demonstrations. The credits for this course are general elective only. They do not apply to any major or minor in NSM or to SI-NPW of the common curriculum. Prerequisites: BIOL 1010 and BIOL 1020, or by departmental permission.

## **BIOL 1010 Physiological Systems (4 Credits)**

The second required course in the introductory biology sequence required for students majoring in Biology or another science. Emphasis on physiology and development of plants and animals. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Co-requisite: BIOL 1020 lab section.

## **BIOL 1011 Evolution, Heredity and Biodiversity (4 Credits)**

The first required courses in the introductory biology sequence required for students majoring in Biology or another science. Emphasis on evolution, basic genetics and inheritance, and biodiversity. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Co-requisite: BIOL 1021 lab section.

## **BIOL 1020 Physiological Systems Lab (1 Credit)**

Exercises and experimentation to complement lecture material. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Co-requisite: BIOL 1010 lecture section.

## **BIOL 1021 Evolution, Heredity and Biodiversity Lab (1 Credit)**

Exercises and experimentation to complement lecture material. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Co-requisite: BIOL 1011 lecture section.

## **BIOL 1220 Molecules to Humankind I (4 Credits)**

First class in a three-quarter sequence for non-majors that examines the mechanisms that sustain life. Emphasis is placed on understanding the human body at the molecular, cellular and physiological levels. In the fall quarter our discussions start with the atom and basic chemistry. We next consider the properties of complex molecules, including DNA, proteins, carbohydrates and lipids, in order to see how such molecules are used and organized by living organisms. Our discussions of large and complex molecules lead naturally to the basic unit of life, the cell. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement.

## **BIOL 1221 Molecules to Humankind II (4 Credits)**

Second class in a three-quarter sequence for non-majors begins with an introduction to the general vertebrate body plan; we emphasize the human body plan but also compare it with other vertebrates. Discussions progress through the major organ and physiological systems of the body, including circulatory, respiratory, excretory, endocrine, nervous, skin, immune, reproductive, gastrointestinal, and skeletal and muscle systems. Discussions concentrate on the organization and function of these systems. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement.

## **BIOL 1222 Molecules to Humankind III (4 Credits)**

Third class in a three-quarter sequence focuses for non-majors on cell biology, genetics, and human reproduction and development. After a review of cell structure and function, focusing on how cells are capable of replication with modification, the mechanisms by which information is passed on from one cell to another and from one generation to the next are considered. The second half of the quarter concerns sexual reproduction and early development. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Prerequisites: BIOL 1221.

## **BIOL 1260 Sustaining Life I (4 Credits)**

A three-quarter sequence for non-majors examining some important biological mechanisms that sustain life -- and "life" in general! Emphasis is placed on the understanding the critical connections between the student's health and the health of the surrounding world. The first quarter begins with a discussion of the defining characteristics of "life" and the basic mechanisms required to sustain it. The course continues with an overview of biological diversity and ends with a focus on the many important connections between food, human health, and environmental health. The second quarter begins by building a basic understanding of how ecosystems function -- including the interactions among living organisms (including humans) and between these living organisms and their environment. The course continues with focused discussions of issues related to the impact of biological diversity on infectious disease and medicine. The third quarter begins with a focus on the importance of biodiversity to biomedical research, especially related to model systems. It then reviews some of the current threats to biodiversity and concludes by exploring some possible solutions that can give hope for sustaining "life" in the future. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement.

**BIOL 1261 Sustaining Life II (4 Credits)**

A three-quarter sequence for non-majors examining some important biological mechanisms that sustain life -- and "life" in general! Emphasis is placed on the understanding the critical connections between the student's health and the health of the surrounding world. The first quarter begins with a discussion of the defining characteristics of "life" and the basic mechanisms required to sustain it. The course continues with an overview of biological diversity and ends with a focus on the many important connections between food, human health, and environmental health. The second quarter begins by building a basic understanding of how ecosystems function -- including the interactions among living organisms (including humans) and between these living organisms and their environment. The course continues with focused discussions of issues related to the impact of biological diversity on infectious disease and medicine. The third quarter begins with a focus on the importance of biodiversity to biomedical research, especially related to model systems. It then reviews some of the current threats to biodiversity and concludes by exploring some possible solutions that can give hope for sustaining "life" in the future. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Prerequisite: BIOL 1260.

**BIOL 1262 Sustaining Life III (4 Credits)**

A three-quarter sequence for non-majors examining some important biological mechanisms that sustain life -- and "life" in general! Emphasis is placed on the understanding the critical connections between the student's health and the health of the surrounding world. The first quarter begins with a discussion of the defining characteristics of "life" and the basic mechanisms required to sustain it. The course continues with an overview of biological diversity and ends with a focus on the many important connections between food, human health, and environmental health. The second quarter begins by building a basic understanding of how ecosystems function -- including the interactions among living organisms (including humans) and between these living organisms and their environment. The course continues with focused discussions of issues related to the impact of biological diversity on infectious disease and medicine. The third quarter begins with a focus on the importance of biodiversity to biomedical research, especially related to model systems. It then reviews some of the current threats to biodiversity and concludes by exploring some possible solutions that can give hope for sustaining "life" in the future. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Prerequisite: BIOL 1261.

**BIOL 1270 Living in the Microbial World I (4 Credits)**

Students receive an introduction to the world of microbiology, the good, the bad and the ugly. With the help of the press and movie industry, most "human hosts" believe that microorganisms are to be feared, sterilized and/or destroyed. While this is true for a very small number of microbes, the majority is composed of essential and beneficial microorganisms that help the existence of all life on Earth. This first course in the sequence for non-majors is dedicated to raising the awareness of students to the value and need of our unseen partners. Laboratory included. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement.

**BIOL 1271 Living in the Microbial World II (4 Credits)**

For such a small size, microorganisms can have a large impact on our human world. This second course in the sequence for non-majors brings a new perspective to students on the role microorganisms, and their associated diseases, have played in turning the tide of war victories, immigration of a country, world politics and more. We tend to believe that humans alone can control their world but sometimes the mightiest of all are our unseen partners. Laboratory included. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Prerequisite: BIOL 1270.

**BIOL 1272 Living in the Microbial World III (4 Credits)**

In this last course in the sequence for non-majors, students are given an opportunity to challenge their beliefs and understandings of how life came to exist on Earth and the perspective of how humans are the most evolutionarily advanced. Students are guided through time on Earth and examine the development of life and the constant contribution of their unseen partners. Laboratory included. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Prerequisite: BIOL 1271.

**BIOL 1988 Study Abroad Resident Credit (0-18 Credits)****BIOL 1990 Independent Study (1-5 Credits)****BIOL 2010 General Ecology (4 Credits)**

Topics in ecosystems, population and community ecology, as well as behavioral ecology. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Prerequisite: BIOL 1011 and BIOL 1010. Co-requisite: BIOL 2011.

**BIOL 2011 General Ecology Lab (1 Credit)**

Exercise and experimentation to compliment the lecture. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Co-requisite: BIOL 2010, and Prerequisite: BIOL 1021 with a minimum grade of D-.

**BIOL 2055 Ways of Seeing and Sensing in Biological Systems at Kennedy Mountain Campus (4 Credits)**

Ways of Seeing and Sensing represents a new collaboration between the departments of Biological Sciences, Physics & Astronomy, and Media, Film & Journalism Studies at DU's Kennedy Mountain Campus (KMC). As part of this course, students will collaborate as part of multidisciplinary teams; to compile and apply new content knowledge in biology/ecology, film-making, science communication and story-telling in a project-based curriculum unique to the KMC. The class is a place-based exercise revolving around the idea that what we know about our surroundings depends on how we "see" or "sense." We will examine various aspects of natural systems specific to the Kennedy Mountain Campus (KMC) using both micro and macro approaches to "seeing" through a variety of technologies, including microscopes, trail cameras, photo and video cameras, night vision glasses, and telescopes. To further develop the concept of "sensing," we will explore the soundscapes of the KMC as well as the ways plants and animals in this ecosystem sense their surroundings. We will also explore the KMC using human senses other than sight to navigate the nighttime environment. Students will work in teams of 3–4 to develop and produce documentary stories unique to the ecology and astronomy of the KMC. Students choosing to participate for credit in Biological Sciences will complete additional reading and assignments focusing on the various ways that biological systems (from cells, to organisms, to communities) sense and respond to changes in their environment, including light, heat, sound, chemical cues, and physical forces such as electricity and gravity. This course will meet together with PHYS 2050 and MFJS 2050 courses, which each have different prerequisites and discipline-specific assignments. Prerequisites: BIOL 1010 and BIOL 1011.

**BIOL 2090 Biostatistics (4 Credits)**

Statistics in biological research. Computer-aided statistical analysis and hypothesis testing focusing on experiments and data unique to the biological sciences. Cross listed with BIOL 4090.

**BIOL 2120 Cell Structure and Function (4 Credits)**

Chemical composition of cells; structure and function of cell organelles; interrelationship of cellular unit with its environment; mechanisms of energy conversion within cells; functions of excitability, contractility and cell growth. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Prerequisite: BIOL 1011. Corequisites: BIOL 2121 lab section and CHEM 1010.

**BIOL 2121 Cell Structure & Function Lab (1 Credit)**

Exercises and experimentation to complement lecture material. Lab fee associated with this course. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Co-requisite: BIOL 2120.

**BIOL 2320 Andean Landscapes (4 Credits)**

This course introduces students to the landscapes, biodiversity, societies, and human-environment interactions in the Andes of Peru through an intensive and immersive field study and travel experience. This field intensive class equals 4 academic credits and occurs during winter interterm. Over a period of 11 days we will visit the cities and surroundings of Lima, Arequipa, and Cusco, Peru where we will examine and compare geography, cultures, history, archaeology, ecology, biodiversity, and sustainability issues. The Andean environment offers unique challenges for environment and societies and by understanding the locations and patterns of human activity in the Andes, students can better appreciate the circumstances affecting individuals and countries other than our own. Through observations, lectures, discussions, readings, assignments and immersion, the course will stress the development of in situ critical thinking skills and the promotion of cultural diversity and global awareness. This course counts toward the sustainability minor and the intercultural global studies minor. This course counts as a category elective for the Ecology and Biodiversity major. Prerequisite: BIOL 1011.

**BIOL 2510 General Genetics (4 Credits)**

Mechanisms of heredity with application to all forms of life. Topics include classical genetics (mendelian inheritance, meiosis, epistasis, recombination gene mapping, chromosomal mutations) and an introduction to modern molecular genetics (DNA structure and function, gene expression and regulation). This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. Prerequisites: BIOL 1010 & 1010, BIOL 1011. Recommended prerequisite: BIOL 2120. Corequisite: BIOL 2511.

**BIOL 2511 General Genetics Lab (1 Credit)**

The laboratory component of BIOL 2510. This course counts toward the Scientific Inquiry: The Natural and Physical World requirement. COREQUISITES: BIOL 2510 PREREQUISITES: BIOL 1020 AND BIOL 1021 RECOMMENDED PREREQUISITES: BIOL 2121.

**BIOL 2825 Biogeographies of Conservation in Serengeti & Zanzibar (4 Credits)**

This course introduces students to the landscapes, biodiversity, societies, and human-environment interactions in mainland Tanzania and the island of Zanzibar through an intensive and immersive field study and travel experience. This field intensive class equals 4 academic credits. Over a period of 9 days we will visit the greater Serengeti ecosystem and Tanzania where we will examine and compare geography, cultures, history, archaeology, ecology, biodiversity, and sustainability issues. The environment in this part of East Africa offers unique challenges for wildlife and societies. By understanding the locations and patterns of human and animal activity there, students can better appreciate the circumstances affecting individuals and countries other than our own. Through observations, lectures, discussions, readings, assignments and immersion, the course will stress the development of in-situ critical thinking skills and the promotion of environmental sustainability, cultural diversity and global awareness. Fulfills biology, geography, environmental science, sustainability minor, and intercultural global studies minor requirements. This course counts as a category elective for the Ecology and Biodiversity major. Prerequisite: BIOL 1011.

**BIOL 2988 Study Abroad Resident Credit (0-18 Credits)****BIOL 3005 Science Communication (4 Credits)**

Science communication has shaped, and continues to shape, the world in which we live (e.g., why you wash your hands, why we don't feed bears in U.S. national parks anymore, and why some students imagine themselves becoming scientists or not). Sharing how science is conducted and how new knowledge is generated through the scientific method also plays a critical role in our future: creating engaged citizens, shaping the next generation of scientists, increasing diversity and diverse perspectives in the sciences, informing policy-makers and lawyers, combatting misconceptions, increasing trust of scientists, and guiding our own individual behaviors. But, like any other complex skillset, science communication takes practice. This course provides students with a range of resources and skills for effective, ethical, and evidence-based communication of complex socio-scientific issues. It provides a supportive environment in which students will practice and refine their science communication through peer feedback and engagement with real audiences. The focus is on cultivating practical communication skills, with emphasis on effective speaking, writing and exhibition of scientific topics with the variety of audiences students will encounter in their future careers. Course readings, activities, and final projects also examine how identity shapes both the science we do and the lenses we and other stakeholders bring to communication tasks. The course is hybrid, highly interactive, and writing-intensive. This course is restricted to Junior or Senior Standing UG majoring in the College of Natural Sciences and Mathematics.

**BIOL 3010 Evolution (4 Credits)**

Evolution is the central concept in biology. This course examines the foundations of evolutionary theory. We will cover the history of life on earth, the genetic basis for evolution, evolutionary processes (natural and sexual selection), the origin of species, and medical applications of evolutionary theory. This course counts as a category elective for the Ecology and Biodiversity major. Prerequisite: BIOL 1010 and BIOL 1011.

**BIOL 3025 Science and the Law (2,4 Credits)**

This course will focus on the intersection of science and US law. Four major areas of focus that will be covered are the admissibility of expert witnesses / scientific evidence in court; how advances in forensic genetics and national DNA databases raise legal issues pertaining to expectations of privacy and the standards for reaching a verdict; the impact of US Supreme Court opinions on the patenting of genes used as diagnostic markers for human disease and the legal landscape surrounding issues of evolution and creationism/intelligent design. Students will then explore how the law impacts their own areas of scientific interest. The goal of this course is to increase our understanding as scientists of how advances in science impact and are impacted by the US judicial system. PREREQUISITES: BIOL 1010 AND BIOL 1011.

**BIOL 3035 Invasive Species Ecology (4 Credits)**

This course investigates those plants and animal species that have dramatically expanded their ranges and cause ecological harm. Topics covered include the mechanisms of ecological impacts across the globe, how invasive species are used to test basic ecological theory, the application of this research for managing real species, and related issues such as the debate within the scientific community about the term "invasive." We use a case-study approach, and students have the opportunity to go into the field as a class to observe the real invasions and learn sampling methods.

**BIOL 3044 Coral Reef Ecology (3 Credits)**

Ecology of coral reefs; organization and distribution of reefs; review of reef organisms and their interactions with each other and their physical environment; threats to coral reef conservation. This course counts as a category elective for Ecology and Biodiversity majors. Prerequisite: (BIOL 2010 or BIOL 2050) OR (GEOG 1201, GEOG 1202, and GEOG 1203).

**BIOL 3045 Coral Reef Ecology Lab (1 Credit)**

Ecology of coral reefs laboratory to supplement lecture material; travel to the Caribbean over spring break to observe coral reefs firsthand; introduction to research methods. SCUBA certification and permission of instructor required. A travel and dive fee is associated with this course.

**BIOL 3055 Ecology of the Rockies (4 Credits)**

A week in residence at the Mt. Evans Field Station prior to the start of fall quarter includes field projects dealing with ecology and environmental issues. On campus classes involve data analysis and interpretation and formal scientific communication. Themes include terrestrial and aquatic ecosystems, taxonomic groups ranging from conifer stands to aquatic insects and mountain goats. Lab fee associated with this course. Prerequisite: BIOL 2010 or permission of instructor.

**BIOL 3070 Ecological Field Methods (4 Credits)**

Series of field exercises for students to learn principles and procedures of field methodology, data analysis and technical writing in ecology; problems drawn from population, community and ecosystem ecology. Lab fee associated with this course. Prerequisite: BIOL 2010.

**BIOL 3074 Forest Ecology (4 Credits)**

This course provides an overview of the distribution, structure, function, and dynamics of forest ecosystems. Topics include: paleoecology, ecophysiology, disturbance, succession, community analysis, forest hydrology, primary productivity, and nutrient cycling. Throughout, we maintain an emphasis on the scientific process and how it is used to study the controls on the distribution and abundance of organisms.

**BIOL 3085 Insect Ecology (4 Credits)**

A general introduction to insect biology and the science of entomology. Arthropods are the most diverse group of animals on Earth and insects account for more than half of all known living organisms. This course explores the biodiversity of insects on Earth, insect morphology and physiology. The evolutionary history and taxonomy of key orders of insects is emphasized as well as the importance of insects to our everyday lives. This course counts as a category elective for Ecology and Biodiversity majors. Prerequisites: BIOL 1010, BIOL 1011, and BIOL 2010.

**BIOL 3090 Microbial Ecology (4 Credits)**

Interactions among microorganisms and their environment. Impact of ecological principles on microbial diseases, pollutant degradation, nutrient cycles and global change. Prerequisites: BIOL 1010, BIOL 1020, AND BIOL 2510.

**BIOL 3095 Global Change Ecology (4 Credits)**

Over the past century, the mean surface temperature of our planet has increased slightly less than 1°C. While this may seem like a small increment, this change is already profoundly affecting Earth's organisms and ecological communities, and predictions for the impacts of continued change range from severe to catastrophic. Humans are also changing the environment through alteration of nutrient and water regimes. Topics include cause of climate change, comparison to past climatic change, human contribution to change and effect on organisms, communities and ecosystems. Prerequisites: BIOL 1010, BIOL 1011, AND BIOL 2010. RECOMMENDED PREREQUISITES/COREQUISITES: BIOL 2090.

**BIOL 3110 Special Topics: Biology (1-5 Credits)**

Topics of special interest to teaching/research faculty of department presented as needed to complement and expand existing curriculum. May be repeated for credit. PREREQUISITES: BIOL 1010.

**BIOL 3120 General Microbiology (4 Credits)**

Fundamental principles of microorganisms in the world and in disease; role of bacteria in biological phenomena. Includes laboratory. Lab fee associated with this course. Counts as a category elective for Ecology and Biodiversity majors. Prerequisite: BIOL 2120.

**BIOL 3145 Cellular and Molecular Biology of Cancer (4 Credits)**

This course examines the mechanisms that underlie the development and progression of cancer. The cellular and molecular events that drive uncontrolled cell proliferation and eventual metastasis of tumors are discussed. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

**BIOL 3150 Intracellular Dynamics (4 Credits)**

Focuses on spatial and temporal control of intracellular processes with an emphasis on neuronal and endocrine cells. Topics include vesicular traffic, protein targeting, dynamics and spatial organization of signaling complexes. Emphasis on modern techniques of cell and molecular biology with examples from primary literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

**BIOL 3160 Biophysics: Ion Channels & Disease (4 Credits)**

Examines ion channel structure and function and the ways in which this information provides insight into human disease. The focus is on the use of biophysical techniques in combination with molecular and genetic analysis of channel genes. General Physics recommended. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

**BIOL 3230 Nutrition (3 Credits)**

Investigation of metabolism, all nutrients and various applications of nutrition to sports and healthy living. Prerequisite: BIOL 3250.

**BIOL 3241 Anatomy and Physiology of the Skeletal, Nervous and Muscular systems (0-5 Credits)**

This course is designed to introduce students to the fundamental concepts, content and scientific bases of Skeletal, Muscular, and Nervous system anatomy and physiology at both macroscopic and microscopic levels. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. The course will utilize diverse resources, exercises, and activities to engage you in the learning process, including, text, video, animations, models, dissections, inquiry-based learning, and a variety of assessments. Please note that the lab portion of this course does require dissection. Prerequisites: BIOL 2120.

**BIOL 3242 Human Anatomy and Physiology - Systems of homeostasis (0-5 Credits)**

This course is designed to introduce students to the fundamental concepts, content and scientific bases of Cardiovascular, Respiratory, Urinary, Digestive, Immune and Reproductive system anatomy and physiology at both macroscopic and microscopic levels. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. The course will utilize diverse resources, exercises, and activities to engage you in the learning process, including, text, video, animations, models, dissections, inquiry-based learning, and a variety of assessments. Please note that the lab portion of this course does require dissection. Prerequisites: BIOL 2120.

**BIOL 3251 Exercise Physiology (4 Credits)**

This course will cover exercise physiology topics included but not limited to: energy systems, physiological response to exercise/training, and exercise programming. A strong background in human physiology is recommended. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 1010.

**BIOL 3252 High Altitude Physiology (4 Credits)**

This course is an advanced course in physiology for those interested in both the impacts of altitude exposure on health and athletic performance. We live at altitude in Denver, and in fact there are many factors affecting our bodies (which we may or may not realize) that impact our daily lives. This course aims to provide insight on the acute and chronic physiological responses of altitude as well as to provide a deeper understanding into the use of hypoxic environments for improving health and benefiting athletic performance. We will explore the physiological mechanisms related to these reduced oxygen environments as well as develop projects that contribute to the understanding of using this environment as a stimulus. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 3242.

**BIOL 3253 Environmental Physiology of Animals (4 Credits)**

By studying species across the animal kingdom, we will learn about the vast array of physiological strategies that have evolved to help animals maintain homeostasis in the face of varied environmental challenges. We will cover foundational principals of animal physiological ecology and evolution, as well as new and exciting discoveries through weekly discussions of primary literature. We will focus primary literature discussions on "extreme environments," as Earth's harshest landscapes provide exciting and powerful examples of adaptations of physiological systems. This course will be delivered through a combination of lectures, active learning assignments, readings from the scientific literature, and group discussions. By the end of this course, you will develop a new perspective on the ecological and evolutionary factors that shape physiological similarities and differences among the animals of our planet (including humans). This course counts as a category elective for the Ecology and Biodiversity major and Physiology in Health and Disease major. Prerequisites: BIOL 1010 and BIOL 1011.

**BIOL 3254 Advanced Cardiovascular and Pulmonary Physiology (4 Credits)**

This course provides a deeper level of physiological knowledge of the cardiac, vascular, circulatory, and pulmonary systems and their functions. With both lecture materials as well as in-class discussion of concepts and research articles, we will go deep into the basic levels of composition and function and facilitate the understanding of mechanisms that limit disease populations, elderly, etc. How can we adapt our lifestyles to improve our cardiovascular health? Prerequisite: BIOL 2120 or BIOL 3242.

**BIOL 3256 Advanced Human Anatomy & Physiology (0-5 Credits)**

This one quarter course is intended for advanced biology and physiology majors with an interest in the anatomical structure and physiological functioning of body systems. This course builds upon the Human Anatomy and Human Physiology courses that are prerequisites. This advanced course will explore in greater depth understanding mechanisms of action of major body systems and elaborate on the relationship between structure and function. In addition to didactic content, students will complete evaluation of primary literature and design laboratory experiments to test hypotheses of interest. The course will utilize diverse resources, exercises, and activities in the learning process including text, video, animations, models, dissections, inquiry-based learning, experimentation and a variety of assessments. The course consists of both lecture and laboratory sessions each week and requires attendance and participation in both. Please note that the lab portion of this course requires dissection. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisites: BIOL 3241 and BIOL 3242.

**BIOL 3257 Clinical Exercise Physiology (5 Credits)**

This is an upper-level course in clinical physiology for those interested in understanding fundamental practices and assessments within clinical settings. We will work to combine knowledge from various backgrounds in physiology and tie theoretical and practical concepts together for assessing body function and developing methods for improving health and performance. We will relate daily experiences with class content to deepen our knowledge and retain this information for future reference. We will connect the physiological concepts related to the cardiovascular, respiratory, muscle systems as well as develop projects that require combining knowledge of the assessment skills and evaluation for clear communication and exercise prescription to special populations. Prerequisite BIOL2120 or BIOL 3242.

**BIOL 3258 Research Techniques in Exercise Physiology (4 Credits)**

This upper-level course is designed to give you exposure to several methods of research within the area of exercise physiology. This is a hands-on course that combines theory and literature with practical research experiences in physiology. For those interested in understanding more about research, this is the course for you as we will perform data collection and analysis of differing topics. These may include the following topics: pulse and tissue oxygenation, signaling (heart rate variability, oxygen kinetics), respiratory loops, Doppler ultrasound (blood flow and tissue structure), etc. Our aims will focus on understanding how and why the method works, how to collect data, as well as the analysis and reporting of variables for proper interpretation.

**BIOL 3259 Electrocardiogram Interpretation (2 Credits)**

This course is an advanced course in cardiac physiology for those interested in understanding principles associated with cardiac function, electrical physiology of the heart, and interpretation of the electrocardiogram. This is applicable for several pre-med career paths especially within clinical settings. As the functions related to our heart drive our cardiovascular system, we will find ways to relate our experiences of daily life to the concepts and principles learned throughout this course to deepen our knowledge and retain this information. We will explore the physiological mechanisms related to the cardiac system as well as develop projects that require combining knowledge of the electrical pathways and of use of electrocardiography for proper interpretation. Prerequisite: BIOL 2120, BIOL 3241, BIOL 3242, or equivalent.

**BIOL 3260 Nutritional Physiology (4 Credits)**

This course is designed to introduce the fundamental concepts, content and scientific bases of nutritional physiology at the levels. This course will examine the scientific structure and properties of carbohydrates, proteins and lipids as the major macronutrients required for human health. In addition, it includes exploration of the digestion, absorption and metabolism of both macronutrients and micronutrients. The course will utilize diverse resources, exercises, and activities in the learning process including text, video, animations, inquiry-based learning, experimentation and a variety of assessments. Prerequisite: BIOL 2120.

**BIOL 3261 Exercise Testing and Prescription (4 Credits)**

The purpose of this upper-level course is to develop knowledge combined with hands-on skills for integration of exercise testing and prescription concepts. Material in this course will be applicable for performance as well as clinical considerations. This is an active course which will require your participation as both the subject and technician, giving perspective and understanding of methods and protocols along with their justification for various purposes. Recommended prerequisite course: Clinical Exercise Physiology.

**BIOL 3280 Intro to Pathophysiology (4 Credits)**

This course is designed as an introduction of the mechanisms and consequences of disease based on physiological dysfunction in the major organ systems. The course will focus on the fundamental concepts and processes of human pathophysiology through exploration of the unique physiological roles of several body systems, how these systems have important integrative relationships that underlie the overall physiological functioning of healthy humans, and how system function is altered in disease and the clinical manifestations of these changes. This course counts as a category elective for the Physiology in Health and Disease major. Prerequisite: BIOL 2120. A course in human physiology is recommended.

**BIOL 3350 Conservation Biology (5 Credits)**

Conservation Biology is the study of documenting the earth's biodiversity, its threats, and how it may be protected. It is a multidisciplinary science within ecology with contributions from environmental chemistry, geography, sociology, and political science, among other fields. In this class students learn the language of conservation biology, the methods used by conservation biologists, and the nuances of current issues. In class, material is learned through both lecture and interactive exercises in the classroom portion, with hands-on practice in techniques and applications during the lab. This course counts as a category elective for the Ecology and Biodiversity major. Prerequisite: BIOL 2010.

**BIOL 3410 Animal Behavior (4 Credits)**

This class examines animal behavior from an evolutionary and ecological perspective. The course provides the background needed to understand behavioral evolution, including a focus on the inheritance of behavior, natural selection, sexual selection, and kin selection. This class studies the evolution of a variety of behaviors, including communication and displays, mate choice, parental care, cooperation, mating systems, social behavior, habitat selection, foraging, and anti-predator behavior. The emphasis is on theoretical principles, design of experiments, and interpretation of data. This course counts as a category elective for the Ecology and Biodiversity major. Prerequisites: BIOL 1010 and BIOL 1011, and BIOL 2010. Recommended Prerequisite: BIOL 2090.

**BIOL 3560 Molecular Biology Laboratory (4 Credits)**

Laboratory based course that covers techniques in gene excision, cloning and reinsertion and gene sequencing. Lab fee associated with this course. Prerequisite: BIOL 2510, or permission of instructor.

**BIOL 3570 Proteins in Biological Systems (4 Credits)**

Proteins considered in their biological setting; protein synthesis and degradation; survey of protein functions in vivo; introduction to protein biotechnology. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120.

**BIOL 3610 Developmental Biology (4 Credits)**

Processes and mechanisms of development, exemplified by higher animal embryogenesis, with consideration of microbial model systems. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120 and 2510.

**BIOL 3615 Blood Vessel Development and Disease (4 Credits)**

This course details the underlying biological programs during blood vessel development and mechanisms that lead to vascular pathologies. The class will incorporate aspects embryology, signaling transduction, and genetics as well as current techniques in developmental biology to comprehensively cover how blood vessels are formed embryonically. Additionally, we will discuss in detail how defects in blood vessel-related signaling programs later manifest into disease. Prerequisite for this course is Cell Structure and Function (BIOL2120/2121).

**BIOL 3630 Cell Biology of Development (4 Credits)**

Every organism has a stereotypical shape, but how does this shape arise? This course examines the cellular and molecular mechanisms that direct the forming of body and tissue shape. This course counts a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

**BIOL 3640 Introductory Neurobiology (4 Credits)**

Organization and function of vertebrate central nervous system; nature of action potential, biochemistry of neurotransmitters, neuropeptides, functional anatomy of nervous system, phylogeny of nervous system. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

**BIOL 3641 Systems Neuroscience (4 Credits)**

Structure and function of the brain and spinal cord, emphasis on functional systems including sensory perception, motor control and consciousness. This course counts as a category elective for the Cognitive Neuroscience concentration. Prerequisite: BIOL 3640 or 3241.

**BIOL 3642 Neuropharmacology (4 Credits)**

How psychoactive drugs exert their effects on the nervous system; drugs of abuse and drugs used in the treatment of psychotic and neurodegenerative disorders. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120. Recommended prerequisites: BIOL 3640.

**BIOL 3644 Neuromuscular Pathophysiology (4 Credits)**

Cellular and molecular basis for normal nerve and muscle functions and the alteration of these functions by toxins, trauma and diseases of the brain, nerves and muscles; how specific insults produce clinical symptoms and pathology. Prerequisite: BIOL 2120.

**BIOL 3646 Seminar: Cognitive Neuroscience (2 Credits)**

This seminar is the capstone course for the neuroscience portion of the cognitive neuroscience program. Seminar topics include but are not limited to neurological disorders, model systems in neuroscience and sensory systems.

**BIOL 3647 Neuroscience of Movement (4 Credits)**

Producing the vast array of movements that humans (and many animals) use everyday represents one of the body's greatest challenges and greatest successes. These various movements require that the nervous, muscular, and skeletal systems work in concert to achieve a common goal. This course will explore the scientific basis of movement production, with particular emphasis on the neuroscience of motor control. We will explore how the nervous system drives the development of movement strategies at an early age, modifies movement strategies to adapt to changing demands throughout life, and how injury, dysfunction, and/or aging can lead to movement challenges. This course counts as a category elective for the Physiology in Health and Disease major and Cognitive Neuroscience concentration. Required prerequisite: Cell Structure & Function (BIOL 2120); Recommended prerequisite (1 or more of the following): Introduction to Neuroscience (BIOL 3640) or permission of instructor.

**BIOL 3648 Molecular Mechanisms of Neurological Disease (4 Credits)**

This course will be an in-depth study into some of the key molecular mechanisms involved in the pathogenesis of human neurological disease. A particular emphasis will be placed on the role of RNA regulation and metabolism. The primary focus will be on five devastating diseases: 1. Spinal Muscular Atrophy (SMA) 2. Fragile X Syndrome (FXS) and Fragile X Tremor Ataxia Syndrome (FXTAS) 3. Myotonic Dystrophy type 1 and 2 (DM1 and DM2) 4. Spinocerebellar Ataxia type 2 (SCA2) 5. Amyotrophic Lateral Sclerosis (ALS) and Frontotemporal Dementia (FTD) This course will cover a variety of topics including disease pathophysiology and pathogenesis. However, readings will be assigned from the recent primary literature discussing cellular and molecular mechanisms. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2510 Genetics.

**BIOL 3649 Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics (4 Credits)**

Neurodegeneration and Neurotrauma: Mechanisms and Therapeutics covers the following disorders: Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, Huntington's disease, spinocerebellar ataxia, Creutzfeldt-Jakob disease, multiple sclerosis, traumatic brain injury and spinal cord injury. Course literature includes primary journal articles and review papers describing the etiology and pathophysiological mechanisms of these disorders. Potential therapeutic approaches to treatment are also investigated. The course format typically includes a lecture reviewing the basic biology, symptoms, and current treatments for each disorder, followed by a thorough analysis of primary research papers focused on novel molecular mechanisms and new targets for therapeutic development. Grading is based on 3 exams throughout the academic quarter and participation in discussing journal articles in class. This course counts as a category elective for the Cognitive Neuroscience concentration. Prerequisite: BIOL 2120 Cell Structure and Function. Recommended: BIOL 3640 Introductory Neurobiology. For Graduate Students: an additional term paper is required with the exact topic to be agreed upon by the student and instructor.

**BIOL 3650 Endocrinology (4 Credits)**

Mechanisms of hormone action, evolution of vertebrate endocrine systems, analysis of function integration of hormonal responses in maintenance of homeostasis. This course counts as a category elective for the Molecular Biology major and Cognitive Neuroscience concentration. Prerequisite: BIOL 2120.

**BIOL 3651 Comparative Endocrinology (4 Credits)**

Intercellular communication systems are essential for the proper coordination of trillions of cells in multi-cellular animals. This course will evaluate the evolution of neuroendocrine networks in both invertebrates and vertebrates with a focus on how these neuroendocrine networks influence, growth, reproduction, osmoregulation, and metabolism. Prerequisite: BIOL 3650.

**BIOL 3656 Cellular Aspects of Diabetes and Obesity (4 Credits)**

This course focuses on specific cellular and molecular events key to the understanding of the pathological conditions of diabetes and obesity. Topics include the endocrine pancreas, adipose tissue and neuroendocrine control energy expenditure and feeding behavior. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2120.

**BIOL 3670 Molecular Immunology (4 Credits)**

The ability to distinguish self from non-self is crucial to all organisms. In humans Organs, cells and other higher animals, this task fall to the immune system. Suppression of this system is key to numerous pathogenic viruses including Ebola and human immunodeficiency virus. The failure to adequately regulate immune response underlies allergic reactions, arthritis and diabetes. This course will introduce students to the organs, cells and molecules that underlie mammalian immune response; immunogenetics and the fundamental mechanisms of cell mediated and humoral immune response; and the relationship of immune system to human disease. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510.

**BIOL 3675 Virology (4 Credits)**

Viruses are the ultimate cell biologists. They usurp essential cellular components to create new virus progeny leading to pathological cellular physiology. This course will delve into the genetic and cellular principles that govern virus entry, replication, and assembly and cover a broad range of DNA and RNA-based virus families. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120 and BIOL 2510.

**BIOL 3690 Cellular Microbiology (4 Credits)**

The field of cellular microbiology broadly defines the interface between commensal or pathogenic microbes, prokaryotes or lower eukaryotes, and their host. The burgeoning field of cellular microbiology has seen an explosion of new knowledge related to the feedback regulation between commensal microbes and their hosts. Furthermore, our knowledge of virulence factors that promote host and pathogenic microbe niches has continued to expand. This topics course will build a medically relevant and coherent picture of the host-microbe interface on genetic, molecular, cellular, and organismal scales by surveying relevant literature that has uncovered interspecies communication and control pathways. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120 and BIOL 2510.



**BIOL 3700 Topics in Ecology (1-4 Credits)**

Topics vary; may include plant, animal, biochemical, alpine or aquatic; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: one quarter of undergraduate ecology and/or instructor's permission.

**BIOL 3701 Topics in Genetics (1-4 Credits)**

Topics vary; may include genetic methods, molecular genetics, human genetics, chromosomes or population genetics; one topic per quarter. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510 and/or instructor's permission.

**BIOL 3702 Advanced Topics in Regulatory Biology (1-4 Credits)**

Topics vary; may include endocrinology, physiology or immunology; one topic per quarter. May be repeated for credit. Taught from original literature. Prerequisite: varies with topic and instructor; instructor's permission usually required.

**BIOL 3703 Advanced Topics in Developmental Biology (1-4 Credits)**

Topics vary; may include gene expression in development, developmental immunogenetics, developmental biochemistry or aging; one topic per quarter. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: instructor's permission.

**BIOL 3704 Advanced Topics in Cell Biology (1-4 Credits)**

Topics vary; may include supramolecular structure, microscopy, membranes and techniques. May be repeated for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisites: BIOL 2120.

**BIOL 3705 Advanced Topics in Molecular Biology (1-4 Credits)**

Topics vary, but may include biochemistry, supramolecular structure and function, molecular genetics, membrane biology. May be taken more than once for credit. Taught from original literature. This course counts as a category elective for the Molecular Biology major. Prerequisite: varies with course and instructor; instructor's permission usually required.

**BIOL 3706 Topics in Evolution (1-4 Credits)**

Topics vary, but may include molecular evolution, plant evolution and animal evolution. Prerequisite: BIOL 2120 and BIOL 2510.

**BIOL 3707 Advanced Topics in Conservation Biology (1-4 Credits)****BIOL 3708 Topics in Integrative Physiology (2-4 Credits)**

Topics for this course include, but are not limited to, human physiology and disease, integrative physiology, environmental or social impacts on human physiology and health, and comparative physiology. Students will gain knowledge of a specific topic in physiology and/or pathophysiology through discussion of current literature and research. May be repeated for credit. Prerequisite: BIOL 2120.

**BIOL 3800 Human Molecular Biology (4 Credits)**

Medical Genetics is the 24th member of the American Board of Medical Specialties. This course will introduce students to the fundamentals of molecular biology with an emphasis on understanding of how the field is applied in the context of medical diagnostics, personalized/precision medicine and other commercial applications. Students will be introduced to published research reports and provided with opportunities to critically examine the application of molecular biology to central questions in such areas as oncology, inherited diseases and genetically engineered organisms. Prerequisite: BIOL 2510.

**BIOL 3850 Genetic Engineering (4 Credits)**

This course will cover principles in gene manipulation and its application in research, medicine and industry. More specifically, this course will explain emerging technologies in genetic engineering and its practical and ethical implications. Topics will incorporate historical and emerging aspects of developmental biology, chemistry, and genetics as well as current techniques in genetic manipulation that are related to genomic editing. Additionally, students will be trained to interface with genomic databases and employ DNA sequence editing software to manipulate DNA sequences to achieve novel cloned products. This course counts as a category elective for the Molecular Biology major. Prerequisite for this course is Genetics BIOL 2510.

**BIOL 3855 Genetic Model Organisms in Health & Disease (4 Credits)**

This course is focused on how basic science studies using genetic model organisms have had a major impact on human health and disease in addition to helping us understand fundamental aspects of biology. We will cover clinically relevant recent advances from bacterial studies (i.e. CRISPR/Cas9-mediated genome editing) to how studies in fruit flies revealed insights into immune disease. Students will gain a better appreciation for why researchers using model organisms were awarded Nobel prizes as well as why major medical funding organizations like the National Institutes of Health, American Cancer Society, and American Heart Association support research using non-human systems. This course will prepare students to understand health-relevant research from varied model systems. Students will learn practical aspects for determining which model systems are best suited to answer which types of questions. They will also practice designing experiments and defending their importance in grant abstract-style essays. Prerequisites: BIOL 2120 and BIOL 2510.

**BIOL 3910 Viruses & Infectious Human Diseases (4 Credits)**

From sexually transmitted viruses to bacterial pneumonia, infectious pathogens are the number one threat to human health. This course will introduce students to prions, viruses and bacterial pathogens with an emphasis on those commonly encountered in clinical medical practice. Through the use of technical/scientific research journals students will be encouraged to investigate the etiology, pathogenesis and treatment of human infectious disease with an emphasis on the clinical, molecular diagnostic and therapeutic aspects of the disease. This course counts as a category elective for the Molecular Biology major. Prerequisite: BIOL 2510. Recommended prerequisite: BIOL 3800.

**BIOL 3920 Forensic Pathology (2-4 Credits)**

In its broadest definition, forensic science represents a fusion of the natural sciences, criminology and jurisprudence. The field of forensic pathology in particular focuses on the investigation of sudden, unnatural, unexplained or violent deaths. Using the most authoritative books available and a multimedia lecture format, students in this course gain an introductory understanding of the pathophysiology of wounding and death as well as the clinical antemortem symptomology of physical abuse, neglect and extrajudicial wounding. Students also learn about the processes responsible for the decomposition of corpses as well as the use of molecular and geometric tools for the reconstruction of crime scenes from bloodstain evidence. Finally, students learn how to integrate a variety of forensic tools in investigations of sexual assault, serial killers, traffic fatalities and mass deaths. Prerequisite: BIOL 2120 or permission of instructor.

**BIOL 3950 Undergraduate Research (1-10 Credits)**

Participation in faculty research programs by agreement between student and faculty member. Maximum of 5 quarter hours of BIOL 3950 and/or BIOL 3991 may be applied to the 45-quarter-hour requirement for a major in biological sciences.

**BIOL 3988 Study Abroad Resident Credit (0-18 Credits)**

**BIOL 3991 Independent Study (1-10 Credits)**

Topic in biology studied under faculty supervision. Student's responsibility to identify faculty supervisor before registering for class. Maximum of 5 quarter hours of BIOL 3991 and/or BIOL 3950 may be applied toward the 45-quarter-hour requirement for a major in biological sciences.

**BIOL 3995 Independent Research (1-10 Credits)**