

Biology

The **Master of Arts in Biology** program helps students to update and deepen their knowledge of the biomedical sciences, prepare for employment in related fields, and advance their professional standing while obtaining a graduate science degree on a part-time basis through evening, weekend and online courses.

The program is designed to be adaptable to each individual's unique background and goals, and it provides a flexible curriculum and close individual advising for each student. Students include science and health professionals, teachers, technicians, and individuals in biology-related businesses.

Students in this program have the option of choosing a concentration in neurobiology for deeper, more focused study.

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Degree Requirements

Master of Arts in Biology

Students seeking the Master of Arts in Biology must satisfactorily complete 30 units of graduate courses in the biological sciences, including a required capstone experience (<http://ucollege.wustl.edu/programs/graduate/masters-biology/final-project/>), which occurs after they have completed 21 units in the program and is chosen from the following options:

1. Complete U29 Bio 401 Problem Based Learning in the Biomedical Sciences
2. Complete a 3-unit independent study
3. Complete a 6-unit master's thesis: Students with appropriate backgrounds, interests and academic qualifications may, with authorization, write a master's thesis based on original library or laboratory research.

Note: The above options cannot count as the capstone experience if they occur before a student has completed 21 units toward the Master of Arts in Biology.

Optional Concentration in Neurobiology

University College students who are admitted to the Master of Arts in Biology program may select an optional concentration in neurobiology. Neurobiology is the study of the structure and function of the nervous system. This concentration helps prepare

students for careers in biomedical fields, including research and clinical practice in medicine, neuroscience and cognitive science. The optional concentration requires 12 units of courses, selected from the list below:

Choose four of the following courses:

Code	Title	Units
Bio 435	Neurobiology	3
Bio 436	The Neural Basis of Behavior	3
Bio 4721	The Biology of Membranes	3
Bio 478	Neuroscience: Sensory Systems	3
Bio 485	Synaptic Change in the Nervous System	3

Credit Transfer

A maximum of 6 credits of related and comparable graduate-level courses may be transferred from another university or from a related graduate program at Washington University with the approval of the program director. These must be graduate-level units not used to fulfill undergraduate degree requirements. Transfer credit may be granted only for authorized courses for which the student received a grade of B or higher.

Please note that the Master of Arts in Biology degree is a terminal graduate degree awarded on the basis of the completion of courses rather than research. Except in rare cases, it is not intended as preparation for a PhD degree. No more than 6 of the 30 credits required for this program may be earned in research courses. Those students interested in graduate research or in earning a PhD should apply to the PhD programs offered by Washington University's Division of Biology and Biomedical Sciences (<http://dbbs.wustl.edu>).

Courses

Visit online course listings to view semester offerings for U29 Bio (<https://courses.wustl.edu/CourseInfo.aspx?sch=U&dept=U29&crslvl=4:8>).

U29 Bio 400 Independent Study

Requires written proposal, instructor, coordinator and deans approval in University College
Credit variable, maximum 3 units.

U29 Bio 401 Problem Based Learning in the Biomedical Sciences

Have you ever wondered how doctors and scientists diagnose and discover cures to modern human afflictions? In this course, small groups of students take responsibility for their own active, inquiry-based learning on biological problems that puzzle modern scientists. Instructors from the Washington University School of Medicine guide students on how to conduct in-depth research on issues of current biological importance. Learning how to read and interpret current research articles from the scientific literature is emphasized. Weekly topics from previous years have included cancer therapy, infectious diseases, CRISPR, microbiome, stem cells, gene therapy,

and Zika viruses. Students should have broad interests and background in general biology and chemistry and should be curious, exploratory, interactive, and willing to try an active, non-traditional educational experience. Bio 401 satisfies the capstone requirement for the MA program in biology, provided that at least 21 units of graduate-level coursework has been completed toward this program prior to enrollment in Bio 401. Prerequisites: General Biology I and II
Credit 3 units.

U29 Bio 4022 Viruses and the Diseases They Cause

The goal of this course is to understand different families of viruses. We will discuss the diseases that they cause, mechanisms they use to evade host defense mechanisms, and current therapies used to treat these viruses. Prerequisites: General Biology I and II or permission of the instructor.
Credit 3 units.

U29 Bio 4024 Biology of Human Disease: Research, Diagnosis, Prevention, Treatment

The aim of this course is to develop appreciation of the complex nature of human diseases. We examine inherited and acquired human diseases including cystic fibrosis, AIDS, Alzheimer's, Parkinson's, and diabetes to help us better understand how genetic mutations, environmental stress, and infections affect various cellular processes, disturb normal functioning of tissues and organs, and lead to the development of a disease. We will learn how latest advances in basic, translational, and clinical research changes our understanding of the underlying causes of human diseases and drives development of new effective methods of diagnosis, prevention, and treatment. Prerequisites: General Biology I and II or permission of the instructor.
Credit 3 units.

U29 Bio 4029 Introduction to Medical Histology

This course is for master's students, as well as premedical and other pre-professional students who want to become proficient in the examination and interpretation of microscopic anatomy. The course uses a lecture format combined with in-class and on-line tissue slide studies. Knowledge of microscopy and basic tissue types gained in the first part of the course is applied in the investigation of complex organs in the second half of the semester. Medical correlates are stressed. Exams are written, on-line, and in-class utilizing microscopes. Prerequisites: College-level Biology and Chemistry.
Credit 3 units.

U29 Bio 4041 Evolutionary Nutrition

This course explores the interrelationships between human nutritional requirements/adaptations and evolution. We will examine ideas and evidence concerning such concepts as biochemical individuality, nutritional genetics and genomics, evolutionary medicine and the microbiome, among others. Lecture-discussions will focus on material from the texts recommended for this course. Drawing upon the latest research into the original human diet (from peer-reviewed scientific journals), students will create literature review case studies related to lecture topics. The overall objective of this course is to understand how each individual's unique body chemistry gives rise to their specific "metabolic type" with its own specific nutritional requirements. Prerequisites: Introductory Biology course; familiarity with molecular biology and evolutionary concepts.
Credit 3 units. UColl: OLI

U29 Bio 405 Introduction to Molecular Biology

This course will examine the fundamental principles of cellular processes at the molecular level. Among the major topics covered are nucleic acid chemistry, gene structure and organization in prokaryotes and eukaryotes, gene expression, and recombinant DNA and transgenic/knockout (including conditional knockout) mouse technology. The topic of the CRISPR/Cas system used for gene editing will also be included. In addition, the idea of genes and genomes will be discussed with an introduction to functional and comparative genomics. In particular, emphasis will be placed on the regulation of gene expression and protein synthesis and the various methodologies utilized to address these topics. In addition, the concepts of siRNA, miRNA, and the phenomenon of RNA-interference will be covered with the topic of micro RNA and disease, and the importance of these small non-coding RNA molecules, highlighted by presentation of current scientific literature. Also included will be a major publication showing how RNA interference can be used as a tool to unlock the secrets of human embryonic stem cells. A number of commonly used molecular biology and biochemical lab techniques will also be covered, in addition to more current tools such as microarray and proteomics that can be used to address global changes in transcriptional profiles. Prerequisites: General Biology I and II and Organic Chemistry I.
Credit 3 units.

U29 Bio 406 Introduction to Biochemistry

This course develops a basic understanding of the molecular structure of bio-molecules, the metabolic processes by which these molecules are synthesized, degraded, and energy produced to support cellular processes. It includes a study of enzyme kinetics and metabolic control mechanisms. Prerequisite: Chem 261 - Organic Chemistry I (either with lab or lecture only is acceptable), or permission of instructor.
Credit 3 units.

U29 Bio 4080 Tropical Marine Biology

This course examines the biological and ecological processes that influence ecosystem dynamics and biodiversity within coral reef, seagrass, shoreline, and mangrove communities. We discuss the threats to coastal and marine ecosystems worldwide. Prerequisite: General Biology I. Online. For MS in Bio students.
Credit 3 units. UColl: OLI

U29 Bio 411 Introductory Plant Biology

In this class students will be introduced to plant structure, metabolism and development in the context of ecological boundaries, symbiotic relationships, evolutionary adaptations and human activities. This course is focused primarily on the flowering plants with particular attention given to plants and activities common to temperate climates. The course will provide students with the basic knowledge needed for further study in plant biotechnology, ecology, pathology, physiology, anatomy or taxonomy. The class format is lecture and discussion.
Credit 3 units.

U29 Bio 4111 Tropical Ecology

This course explores the terrestrial ecosystems of the tropics, focusing predominantly on the lowland and mountain rainforests, mangroves, cloud forests, and tropical dry forests of the Neotropics. We will examine the biological and ecological processes that influence ecosystem dynamics and biodiversity

within representative communities. We will discuss issues of conservation, sustainable development and resource use, and the human impact on these fragile ecosystems. Lectures are interspersed with student presentations and discussions of primary literature.

Credit 4 units. UColl: OLH

U29 Bio 413 Environmental Science: Regional and Global Perspectives

This course examines the interrelationships between humans and their environment, moving from local and regional views up to a global perspective. Taking an ecosystem approach, the course starts with basic ecological principles necessary for understanding our environment. We will then explore how environmental science incorporates concepts from politics, social sciences, economics, ethics, and philosophy; physical and biological resources; conservation, management, sustainability, and restoration; population principles; environmental economics; human impacts (especially pollution and disturbance); environmental health and toxicology; and environmental policy. Lectures and discussions will focus on the major issues involved in environmental challenges, drawing on current, carefully selected articles from some of the most respected magazines, newspapers, and journals published today. Prerequisite: General Biology I or permission of the instructor.

Credit 3 units. UColl: OLI

U29 Bio 4130 Environmental Medicine

Environmental Medicine explores the interactions between the environment and human health, focusing on the role of the environment in causing or mediating disease. Environmental hazards are examined in terms of toxicology, epidemiology, exposure assessment, risk assessment, individual susceptibility, adaptation/maladaptation, and the total load concept. Prerequisite: General Biology I or permission of the instructor.

Credit 3 units. UColl: OLI

U29 Bio 4170 Endocrine Physiology

Biochemical, physiological, and regulatory properties of the mammalian endocrine system at the molecular, cellular, and systemic level with a focus on human physiology and development. Topics will explore endocrine cell signaling, molecular mechanisms of hormone action, homeostasis and feedback systems including neuroendocrine integration of physiological processes, endocrine control of cardiovascular and calcium homeostasis, and select discussion of endocrine pathologies. In addition to class and textbook material there will be exposure to the primary research literature.

Credit 3 units.

U29 Bio 419 Ecology

Community ecology is an interdisciplinary field that bridges concepts in biodiversity science, biogeography, evolution and conservation. This course provides an introduction to the study of pattern and process in ecological communities with an emphasis on theoretical, statistical and experimental approaches. Topics include: ecological and evolutionary processes that create and maintain patterns of biodiversity; biodiversity and ecosystem function; island biogeography, metacommunity dynamics, niche and neutral theory; species interactions (competition, predation, food webs), species coexistence and environmental change. The class format

includes lectures, discussions, and computer labs focused on analysis, modeling and presentation of ecological data using the statistical program R. Prereq: Bio 2970 required, Bio 381 recommended, or permission of instructor.

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

U29 Bio 4241 Immunology

This course covers basic molecular and cellular aspects of the vertebrate immune system emphasizing specific and nonspecific host defense against disease, the nature of immunological specificity, and its underlying molecular genetics. We also cover immunochemistry and its use in immunoassay systems, the nature of cell activation, cytokines, tolerance and autoimmunity, allergic reactions, blood groups, transplantation reactions, immunodeficiency, and complement systems. Prerequisites: two or more of the following courses are recommended: Biochemistry, Cell Biology, Molecular Biology/Nucleic Acids, Microbiology/Virology, Pathology/Pathobiology. Does not apply to day undergraduate biology major or College of Arts and Sciences distribution requirement.

Credit 3 units. UColl: OLI

U29 Bio 4242 Immunology Laboratory

The Immunology Laboratory will introduce students to a variety of common, broadly useful immunological techniques and then allow each student to employ most of the learned techniques in addressing a current research question. Experiments will employ mouse cells in vitro and will emphasize quantitative analysis of the data. Prereq: Bio 424 and permission of instructor.

Same as L41 Biol 4241

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

U29 Bio 431 Biology of Aging

This course provides concepts and examples of the biology of aging. We discuss current literature with emphasis on theoretical causes of aging and the practical implications of these theories. Major topics include biochemical processes of aging, cell cycle senescence, age-related organ dysfunction, interventions to alter the aging process, and medical illnesses associated with aging, such as Alzheimer's disease and the dementias. We also study animal and human models for extending longevity, and current approaches for dealing with the aging process are included. Prerequisites: General Biology I and II, and General Chemistry I and II are also recommended.

Credit 3 units.

U29 Bio 432 Conservation Biology and Biodiversity

This overview of the fields of conservation biology and biodiversity covers topics such as species preservation, habitat restoration, refuge design and management, and human population growth. Does not count for day, undergraduate Biology major. Prerequisite: General Biology I or permission of the instructor.

Credit 3 units. UColl: OLI

U29 Bio 4331 Regenerative Medicine: Cell Based Therapies and Tissue Engineering

Regenerative medicine focuses on the development of novel therapies to repair, replace, restore or regenerate cells, tissues and body organs that are defective, damaged or injured by disease. Cell-based therapies, including the use of native stem or immune cells and genetically-modified or bioengineered cells, are being evaluated for treatment of a wide variety of diseases

such as cancer, diabetes, and Parkinson's disease. This course will highlight basic, translational, and clinical advances in cell-based therapies and tissue engineering, with some discussion of ethical, financial, and regulatory issues that may impact such advances. Prerequisites: General Biology I and II or permission from the instructor.

Credit 3 units.

U29 Bio 435 Neurobiology

An extensive introduction to neurobiology. Starting with the elementary building blocks of the nervous system, neurons, the course covers development and regeneration of the nervous system, properties of neurons and glia, ionic basis of signaling and neurotransmitters, neural circuits and the generation of behavior, and brain function in health and disease. Introduction to the latest techniques available to the modern neuroscientist. Guest speakers and discussion sessions. (Not applicable for undergraduate biology major.)

Credit 3 units. UColl: OLI

U29 Bio 436 The Neural Basis of Behavior

This course provides an overview of how the nervous system works from a biological perspective. We will begin by studying how nerve cells function, focusing on how they transmit signals and communicate with one another through specialized connections called synapses. We will further examine the anatomy of the nervous system to discover how nerve cells are organized into circuits and how these circuits develop. Finally, we will investigate how the specialized properties of our nerve cells allow us to interact with our environment through an in-depth study of our motor and sensory systems. Prerequisites: General Biology I and II or permission from the instructor.

Credit 3 units. UColl: OLI

U29 Bio 438 Virology

In this overview of virology, we explore strategies used by viruses to enter host cells, transcribe genes, replicate, assemble progeny viral particles, and exit the host cell. We then look at recent advances and problems arising in the field of virology. We discuss the host response to viruses, the use of viruses as vectors for vaccines and gene therapy, the role of viruses in eliciting cancer, as well as the evolution of viruses and emerging viral diseases.

Credit 3 units.

U29 Bio 4391 Modern Genetics

This course focuses on the concepts of Mendelian genetics, linkage analysis, gene mutation, genomics, cancer genetics, genetics of model organisms, and population genetics. We will focus on gaining experience in data analysis and experimental design and on developing problem-solving skills. Analytical thinking and the ability to integrate mathematical analysis with a firm understanding of biological events are essential to this course. Prerequisite: General Biology I.

Credit 3 units.

U29 Bio 4501 Evolution

Evolution, in its broadest senses, is the fundamental unifying theory in biology; as such, its scope is arguably the greatest in all the biological sciences. This course is intended to provide a framework for understanding advanced concepts of evolutionary biology. Particular emphasis will be placed on how knowledge of evolutionary theory can be applied to the problems of today?

world and to providing a general understanding of the diversity of life on earth and its origins. The course will cover both micro and macro-evolution and include topics such as natural, kin, and sexual selection; the ecological context of adaptation, speciation, coevolution, as well as misconceptions described by opponents of evolutionary biology. Prerequisite: General Biology I.

Credit 3 units. BU: SCI

U29 Bio 458 Readings and Research in Biomedical Sciences

Each day, more than 5000 new biomedical research articles are published. As a future physician and scientist, you will need to be able to identify and stay current on medical advancements. Medicine is interdisciplinary, and a successful scientific career means being able to make connections between diverse research fields. The goal of this journal club is help students develop skills for locating, analyzing, and understanding scientific research articles. Students will learn how to locate primary journal articles using a variety of search engines such as PubMed and Ovid, and practice reading articles outside of their comfort zone without being intimidated by scientific jargon and formal writing styles. Students will be expected to discuss current research articles and develop effective scientific writing skills by analyzing the main sections of a scientific manuscript (Abstract, Background, Methods, Results, Discussion, Conclusion, Implications).

Credit 2 units.

U29 Bio 4582 The Essentials of Biomedical Scientific Reviewing, Writing, and Presenting

This course will provide the most fundamental techniques for effectively reviewing, writing and presenting scientific information. The goal of this course is to help students understand scientific communication better. They will become familiar with the structure of scientific papers, grants and presentations and will learn to critically evaluate each form of communication. Students will learn the characteristics of outstanding scientific writing and presenting, including academic style, coherence, clear data presentation, and word choice through classroom exercises and mock presentations. Classes will consist of a lecture (1 hour) followed by a classroom exercise (1.5 hours). Students will be graded on classroom exercises and writing assignments. Prerequisites: General Biology I and General Biology II.

Credit 3 units.

U29 Bio 4590 Advanced General Physiology

This graduate-level course will examine physiology in a cohesive evolutionary context. For each system we will first review the general anatomy and physiology, turning then to the molecular basis of function and dysfunction. Each class provides an overview of the basic physiology of one of the major organ systems including: neural, respiratory, cardiovascular, endocrine, digestive, urogenital and immune, followed by a discussion of recent discoveries presented in primary scientific literature and current reviews. Prerequisites: General Biology I and II, and Anatomy & Physiology is also recommended.

Credit 3 units.

U29 Bio 462 Behavioral Ecology

This graduate-level course will examine animal behavior in an evolutionary context. We will evaluate models of behavior ranging from optimal foraging, mimicry, and communication to sexual selection, kin recognition, and social behavior. Each class will begin with a lecture reviewing the theory on the weekly topic.

We will then discuss recent articles on that topic from the current literature. Each week different students will be responsible for preparing a brief presentation outlining the selected articles and will lead a discussion examining the methods, analysis and interpretation.

Credit 3 units.

U29 Bio 463 Global Health Issues

This course is designed to inform and challenge participants to observe and solve problems relating to world health issues while teaching basic biology concepts. Participants will investigate barriers to solving problems of Nutrition, Infectious disease and Environmental factors that prevent progress of global communities. They will also research new technologies being developed that could potentially provide solutions as well as create an ideal lesson using global health issues the focus. Open to Post-Bacc Students. Prerequisite: General Biology I or permission from the instructor.

Credit 3 units. UColl: OLI

U29 Bio 4631 Urban Agriculture and Sustainable Food Systems

In this course we take a systems (holistic) approach to sustainable agriculture. We review the basic principles of food systems geography, food and nutritional security and insecurity, work with cross cultural perspectives, and examine the inter-related issues of poverty, hunger, equity, access and distribution throughout the global, regional and local food systems. We will critically review large, medium, and small scale agricultural systems, comparing industrial, organic, natural and ecological systems. Students will develop a food systems framework through examination of the social, ecological, economic, and institutional dimensions of the many sustainability challenges associated with food system activities (production, processing, distribution, consumption, waste).

Credit 3 units. UColl: OLI

U29 Bio 471 Topics in Cancer Biology

Cancer has a significant impact on society in the United States and across the world. This course aims at providing students with a more extensive understanding of what cancer is and how it affects the human body. This course will teach you to be conversant on issues related to cancer, including its etiology, development, genetics, treatments, and prevention. We will be using a combination of lectures and discussions, so each student is expected and encouraged to participate in class discussions and contribute relevant thoughts and ideas. The material will cover the basics of cancer biology using a traditional lecture including a review of relevant primary literature. The online portion of the course will include discussions of current topics and research articles and videos that will be assigned. The major topics covered in the course include causes of cancer, Oncogenes, p53 its role in cell cycle and cell death, Mutagens and carcinogenesis, Cancer Genetics, Cancer metastasis, Hypoxia, Angiogenesis, Epithelial-Mesenchymal Transition (EMT), Cancer screening, diagnosis, Cancer therapy including immunotherapy, Cancer biomarkers, Cancer staging, Cancer Imaging and Personalized medicine. Prerequisite: General Biology I.

Credit 3 units. UColl: OLH

U29 Bio 4715 Basic Cancer Biology

Over two-thirds of all people know someone who has cancer. This course provides students with a more extensive understanding of what cancer is and how it affects the human body. We will discuss the history of cancer research, the many different types of human cancers, and basic chemotherapeutics. The topics will be presented in a basic scientific nature with an emphasis on gaining a broad understanding of the subjects.

Prerequisite: General Biology I.

Credit 3 units.

U29 Bio 4716 Advanced Cancer Biology

This advanced course provides students with a more in-depth understanding of the molecular mechanisms of cancer. We will discuss tumor suppressors, oncogenes, signaling pathways, animal models in cancer, and novel targeted cancer therapies being developed by biotechnology and pharmaceutical companies. Prerequisite: Basic Cancer Biology.

Credit 3 units.

U29 Bio 472 Molecular Cell Biology

The goal of this course is to study cellular events in eukaryotes and their molecular foundation. This course focuses on studying how DNA is decoded into messages for various cellular activities, how structures and functions of cells are maintained, how cells communicate with their environment, and how interactions between cells lead to construction of multi-cellular organisms. Current technologies for cell biology study will be also discussed. Students will learn to appreciate, for examples, how a cell goes through its life journey, how our eyes detect light, and how molecular defects lead to cancer. Prerequisites: General Biology I and II.

Credit 3 units.

U29 Bio 4721 The Biology of Membranes

Biological membranes not only define cell and organelle boundaries but also control the substances that are allowed to enter or exit the cell or organelle. Biomembrane structures, including composition, determine functions. The goal of this class is to examine cell membrane structure, membrane components and their organization into domains, and functions. Cholesterol is an important membrane lipid that is linked to biomembranes structurally and functionally. Misregulation of synthesis or trafficking of lipids, including cholesterol, contributes to many human diseases. Students will learn historical background and recent advances in membrane biology, following the path taken by cholesterol and others. Prerequisite: General Biology I or permission of the instructor.

Credit 3 units. UColl: OLI

U29 Bio 477 Fundamentals of Parasitology

This course covers a variety of clinically relevant parasitic organisms and their importance to human disease. We will discuss in detail the interactions of parasites with the host immune response both in terms of mechanisms whereby the host resists infections by these organisms and also how these parasites circumvent the host's ability to eliminate them. Because so much of the clinical importance of parasites has to do with this interaction, we will also cover general aspects of the workings of the immune system. There will be an emphasis on the nature of the host-parasite interaction on a molecular level. Lectures include discussions of recent literature concerning parasites and their interactions with the host.

Credit 3 units.

U29 Bio 478 Neuroscience: Sensory Systems

This course examines transduction and neural processing of various sensory inputs, including vision, audition, somatosensation, and special senses. Topics ranging from anatomy and physiology of the human sensory systems to the sensory plasticity will be discussed. Topics also include organization of sensory map, sensory reorganization, sensory integration, sensory-motor interactions and higher cognitive functions. We also discuss clinical aspects of sensory dysfunctions. We will explore landmark works and recent studies on sensory neurosciences. Prerequisite: General Biology I
Credit 3 units.

U29 Bio 480 Mechanisms of Microbial Pathogenesis

This class is designed to specifically address mechanisms whereby microbes of three basic types: Bacteria, Viruses, and eukaryotic parasites, subvert the host immune response and cause disease. The class will therefore be subdivided into three sections studying each of these three types of organisms. This class will primarily focus on recent publications with a short lecture preceding each discussion. Prerequisites: General Biology I and II or permission from the instructor.
Credit 3 units.

U29 Bio 481 Evolutionary Medicine

Evolutionary Medicine examines how human evolution relates to a broad range of contemporary health problems including infectious, chronic, nutritional, and mental diseases and disorders. The primary goal of the course is to compare modern human environments and behaviors with the conditions under which humans evolved to determine the extent to which medical conditions of the present may be a consequence of adaptation to different conditions of the past. Hybrid online, meeting on the following Thursdays 1/29, 2/12, 2/26, 3/12, 4/9, 4/23.
Credit 3 units.

U29 Bio 4811 Advanced Wilderness Medicine

This course, open to both graduate-level and undergraduate students, will cover the physiology underlying wilderness and remote first aid. We will review evidence-based, best practices and then explore the underlying mechanisms and physiology. In addition to learning the theory of emergency medical care, we will gain experience practicing life saving techniques including: CPR, wound cleaning and care, splinting of fractures and dislocations, spinal stabilization, and treatment of heat stroke and hypothermia. A Lab Fee of \$90 will cover American Red Cross certification in CPR and Wilderness and Remote First Aid, as well as all materials necessary for hands-on practice and realistic emergency scenarios. Prerequisites: Introductory Biology and Anatomy & Physiology, or permission of instructor.
Credit 3 units.

U29 Bio 485 Synaptic Change in the Nervous System

In this course, we study synapses and how they are modified by experience in development, learning, and memory. Topics include the impact of different types of synapses on neural function; activity-dependent synaptic organization during nervous system development; the link between synaptic plasticity and learning and memory; circuitry and mechanisms of explicit and implicit memory formation; and synaptic organization and

function in aging. We also learn how learning and memory are altered in mood disorders and addiction, as well as how they are affected by sleep and exercise. Prerequisites: Introduction to Psychology and previous course work in biology.
Credit 3 units.

U29 Bio 487 Undergraduate Teaching Assistant

Exceptional undergraduates serve as teaching assistants for laboratory and/or discussion sections in departmental courses. Normally 2 or 3 units are given per semester, subject to the approval of the instructor and the department. Credit may not be counted toward fulfilling a major in University College; Independent Study application form required. Prerequisite: permission of instructor. Credit /No Credit only.
Credit variable, maximum 3 units.

U29 Bio 493 Seminar in Advanced Biology

In special cases, credit may be given for individual study. Topics of study and credit must be arranged with a faculty sponsor and approved by the Department.
Same as L41 Biol 493
Credit variable, maximum 4 units. A&S IQ: NSM Arch: NSM Art: NSM

U29 Bio 500 Independent Study

An independent research project under the supervision of a member of the Biology faculty. Open only to students admitted to the graduate program in Biology. Approved proposal must be presented at the time of registration. For more information, contact the assistant dean for Graduate Programs at 314-935-6700.
Credit variable, maximum 3 units.

U29 Bio 5012 Human Anatomy and Development

Study of the human body primarily by dissection; extensive use of X-rays and CT scans. Emphasis on functional and clinical aspects of anatomy. Prerequisite: This course is restricted to first year medical students. Same as L48 Anthro 502 and M05 Neurosci 501A.
Same as L41 Biol 501
Credit 6 units.

U29 Bio 521 Program Capstone I

Graduate students will teach a secondary biology unit integrating major concepts from the first summer institute and conduct action research on its implementation. Teachers will analyze its successes and failures, discuss solutions, and document measures of student learning. Each capstone project will culminate in a final report. As part of the process of developing and reporting on the project, graduate students will work together in small groups based on school and unit topic. Prerequisite: for participants in MS in Biology degree program or by permission of instructor.
Credit 1.5 units. UColl: OLI

U29 Bio 5285 Fundamentals of Mammalian Genetics

This course aims to provide both biologists and those with mathematical backgrounds with a basis in mammalian genetics. The course will include the following modules: nucleic acid biochemistry; gene and chromosome organization; introduction to human genetics; mutations and DNA repair; cancer genetics; genomic methodologies; biochemical genetics; murine genetics;

epigenetics; neurodegenerative diseases; mitochondrial disorders; pharmacogenetics; introduction to human population genetics; applications of modern human genetics; introduction to web-based informatics tools for molecular genetics. One of the required courses in the Quantitative Human Statistical Genetics graduate program.

Same as L41 Biol 5285

Credit 3 units.

and reporting on the project, graduate students will work together in small groups based on school and unit topic. Prerequisite: for participants in MS in Biology degree program or by permission of instructor.

Credit 1.5 units. UColl: OLI

U29 Bio 5319 Molecular Foundations of Medicine

This course will cover fundamental aspects of biochemistry and cell biology from a medical perspective. The course begins with a treatment of protein structure and the function of proteins in the cytoskeleton and cell motility. The principles of enzyme kinetics and regulation are then discussed, and basic pathways for the synthesis and metabolism of carbohydrates and lipids are introduced. This leads in to a discussion of membrane structure and the function cellular organelles in biological processes including energy production, protein degradation, and protein trafficking. Prerequisite: two semesters of organic chemistry. Course director approval is required. Please note: This course is given on the medical school schedule, so it begins eight days before the graduate school schedule.

Same as L41 Biol 5319

Credit 3 units.

U29 Bio 5432 Conservation Biology and Biodiversity

We will explore real-world examples of issues involving threats to biodiversity, ecological economics and nature conservation, habitat degradation and loss, habitat fragmentation, overexploitation, species invasions, biological impacts of climate change, conservation genetics, species and landscape approaches to conservation, ecosystem approaches to conservation, restoration of damaged ecosystems, and sustainable development. This course is fully online. Students enrolled in day classes at Washington University should review the policies of their home division on credit earned for online courses. Prerequisite: for MS in Biology students only.

Credit 3 units. UColl: OLI

U29 Bio 552 Human Genetics and Cytogenetics

Human or medical genetics is one of the most rapidly advancing fields of science and is now integral to all aspects of biomedical science. This course provides a genetic perspective on the function of the human body in health and disease. Beginning with a study of chromosomes and the disorders that result from their aberrations, the course presents the theoretical background necessary for a deeper understanding of the emerging impact of human genetics on biology. Topics includes chromosomal basis of heredity, autosomal and sex chromosomal abnormalities, and cancer genetics. Students will be introduced to the specific molecular and cytogenetic techniques that have revolutionized the study of human genetics.

Credit 3 units. UColl: OLI

U29 Bio 5771 Program Capstone II

Graduate students will teach a secondary biology unit integrating major concepts from the second summer institute and conduct action research on its implementation. Teachers will analyze its successes and failures, discuss solutions, and document measures of student learning. Each capstone project will culminate in a final report. As part of the process of developing