BIOLOGY

http://www.bio.jhu.edu

The Department of Biology offers a broad program of undergraduate, graduate, and postgraduate study in the biological sciences. Included among the areas in which instruction and research opportunities are available are biochemistry and biophysics, cell biology, molecular biology, microbiology, developmental biology, genetics, neuroscience, and immunology.

Undergraduate Programs

The Biology Department offers two degree options for undergraduate students, a Bachelor of Arts degree for biology majors and a Bachelor of Science degree for molecular and cellular biology majors.

Teaching Opportunities

Since most biology Ph.D.'s will teach at some time during their careers, experience in teaching is considered an essential part of the Ph.D. program. The minimum teaching requirement is three contact hours a week for one year in the laboratory sections of undergraduate courses. Further teaching experience is gained through the preparation and presentation of reports in seminars and journal clubs. The department stresses organization of material and clarity of presentation.

Facilities

The lecture rooms, teaching laboratories, and research facilities of the Biology Research Complex (consisting of Seeley G. Mudd Hall and Undergraduate Teaching Laboratories) offer a thoroughly modern research facility for molecular biology.

Financial Aid

The department has fellowship funds for the support of graduate students. Awards are granted for tuition and living expenses. Laboratory fees and research expenses are paid by the department.

Programs

- Biology, Bachelor of Arts (http://e-catalog.jhu.edu/arts-sciences/full-time-residential-programs/degree-programs/biology/biology-bachelor-arts/)
- Biology, Bachelor of Arts/Master of Science (http://e-catalog.jhu.edu/arts-sciences/full-time-residential-programs/degree-programs/biology/biology-bachelor-arts-master-science/)
- Cellular, Molecular, Developmental Biology and Biophysics, PhD (http://e-catalog.jhu.edu/arts-sciences/full-time-residential-programs/degree-programs/biology/cellular-molecular-developmental-biology-biophysics-phd/)
- Molecular & Cellular Biology, Bachelor of Science/Master of Science (http://e-catalog.jhu.edu/arts-sciences/full-time-residential-programs/degree-programs/biology/molecular-cellular-biology-master-science/)
- Molecular and Cellular Biology, Bachelor of Science (http://e-catalog.jhu.edu/arts-sciences/full-time-residential-programs/degree-programs/biology/molecular-cellular-biology-bachelor-science/)

For current course information and registration go to https://sis.jhu.edu/classes/

Courses

AS.020.101. Freshman Seminar: The Cell Biology of Neurodegeneration. 3 Credits.
This course will examine the underlying biology of multiple neurodegenerative disorders, ranging from the well known (Alzheimer's, Parkinson's, etc.) to the rare (Cockayne syndrome, Salla disease, etc.). For each disease, relevant cellular and molecular mechanisms important for normal functioning of the nervous system will be examined, followed by exploration of the errors that can occur in these processes and give rise to disease states. Specific cellular activities to be explored include protein folding and stability, DNA repair, and lysosomal trafficking and degradation. Popular topics in biology and neuroscience (e.g., personal genome sequencing, CRISPR-based gene editing, microbiomes) will also be covered.
Area: Natural Sciences

AS.020.104. Freshman Seminar: From Genes to DNA and Back. 1.5 Credits.
A course consisting of introductory lectures followed by student presentations in the form of seminars. The issues we usually analyze are: How did we arrive at the concept of the "gene"? What are the early observations that gave substance to this concept? How did we arrive at the "one gene, one enzyme" dogma? What is the chemical nature of the gene? Is DNA enough for regulated gene expression? Is it "all in our genes"? What is genetic plasticity and epigenetics? What about genomics and proteomics? In the course of our analyses we bring together observations, and experimental results and ideas not only from biological sciences (Genetics, Cell and Developmental Biology and Genetics) but also from Physics, Sociology, Politics and Philosophy. We do all this in order to clarify how observations turn to ideas, then dogmas and even biases that distort the true meaning of objective Sciences.
Area: Natural Sciences

AS.020.106. Freshman Seminar: Tuberculosis. 1 Credit.
Mycobacterium tuberculosis is an extremely successful intracellular bacterial pathogen able to manipulate phagocytic cells and its own metabolism to survive within a host. The molecular mechanisms of this survival and resistance to antibiotics will be studied. Freshmen only.
Area: Natural Sciences

AS.020.115. Bioenergetics. 2 Credits.
This course is a combination of lectures, student presentations and group discussions that address fundamental principles and also contemporary issues examining the way all forms of Life on Earth are ultimately dependent on sunlight to satisfy their food and energy requirements. We examine the steps from the capture of Physical energy (photons), to the development of electrochemical potentials and finally, to their utilization by cellular organelles towards the synthesis of the chemical "currency" that fuels all biological processes (biosynthesis, cell communication, movements, etc.). Special emphasis will be on current developments in biotechnologies that utilize microbial populations to supply us with fuels and also to clean up environmental hazards. The course will also consider ways to extract lessons from Nature's successful designs and harmonious adaptations so that we, in the long run, can utilize them towards a minimization of our negative impact on the environment.Note: Freshmen and Sophomores only, with good foundations in any two of the following: Physics, Chemistry, Biology, Biophysics.
Area: Natural Sciences

AS.020.120. Introduction to Laboratory Research. 1 Credit.
This course will introduce students to a variety of biochemical and molecular biological laboratory techniques. These will include DNA analysis by restriction enzyme mapping, amplification of DNA segments by PCR, lipid analysis by chromatography. Additionally, students will visit a variety of biological laboratories to observe actual research projects. * Prerequisites: High school biology and chemistry.

AS.020.126. Techniques in Molecular Biology. 1 Credit.
This course is designed to supplement the scientific classroom experience of students by providing hands on experience with the essential core molecular biology techniques of bacterial DNA cloning, DNA analysis, and protein analysis. Students will be able to understand and explain how these methodologies work scientifically and will develop the basic laboratory skills necessary for the successful completion of the assays.

AS.020.129. Introduction to Biology & Medicine. 1 Credit.
Introduction to Biology & Medicine: from Textbook to Application. Biology is the study of life dynamics, and medicine is the application of biology to enhance human health. With a particular emphasis on imaging approaches from the scale of the cell to that of the whole body, this course explores how biology research is designed to improve our knowledge and health. The goal is to show students the possible ways of using information learned in textbooks as a starting point to explore new application frontiers and careers in academic research, industrial/biotech development, and medicine. Course is highly interactive and includes lectures, readings, field trips, and guest lectures by professors involved in the scientific advancements. Grades determined by class participation, attendance, quizzes, and oral presentation.

AS.020.132. Medical School Intensive. 1 Credit.
The 2-week program is designed to engage bright high school students who are interested in medicine. Taught and guided by Johns Hopkins University School of Medicine faculty post-docs and fellows, students will learn basic knowledge and techniques related to surgery, internal medicine, pediatrics, emergency medicine, and biomedical science by participating in interactive lectures and labs, experiencing hands-on medical trainings at Johns Hopkins Medical Simulation Center, interviewing and networking with diverse medical professionals, and visiting the world-renowned hospital.

AS.020.135. Project Lab: Phage Hunting. 2 Credits.
This is an introductory course open to all freshman regardless of intended major. No science background is required. This is the first semester of a year-long research-based project lab course in which students will participate in a nation-wide program in collaboration with undergraduates at other colleges. Students will isolate and characterize novel bacteriophages (viruses that infect bacteria) from the environment using modern molecular biological techniques. The course includes two lab meetings per week. Continues in the spring. Each semester provides 2 credit hours of Natural Sciences (N) distribution credits and/or counts 2 hours toward the research requirement for the Molecular and Cellular Biology degree. No textbook is required. Freshmen only.
Area: Natural Sciences

AS.020.136. Phage Hunting II. 1 Credit.
This is an introductory course open to all freshman regardless of intended major. No science background is required. This is the second semester of a year-long research-based project lab course in which students will participate in a nation-wide program in collaboration with undergraduates at other colleges. In the spring semester, students will annotate the genome of a bacteriophage isolated and characterized by a student in AS.020.135, in preparation for submission to a database and eventual publication. Enrollment by permission of the instructor only.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.;AS.020.137 or permission of instructor
Area: Natural Sciences

AS.020.137. Project Lab: Phage Discovery. 1 Credit.
In this small-section introductory research lab course, students are introduced to basic microbiological techniques as they isolate and characterize a bacteriophage, a virus that infects bacteria, from an environmental sample. One meeting per week. No textbook required. Modeled after the Phage Hunting project lab course, but with a focus on benchworkStudents cannot receive credit for both AS.020.135 and AS.020.137.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.;Not open to anyone who has taken AS.020.135
Area: Natural Sciences

AS.020.151. General Biology I. 3 Credits.
This course is an introduction to biology from an evolutionary, molecular and cellular perspective. Specific topics and themes include evolutionary theory, the structure and function of biological molecules, mechanisms of harvesting energy, cell division, classical genetics and gene expression. This section will involve in-class problem solving and the use of assigned pre-class videos and questions.
Area: Natural Sciences

AS.020.152. General Biology II. 3 Credits.
This course builds on the concepts presented and discussed in General Biology I. The primary foci of this course will be on the diversity of life and on the anatomy, physiology, and evolution of plants and animals. There will be a special emphasis on human biology.
Prerequisite(s): AS.020.151
Area: Natural Sciences

AS.020.153. General Biology Laboratory I. 1 Credit.
This course reinforces the topics covered in AS.020.151. Students participate in a semester-long project, identifying bacteria from Homewood campus soils using molecular biology techniques. Other laboratory exercises cover aspects of evolution, genomics and biochemistry. Cross-listed with Behavioral Biology. Student must have enrolled in AS.020.151 either this term or in past terms. Students who have credit for AP Biology but take General Biology Lab I will lose four credits of AP Biology credit. Cross-listed with Behavioral Biology.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.;AS.020.151
Area: Natural Sciences

AS.020.154. General Biology Lab II. 1 Credit.
This course reinforces the topics covered in AS.020.152. Laboratory exercises explore subjects ranging from evolution to anatomy and physiology. Students participate in a project using molecular biology techniques to determine whether specific foods are made from genetically engineered plants.Cross-listed with Behavioral BiologyStudents who have credit for AP Biology but take General Biology Lab II will lose all four credits of their overall credit for AP Biology.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.
Area: Natural Sciences

AS.020.161. Current Events in Biology I. 1 Credit.
In this lively and collaborative course, students discuss current events and controversies in biology ranging from bioterrorism to the health of the Chesapeake Bay.
Area: Natural Sciences

AS.020.162. Current Events in Biology II. 1 Credit.
Students will discuss current events and controversies in biology, ranging from genetic engineering to nanotechnology in medicine.
Area: Natural Sciences

AS.020.205. Introduction to Biological Molecules. 3 Credits.
This course presents an overview to biochemistry and molecular biology, especially focusing on biotechnology and medicine. Students will have classroom and laboratory experience and group presentations. Prerequisite: High school level Chemistry and Biology (both with a grade of A).
Area: Natural Sciences

AS.020.303. Genetics. 3 Credits.
Presentation of the principles of heredity and variation, and their application to evolution and development; physico-chemical nature of the gene; problems of recombination; gene action.
Prerequisite(s): Students may receive credit for AS.020.330 or AS.020.303, but not both.
Area: Natural Sciences

AS.020.304. Molecular Biology. 3 Credits.
This course will focus on the ways that nucleic acids direct the synthesis of nucleic acids and proteins. Emphasis will be on modern techniques to study these fundamental processes and important biological molecules. This course fulfills a core requirement for biology majors and molecular and cellular biology majors and cannot be taken by students who have already taken AS.020.305. This course does not fulfill does not fulfill the elective requirement for biology or molecular and cellular biology majors.
Area: Natural Sciences

AS.020.305. Biochemistry. 4 Credits.
The molecules responsible for the life processes of animals, plants, and microbes will be examined. The structures, biosynthesis, degradation, and interconversion of the major cellular constituents including carbohydrates, lipids, proteins, and nucleic acids will illustrate the similarity of the biomolecules and metabolic processes involved in diverse forms of life.Sophomores, Juniors, and Seniors Only.
Prerequisite(s): AS.030.205 OR AS.030.212 OR EN.540.202, may be taken concurrently.
Area: Natural Sciences

AS.020.306. Cell Biology. 4 Credits.
How the molecules of living systems are organized into organelles, cells, tissues, and organisms will be explored, as well as how the activities of all of these are orchestrated and regulated to produce “life”—a phenomenon greater than the sum of its parts. Considerable emphasis is placed on experimental approaches to answering these questions. Topics covered include biological membranes, cytoskeletal elements, cell locomotion, membrane and protein traffic, the nucleus, signal transduction, the cell cycle, the extracellular matrix, epithelial structure and function. Sophomores, juniors, and seniors only. Recommended Course Background: (AS.020.151 or AS.020.305) or equivalent knowledge of biomolecules or AS.020.303.
Prerequisite(s): Cell Biology restriction: students who have completed EN.540.307 may not enroll..
Area: Natural Sciences

AS.020.312. Introduction to the Human Brain. 3 Credits.
This course explores the outstanding problem of biology: how knowledge is represented in the brain. Relating insights from cognitive psychology and systems neuroscience with formal theories of learning and memory, topics include (1) anatomical and functional relations of cerebral cortex, basal ganglia, limbic system, thalamus, cerebellum, and spinal cord; (2) cortical anatomy and physiology including laminar/columnar organization, intrinsic cortical circuit, hierarchies of cortical areas; (3) activity-dependent synaptic mechanisms; (4) functional brain imaging; (5) logicist and connectist theories of cognition; and (6) relation of mental representations and natural language.
Prerequisite(s): AS.020.306 OR EN.540.307
Area: Natural Sciences

AS.020.315. Biochemistry Project lab. 1 Credit.
This research project laboratory investigates the flow of energy through biological systems using focused examination of key cellular energy-conversion processes. Students will be introduced to the broad field of biochemistry research through computational structural analysis, directed mutation, recombinant protein production, and enzymatic analysis. Participants will be trained in biochemical laboratory techniques and expected to contribute their findings to the scientific community using formal, academic communications.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.;AS.020.305 OR AS.250.307 OR AS.250.315. These may be taken concurrently.
Area: Natural Sciences

AS.020.316. Cell Biology Lab. 1 Credit.
The Cell Biology Laboratory will use projects with the nematode C. elegans and mouse 3T3 cells in culture to illustrate experimental systems which are used in cell biology. Light microscopy, fluorescence microscopy, RNA interference, fluorescence-activated cell sorting, Western blotting and the culture of nematodes and cells are techniques which will be used. Because we will be using growing organisms, there will be at least one week when students will have to visit the lab the day after their section meets to complete an experiment.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.;Students may have previously taken AS.020.306 prior to enrolling in AS.020.316 OR students may concurrently enroll in AS.020.306 ANDAS.020.316 OR students must have previously completed both EN.540.202 and AS EN.540.307 prior to enrolling in as.020.316.
Corequisite(s): Students must have completed EN.540.307 prior to enrolling in AS.020.316.
Area: Natural Sciences

AS.020.317. Signaling in Development and Disease. 3 Credits.
An advanced undergraduate level seminar on current topics on signal transduction mechanisms underlying neuronal morphology, development and function. The proper functioning of the nervous system relies on the establishment of precise neuronal circuits through a developmental program including proliferation, neuronal migration, axonal growth, and neuronal survival. This course pertains to the extracellular cues and downstream neuronal signaling pathways that coordinate these key events during neuronal development. The course will also cover the role of aberrant signaling mechanisms in neuronal degeneration and disease. Recommended Course Background: AS.020.305, AS.020.306, and AS.080.306
Area: Natural Sciences

AS.020.319. Human Genome Variation. 2 Credits.
A supplement to this course is the elective "Analysis of Genomic Data" 020.xxx that takes a deeper dive into the data presented in HGV. Students of HGV are encouraged to enroll separately in this exciting new course.
Prerequisite(s): AS.020.303
Area: Natural Sciences

AS.020.320. Cell Division Mechanisms and Regulation. 3 Credits.
This course will focus upon the molecular mechanisms that underpin the reproduction of eukaryotic cells. General topics will include chromosome duplication, mitotic spindle action, cytokinesis, meiosis, cell cycle control, damage repair and checkpoints, and aberrant regulation characteristic of cancer. Most readings will be from recent research manuscripts and review articles. Classes will consist of a mix of lectures and student oral presentations.
Prerequisite(s): AS.020.306
Area: Natural Sciences

AS.020.321. Human Genome Variation with Computational Lab. 3 Credits.
The prerequisite/co-requisite course on Human Genome Variation has exposed you to the power of genomic studies for understanding human evolutionary history as well as revealing the genetic basis of human traits and disease. What does real human genomic data look like? How are these data analyzed in practice? Supplementing the main course, this module will explore public datasets and computational tools used to analyze human genomic data to better understand how patterns in these data can be used to test hypotheses about evolution and human phenotypes.
Prerequisite(s): AS.020.303
Area: Natural Sciences

AS.020.329. Microbiology. 3 Credits.
This course explores the physiology and genetics of microorganisms within an evolutionary and ecological framework. Concepts in microbiology will be supported by molecular studies of microbial evolution and microbial communities including that of the human microbiome. Recommended Course Background: AS.020.305
Area: Natural Sciences

AS.020.331. Human Genetics. 2 Credits.
Will examine the growing impact of human genetics on the biological sciences, on law and medicine, and on our understanding of human origins. Topics include structure and evolution of human genome, genetic and physical mapping of human chromosomes, molecular genetics of inherited diseases and forensic genetics.
Area: Natural Sciences, Social and Behavioral Sciences

AS.020.337. Stem Cells & the Biology of Aging & Disease. 2 Credits.
This will be a team-taught lecture course that focuses on the properties of stem cells, their possible role in cancer (breast and prostate), stem cell aging, and the potential utilization of stem cells for therapy. Topics will include: mechanisms of stem cell renewal, stem cell potency, the impact of the stem cell niche, stem cells and the hematopoietic system, stem cells and the neural system, stem cells in the male and female gonads, induced pluripotent stem cells and cellular reprogramming, stem cell changes with aging, and ethical and policy issues in stem cell research and use. Most lectures will be research-oriented. Students will be expected to read and critically analyze current literature, with an emphasis on the experimental bases from which our current understandings derive.
Prerequisite(s): AS.020.305 (Biochemistry) or AS.020.306 (Cell Biology) or EN.580.221 (Molecules and Cells) or EN.540.307 (Cell Biology for Engineers) or permission of instructor.
Area: Natural Sciences

AS.020.340. Developmental Genetics Lab. 2 Credits.
This class will explore the development of animals from a single fertilized egg into a fully formed organism. We will emphasize experimental methods to understand the molecular mechanisms controlling development.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.;AS.020.303 can be taken prior to or during enrollment in AS.020.340.

AS.020.341. Quantitative Methods in Biology. 3 Credits.
This course reviews a variety of quantitative tools commonly applied in biological research. The course is divided into three sections. The first section covers dynamical modeling of biological processes, with an emphasis on chemical kinetics and cell signaling. The second section is devoted to statistical tools used to analyze datasets, as well as techniques to reduce data complexity and clustering. The third section applies the learned statistical tools to image processing, as well as commonly used techniques to process and extract features from images. Students will learn the quantitative concepts during lecture and discussion, and apply these concepts in lab sections where they will use MATLAB to apply the learned tools to biological problems.
Prerequisite(s): AS.020.305 AND AS.020.305 and one year of calculus.
Area: Natural Sciences

AS.020.344. Virology. 3 Credits.
This course will cover basic principles of viral replication and pathogenesis, as well as the host response to viral infection. It will then focus on several viruses of interest, including HIV-1, Influenza, Human Papilloma Virus, Hepatitis C, Ebola Virus, and Zika Virus.
Prerequisite(s): AS.020.305 OR AS.250.315
Area: Natural Sciences

AS.020.346. Immunobiology. 3 Credits.
A course for upper level undergraduates that introduces the molecules, cells, systems and biologyof the immune system.
Prerequisite(s): AS.020.306 AND (AS.020.303 OR AS.020.330)
Area: Natural Sciences

AS.020.347. AIDS. 3 Credits.
AIDS is the world's deadliest infectious disease. This course will cover the biology of human immunodeficiency virus (HIV, the infectious agent that causes AIDS), the effects of HIV on the immune system, the pharmacology of the anti-viral agents that are used to suppress HIV infection, and the ongoing quest for an HIV vaccine. Because HIV drugs cannot cure HIV-infected individuals and no HIV vaccine yet exists, we will also study the long-term consequences of HIV infection including opportunistic infections, comorbid conditions, and the HIV-related cancers Kaposi's Sarcoma and AIDS-Related lymphoma. Recommended Course Background: AS.020.306
Prerequisite(s): AS.020.306
Area: Natural Sciences

AS.020.349. DNA Repair, Damage and Genomic Instability. 3 Credits.
Errors in DNA replication and damage response pathways are the source of many pathologies, including cancer. In this literature-based discussion course, students will have the opportunity to examine our current understanding of DNA damage and repair mechanisms, as well as the many strategies cells employ to ensure fidelity during DNA replication and chromosome segregation. Students will examine various repair mechanisms have evolved with the emergence of complex organisms and gain a comprehensive knowledge of DNA double stranded break repair by nonhomologous end joining and homologous recombination. This course will leave students with a complete understanding of both internal and external sources of DNA damage, as well as the many different ways organisms have adapted to maintain genome integrity and the health consequences when these adaptations do not work as designed.Prior completion of genetics is required for this course, as well as a basic comprehension of the principles of transcription and translation.
Prerequisite(s): AS.020.303
Area: Natural Sciences

AS.020.350. Introduction to Clinical Medicine. 2 Credits.
Perm. Req'd. Post-Bac Students Only
Area: Natural Sciences

AS.020.351. Cancer Biology. 3 Credits.
While the "war on cancer" has produced modest victories with respect to clinical outcomes, our knowledge of the cellular mechanisms of cancer is now vast and represents one of the most significant scientific achievements of the past 40 years. Key aspects of cancer biology will be covered with a combination of textbook and original literature readings. Topics will include cancer cell characteristics, oncogenes, tumor suppressor genes, apoptosis, metastasis and immuno-surveillance of cancer cells. Application of our knowledge to the rational treatment of cancer will also be discussed.
Prerequisite(s): Cell Biology 020.306 or permission of instructor
Area: Natural Sciences

AS.020.355. Fundamentals of Genome Informatics. 3 Credits.
This course will cover fundamental methods used in the analysis of genomic sequencing data, with a particular focus on recent developments in comparative and functional genomic assays. In particular, we will cover approaches for 1) genomic sequencing and assembly, including resequencing and personal genomes, 2) comparing genomes and modeling genome evolution, 3) identifying functional elements using both functional genomicsand computational models. While thecourse will focus on particular problems in genomics, we will emphasize core algorithmic concepts that generalize to the analysis of other types of biological data.
Prerequisite(s): AS.020.151 AND (AS.020.152 OR AS.020.303)
Area: Natural Sciences

AS.020.360. Gene Regulation During Development and Disease. 3 Credits.
This course examines how regulation of gene expression impacts development and disease. The course will focus on the mechanisms controlling transcriptional, post-transcriptional, translational, and post-translational regulation. For each topic, one class will be a lecture/discussion of key concepts and experimental approaches followed by a class with student-led presentations of related publications. Recommended Course Background: AS.020.303 and AS.020.305.
Area: Natural Sciences

AS.020.361. Advanced Research Lab in Cell and Molecular Biology. 3 Credits.
An intensive research laboratory course on single-molecule, live-cell imaging of chromatin and epigenetic factors designed for undergraduate students with interests in biochemistry, molecular, cellular and computational biology. The course introduces the use of advanced fluorescence microscopy to visualize the single-molecule dynamic behaviors and spatial distributions of important nuclear proteins and chromatin factors in living cells of Saccharomyces cerevisiae as a model for conserved epigenetic regulators in humans. Students will learn and apply imaging and computational tools to localize and track single protein molecules in real time and calculate their diffusive parameters. Students are expected to interpret and integrate data to acquire conceptual insights on chromatin functions, e.g. how chromatin proteins, enzymes, and large protein complexes are distributed in nuclear space and time. Students will gain practical experience in yeast molecular genetics by engineering protein tags on designated factors, and evaluating protein functionality under natural levels of expression. General access to laboratory facilities, with two afternoons (~8 hours/week) mandatory. After course completion, option for post-course research in the Wu laboratory.Open to advanced sophomores or upper level students with permission of Instructor Carl Wu (wuc@jhu.edu).
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.
Area: Natural Sciences

AS.020.362. Single Molecule Approaches to Biology. 3 Credits.
This course examines how recently developed single-molecule methods have enhanced our understanding of cellular processes. The ability to observe and manipulate individual biological macromolecules has revolutionized our understanding of the machines and processes that enable life. The course will provide an overview of single-molecule approaches and discuss relevant publications that exemplify how these methodologies are applied to biological problems. For each approach, key concepts will be introduced in a lecture/discussion, followed by a student-led presentation of a related publication.Recommended coursework: Physics II
Prerequisite(s): AS.020.305 OR AS.250.316
Area: Natural Sciences

AS.020.363. Developmental Biology. 3 Credits.
This class will explore the development of animals from a single fertilized egg into a fullyformed organism. We will emphasize experimental methods to understand the molecular mechanisms controlling development.
Prerequisite(s): AS.020.306 AND (AS.020.330 OR AS.020.303)
Area: Natural Sciences

AS.020.364. Molecular and Cellular Mechanisms of Reproduction. 3 Credits.
This course will address current research in the cellular and molecular biology of fundamental reproductive processes. The topics covered will vary from year to year, based on current issues in the scientific literature. The focus will be on cellular and molecular mechanisms involved in the synthesis and actions of hormones, gametogenesis, fertilization, pathologies of the reproductive tracts, developmental origins of reproductive health and disease, contraception, and infertility. The emphasis will be on defining cellular and molecular mechanisms that regulate reproductive processes, identifying the hypotheses tested in scientific papers and the strengths and limitations of experimental methods used to test the hypotheses, and evaluating and integrating data described in scientific papers. Classes will consist of a mix of lectures and student oral presentations.Recommended coursework: Reproductive Physiology
Prerequisite(s): AS.020.306
Area: Natural Sciences

AS.020.365. Intro To Human Skeleton. 3 Credits.
This course will provide a basic understanding of human skeletal biology, including bone composition and bone growth, recognition of skeletal elements, functional anatomy of different skeletal systems, comparative anatomy, and forensic anthropology (sexing and aging, body size reconstruction, bone pathology). Lectures will be combined with hands-on experience with bone models and real bone specimens.
Area: Natural Sciences

AS.020.367. Primate Adaptation and Evolution. 3 Credits.
A close look at our closest relatives, the primates. Topics include: evolutionary theory, primate evolution, primate behavior and ecology, human evolution, and modern human variation.
Area: Natural Sciences

AS.020.373. Develop Biology Lab. 2 Credits.
This laboratory is designed to give students exposure to the different techniques and organisms used in Developmental Biology research. Our primary goal in this course is to help you learn to think like a scientist and gain a better understanding of how scientists study development. With that goal in mind, students design and execute an independent project during the second half of the semester. The independent projects will culminate with a poster session in which the project and its outcome will be shared with the other students. Please be aware that because we are working with live developing embryos, you will sometimes be required to return to lab between scheduled class times.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class.;AS.020.363

AS.020.374. Comparative Animal Physiology. 3 Credits.
This class examines animal physiology from an evolutionary and comparative viewpoint. The goal is to examine the commonalities, as well as unique differences, in how various animal organisms address the necessary life functions. Topics will include metabolism, neural systems, respiration, muscle systems, water and salt homeostasis, thermal regulation, and reproduction
Prerequisite(s): AS.020.305
Area: Natural Sciences

AS.020.377. Comparative Physiology Lab. 1 Credit.
This course examines the physiological principles that guide animal life processes. As a complement to the Comparative Animal Physiology lecture course, this Laboratory examines fundamental physiological principles through hands-on investigations of animal physiology using zebrafish and mussel as model systems and research-grade data acquisition systems.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.;AS.020.374, students may enroll concurrently.
Area: Natural Sciences

AS.020.379. Evolution. 3 Credits.
This course takes a broad look at the impact of natural selection and other evolutionary forces on evolution. Emphasis is placed on what we can learn from genome sequences about the history of life, as well as current evolutionary pressures.Recommended Course Background: AS.020.306, AS.020.330, or permission required
Area: Natural Sciences

AS.020.380. Chromatin, Chromosomes and The Cell Nucleus. 3 Credits.
The course will present analysis of the structural basis of the genome organization in a eukaryotic nucleus and the utilization of its genomic content. We start with the analysis of the fluctuations of the structure of the double helix in response to its cellular microenvironment that yield DNA structural and functional polymorphism. Next we will deal with the mechanics of DNA compaction into chromatin and the differentiation of the chromatin structure at the level of the nucleosome via histone variants and posttranslational modifications and chromatin-based epigenetics. We will next move to chromosomal territories, chromosomal imprinting and chromosome inactivation. Finally, a few lectures will focus on selected topics of special interests that bridge current basic discoveries with potential medical applications such as the nature of telomeres and telomerase-related diseases; the role of histone octamer tails in epigenetics; transcription factors and the regulated expression of the genome. Whenever possible. paradigms will be used that correlate chromatin differentiation to certain human diseases.
Prerequisite(s): AS.020.305 OR AS.020.306; AS.020.303 with approval of the instructor only.
Area: Natural Sciences

AS.020.382. A Biophysical View of Biology. 3 Credits.
The objective of this course is to develop in students a strong, intuitive, and physically based sense of how fundamental biological processes work—that is, the sizes, shapes, motions, interactions, and cellular functions of biological molecules. Topics will include cell and population growth, diffusion, enzyme kinetics, the qualitative and quantitative aspects of the synthesis, structure, and function of proteins and nucleic acids, least squares equation fitting, Bayesian statistics, and the fluctuation test. The biophysical constraints that dictate the form of the immune system and constraints relevant to development will be discussed.
Prerequisite(s): AS.020.303 AND AS.110.107 AND AS.171.104
Area: Natural Sciences

AS.020.384. Fundamentals of Drug Discovery. 3 Credits.
The creation and implementation of new approaches to the drug discovery and development process is a very active area of research. Currently, only one compound out of 5,000 that enter preclinical studies becomes a drug. Moreover, the development process is time consuming, lasting more than ten years on average. The rate of failure is extremely high. It has become evident that this field is in urgent need of revolutionary changes. This course will cover drug discovery issues ranging from the identification of hits to their optimization as drug candidates. Current as well as novel and proposed approaches aimed at accelerating discovery, potency optimization, selectivity, pharmacokinetics and other drug properties will be discussed.
Prerequisite(s): AS.020.305 AND AS.020.306
Area: Natural Sciences

AS.020.385. Epigenetics. 3 Credits.
Course description: This course emphasizes epigenetic regulatory mechanisms including DNA methylation, histone modifications, histone variants, non-coding RNA regulation, and chromatin remodeling, etc. We will discuss the broad impact of epigenetic regulation in various biological events, ranging from stem cell activity, small RNAs' and long non-coding RNAs' function, to transgenerational epigenetic inheritance and human diseases. We will mainly use recent literatures to discuss various topics. There are both students' presentation and writing components for this course. Students will be assigned a series of papers for their presentation and faculty will meet with student presenters ahead of the time to go through the presentation content.
Prerequisite(s): AS.020.303 OR AS.020.330
Area: Natural Sciences

AS.020.392. Anatomy & Physiology. 3 Credits.
Lectures will cover descriptive and functional anatomy; and should leave students with a better understanding of anatomical terminology and the relationship of structure to biological function within the human body. Additionally, students will gain perspective on human disease as they study the anatomical and functional basis of clinical symptoms.
Area: Natural Sciences

AS.020.401. Master's Seminar: Molecular & Cellular Biology I. 3 Credits.
This is a weekly seminar designed for graduate students enrolled in the B.A./M.S. and Ph.D. programs. The seminar involves student presentations of research and discussion of topics of current interest in the field. BA/MS candidates only.
Area: Natural Sciences

AS.020.402. Master's Seminar: Molecular and Cellular Biology II. 3 Credits.
This is a weekly seminar designed for students enrolled in the BA/MS program. The seminar involves student presentations of research and discussion of topics of current interest in the field. BA/MS students only.
Area: Natural Sciences

AS.020.410. Teaching and Learning in Biology. 1 Credit.
tHIS COURSE IS BY INSTRUCTOR PERMISSION AND ONLY AND ECLSUVELY FOR STUDENT WHO AREINVITED AND ACCEPTED TO BE LEARNING ASSISTANTS FOR OTHER BIOLOGY OURSES. THE COURSE WILL FOCUS ON DISCUSSING EDUCATION AND APPLICATION OF CURRENT BEST TEACHING PRACTICES TO BIOLOGY CLASSES.
Area: Natural Sciences

AS.020.415. Advanced Biomedical Research. 3 Credits.
This course for advanced undergraduates includes classroom instruction in interdisciplinary research approaches and lab work on an independent research project in the lab of a Bloomberg Distinguished Professor. Lectures will focus on cross-cutting techniques such as data visualization, statistical inference, and scientific computing. In addition to two 50-minute classes per week, students will commit to working approximately 3 hours per week in the lab of one of the professors. The student and professor will work together to schedule the research project. Students will present their work at a symposium at the end of the semester. This course can be used as 1 credit of independent research for the MCB major requirement.
Area: Natural Sciences

AS.020.441. Mentoring in General Biology. 1 Credit.
To become a mentor, students must have successfully completed AS.020.151/152, must apply using the form on the Biology Dept. website (https://bio.jhu.edu/undergraduate/courses/), and must be accepted by the instructors. The deadline to apply is April 15th. S/U
Area: Natural Sciences

AS.020.442. Mentoring in General Biology. 1 Credit.
This course provides students who have taken General Biology I & II the opportunity to mentor new students in General Biology I & II. Mentors collaborate with faculty on how to lead effective sessions, help student teams complete team assignments, and generally help students understand difficult concepts and principles in biology. Mentors must have a firm command of the topics covered in biology and must meet with both faculty and students through the course of the semester. To become a mentor, students must have successfully completed AS.020.151/AS.020.152, must apply using the form on the Biology Department website, and must be accepted by the instructors. The deadline to apply is April 8th. Recommended Course Background: AS.020.151/AS.020.152
Area: Natural Sciences

AS.020.501. Introduction Independent Study. 3 Credits.
An independent course of study may be pursued under the direction of an adviser on those topics not specifically listed in the form of regular courses. Freshmen and Sophomores only. Perm. Req'd.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.502. Introduction Independent Study. 0 - 3 Credits.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.503. Independent Research in Biology. 3 Credits.
Planning and conducting original laboratory investigations on biological problems, collection and analysis of data, reporting of results. Permission of full-time faculty member in Biology dept.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.504. Introduction to Research. 0 - 3 Credits.
Perm. Req'd. Freshmen or Sophomores only
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.505. Internship - Biology. 0 - 3 Credits.
An independent course of study may be pursued under the direction of an adviser on those topics not specifically listed in the form of regular courses. Consent of adviser required.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.506. Internship - Biology. 1 Credit.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.511. Independent Study. 3 Credits.
An independent course of study may be pursued under the direction of an adviser on those topics not specifically listed in the form of regular courses. Perm. Req'd.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.512. Independent Study. 0 - 3 Credits.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.513. Research Problems. 3 Credits.
Planning and conducting original laboratory investigations on biological problems, collection and analysis of data, reporting of results. Juniors and Seniors Only. Recommended Course Background: Permission of full-time faculty member in Biology dept.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.514. Research Problems. 0 - 3 Credits.
Perm. Req'd.Juniors and Seniors only
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.551. Mentored Research. 9 Credits.
This courses provide BA/MS students with intensive research experience for a full academic year. Students in the program work under the direction of a research mentor on an original research project, produce a written report in the form of a thesis, and make a presentation of the work to the Biology Department. BA/MS or BS/MS candidates only.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.553. Mentored Research. 9 Credits.
BA/MS candidates only.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.591. Summer Research Experience. 0 - 3 Credits.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.594. Internship - Summer. 1 Credit.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.597. Research. 3 Credits.
Prerequisite(s): You must request Independent Academic Work using the Independent Academic Work form found in Student Self-Service: Registration > Online Forms.

AS.020.601. Current Research in Bioscience.
This course involves 30 minute sessions with each member of the training faculty. It is designed to acquaint incoming graduate students with the research topics and research philosophy of each laboratory. This should help students choose future rotations. More generally the course provides a range of perspectives on the future of specific fields and strategies for success in science. First year Biology Graduate students only

AS.020.605. COMPUTATIONAL SIMULATION AND ANALYSIS OF PROTEIN STABILITY AND INTERACTIONS.
This course deals with the development of computer code for the simulation and non-linear least squares analysis of experimental macromolecular data including protein stability (chemical and temperature denaturation, single and multiple domain proteins); different types of binding (single site, multiple sites, independent and cooperative binding); linkage between conformational equilibrium and binding; enzyme kinetics and inhibition; kinetics of protein denaturation/aggregation. The course will use Python as the programing language.Requirements for this course include: 1) Basic Python programing skills; 2) Calculus; 3) Students must have a basic understanding of conformational equilibrium, binding equilibrium and enzyme kinetics. If not sure, please talk to the Instructor.
Area: Natural Sciences

AS.020.607. Quantitative Biology Bootcamp.
Quantitative and computational methods have become essential to modern biological research. The goal of this course is to provide an introduction to basic skills that will enable students to employ these methods. Students will learn how to work in a command line shell and use software to perform analyses of large biological datasets.Students will learn basic programming using the Python language.Throughout the course students will apply the skills learned to practical analysis problems emphasizing parsing and working with biological data formats, exploratory data analysis and visualization, and numerical and statistical methods. This course is only open to first-year students in the CMDB program and will be held from September 2nd through September 5th, 2014.

AS.020.612. Introduction to the Human Brain.
This course explores the outstanding problem of biology; how knowledge is represented in the brain. Relating insights from cognitive psychology and systems neuroscience with formal theories of learning and memory, topics include (1) anatomical and functional relations of cerebral cortex, basal ganglia, limbic system, thalamus, cerebellum, and spinal cord; (2) cortical anatomy and physiology including laminar/columnar organization, intrinsic cortical circuit, hierarchies of cortical areas; (3) activity-dependent synaptic mechanism; (4) functional brain imaging; (5) logicist and connectist theories of cognition; and (6) relation of mental representations and natural language. Co-listed with AS.020.312.

AS.020.614. Signaling in Development and Disease.
A seminar on current topics on signal transduction mechanisms underlying neuronal morphology, development and function. The proper functioning of the nervous system relies on the establishment of precise neuronal circuits through a developmental program including proliferation, neuronal migration, axonal growth, and neuronal survival. This course pertains to the extracellular cues and downstream neuronal signaling pathways that coordinate these key events during neuronal development. The course will also cover the role of aberrant signaling mechanisms in neuronal degeneration and disease.
Area: Natural Sciences

AS.020.617. Quantitative Biology Lab 1.
This computer lab is designed for first year CMDB graduate students to enhance their quantitative skills for fall core courses.This course will cover quantitative and computational analysis of biological datasets, emphasizing molecular biology. In a hands on lab setting, students will carry learn to perform essential analyses including assembly of genomes, detection of DNA methylation, analysis of transcription factor binding and motifs, detecting genome variation, measuring expression of genes, and understanding genome evolution.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.

AS.020.618. Quantitative Biology Lab II.
This computer lab is a continuation of the fall quantitative biology lab for CMDB graduate students. This semester will cover quantitative and computational modeling of selected topics from biophysics, cellular biology, and developmental biology
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.

AS.020.619. Communicating Science.
“Communicating Science” is a required course for 2nd year students in the CMDB program. It will be held at the Carnegie Institution for Science Bldg., 3520 San Martin Drive commencing August 30th, 2018. The course is intended to provide students with practical experience organizing oral presentations, preparing science manuscripts, and writing an application for an NIH National Research Service Award (F31). Participants will also learn about critically reviewing grants and papers. Instructor: Dr. M.E. Halpern.

AS.020.629. Microbiology.
This course explores the physiology and genetics of microorganisms within an evolutionary and ecological framework. Concepts will be supported by primary literature exploring microbial evolution and microbial communities including that of the human microbiome.

AS.020.630. Human Genetics.
Will examine the growing impact of human genetics on the biological sciences, on law and medicine, and on our understanding of human origins. Topics include structure and evolution of human genome, genetic and physical mapping of human chromosomes, molecular genetics of inherited diseases and forensic genetics.
Area: Natural Sciences, Social and Behavioral Sciences

AS.020.637. Genomes & Development.
This course covers gametogenesis, embryogenesis, post-embryonic development, genetic analysis, developmental genetics, model developmental systems, and cell determination. Biology graduate students only except with written permission from the instructor.

AS.020.643. Graduate Virology.
This course will cover basic principles of viral replication and pathogenesis, as well as the host response to viral infection. It will then focus on several viruses of interest, including HIV-1, Influenza, Human Papilloma Virus, Hepatitis C, Ebola Virus, and Zika Virus.

AS.020.644. RNA.
A graduate seminar course that will explore RNA from its beginning in the primordial RNA world to its present-day roles in gene regulation in bacteria, mammals, and viruses. Topics will include: The early RNA world, Riboswitches, Ribozymes, evolution of protein synthesis, splicing, telomerase, RNA interference, microRNAs, long non-coding RNAs, Viral non-coding RNAs, and RNA therapeutics.Biology PHD students only. MCB MS students with instructor's permission during ADD/DROP Period.
Area: Natural Sciences

AS.020.662. Single Molecule Approaches to Biology.
This course examines how recently developed single-molecule methods have enhanced our understanding of cellular processes. The ability to observe and manipulate individual biological macromolecules has revolutionized our understanding of the machines and processes that enable life. The course will provide an overview of single-molecule approaches and discuss relevant publications that exemplify how these methodologies are applied to biological problems. For each approach, key concepts will be introduced in a lecture/discussion, followed by a student-led presentation of a related publication.
Area: Natural Sciences

AS.020.668. Advanced Genetics and Molecular Biology.
This course examines modern concepts in genetics and molecular biology. The coursefocuses on the mechanisms controlling replication, recombination, transcriptional, posttranscriptional, translational, and posttranslational regulation. Lectures will have threeparts: a student-led paper presentation, a discussion about the concepts surrounding atopic, and a discussion of modern techniques to experimentally probe the topic.Biology PHD students only.

AS.020.674. Quantitative Biology and Biophysics.
Students will be given instruction in the concepts of physical and quantitative biology. Students will learn to simulate biological processes, identify the relationship between data and models, and will learn to fit biological data. Note: Friday classes will be held in UTL 398.

AS.020.675. Graduate Comparative Physiology.
This course addresses the basic principles that underlie physiological processes in animals. Framed in an evolutionary context, processes ranging from respiration, circulation, neural control, movement, excretion and metabolism will be understood in terms of core principles that also apply to humans. Emphasis is placed on the physical and chemical principles underlying the comparative biology of how different animals solve physiological problems.

AS.020.684. Fundamentals of Drug Discovery and Development.
The creation and implementation of new approaches to the drug discovery and development process is a very active area of research. Currently, only one compound out of 5,000 that enter preclinical studies becomes a drug. Moreover, the development process is time consuming, lasting more than ten years on average. The rate of failure is extremely high. It has become evident that this field is in urgent need of revolutionary changes. This course will cover drug discovery issues ranging from the identification of hits to their optimization as drug candidates. Current as well as novel and proposed approaches aimed at accelerating discovery, potency optimization, selectivity, pharmacokinetics and other drug properties will be discussed. Grad students only.
Area: Natural Sciences

AS.020.686. Advanced Cell Biology.
All aspects of cell biology are reviewed and updated in this intensive course through critical evaluation and discussion of the current scientific literature. Topics include protein trafficking, membrane dynamics, cytoskeleton, signal transduction, cell cycle control, cell physiology, and the integration of these processes in neurons. Recommended Course Background: AS.020.306

AS.020.687. Foundations & Applications of Molecular Biology.
An advanced course for graduate students in the biological sciences, although undergraduates are welcome, that stresses fundamental principles and analysis. It is generally focused on gene and protein structure and function.
Area: Natural Sciences

AS.020.699. CMDB Responsible Conduct in Research.
This course involves discussions of ethical conduct and the responsible practice of scientific research.Department signature only; restricted to graduate students in Biology PhD students only.

AS.020.753. Logic and Methods in Modern Biology.
The purpose of this course is to gain experience in critical thinking about the logic and methods used in modern biological research. The main approach will be the critical reading, presentation, and discussion of primary research papers, and the preparation and presentation of a research proposal. It is held once a week on the NIH Bethesda campus. Grad students only.
Prerequisite(s): AS.020.637 AND AS.020.668 AND AS.020.674
Area: Natural Sciences

AS.020.801. Research – Biological Problems.
Independent research for the Ph.D. dissertation. Biology Ph.D. students only

AS.020.802. Research-Biological Problems.
Biology Graduate students only.

AS.020.823. Introduction to Biology Research.
First year Biology Graduate Students only

AS.020.824. Introduction to Biology Research.
First year Biology Graduate Students only

AS.020.825. Introduction to Research.
Open to first year Biology graduate students only.

AS.020.826. Introduction to Biology Research.
Open to first year Biology graduate students only.

Cross Listed Courses

Biochemistry and Molecular Biology

PH.120.852. Core Research Literature. 1 - 2 Credits.
Provides a complement to the BCMB core curriculum. Student reads research papers relating to a core lecture topic. Discussions are led by a student while a faculty member from Biochemistry or MMI act as facilitator. Helps students to develop skills in reading the primary literature and provides an introduction to the experimental paradigms underlying the concepts presented in the core course.
Course location and modality is found on the JHSPH website (https://www.jhsph.edu/courses/).

Biology

AS.020.151. General Biology I. 3 Credits.
This course is an introduction to biology from an evolutionary, molecular and cellular perspective. Specific topics and themes include evolutionary theory, the structure and function of biological molecules, mechanisms of harvesting energy, cell division, classical genetics and gene expression. This section will involve in-class problem solving and the use of assigned pre-class videos and questions.
Area: Natural Sciences

AS.020.152. General Biology II. 3 Credits.
This course builds on the concepts presented and discussed in General Biology I. The primary foci of this course will be on the diversity of life and on the anatomy, physiology, and evolution of plants and animals. There will be a special emphasis on human biology.
Prerequisite(s): AS.020.151
Area: Natural Sciences

AS.020.153. General Biology Laboratory I. 1 Credit.
This course reinforces the topics covered in AS.020.151. Students participate in a semester-long project, identifying bacteria from Homewood campus soils using molecular biology techniques. Other laboratory exercises cover aspects of evolution, genomics and biochemistry. Cross-listed with Behavioral Biology. Student must have enrolled in AS.020.151 either this term or in past terms. Students who have credit for AP Biology but take General Biology Lab I will lose four credits of AP Biology credit. Cross-listed with Behavioral Biology.
Prerequisite(s): Students must have completed Lab Safety training prior to registering for this class. To access the tutorial, login to myLearning and enter 458083 in the Search box to locate the appropriate module.;AS.020.151
Area: Natural Sciences

Biomedical Engineering

EN.580.220. he Science of Medicine: Thinking Critically. 3 Credits.
This course investigates some of the most pressing issues in biomedical science with direction from leading clinicians, scientists, policy experts, and industry professionals. The underlying science and ethical implications for topics such as “Rogue Clinics and Designer Babies: How can I decide the genotype of my offspring – and should I,” “Mosquito-borne Diseases: Fighting an enemy that outnumbers us 15,000 to one with genetics,” and “HIV: Pushing for a cure versus settling for a treatment: What makes healthcare sufficient” are explored. The class is taught in a flipped method: students will be expected to listen to e-presentations at home so that class time can be devoted to problem solving activities, experimental design, debates, and discussion. The goal of this course is to teach students how to think critically and to expose students to the great unknowns that remain in science today.
Area: Natural Sciences

Biophysics

AS.250.351. Reproductive Physiology. 2 Credits.
Focuses on reproductive physiology and biochemical and molecular regulation of the female and male reproductive tracts. Topics include the hypothalamus and pituitary, peptide and steroid hormone action, epididymis and male accessory sex organs, female reproductive tract, menstrual cycle, ovulation and gamete transport, fertilization and fertility enhancement, sexually transmitted diseases, and male and female contraceptive methods. Introductory lectures on each topic followed by research-oriented lectures and readings from current literature.
Area: Natural Sciences

Biostatistics

PH.140.636. Computer Science for BioInformatics. 4 Credits.
Introduces the computational hardware and programming model upon which analysis tools and languages are based. Introduces and uses three main languages (Python, Perl, SQL) and their underlying rationale to develop computer science concepts such as data structures, algorithms, computational complexity, regular expressions, and knowledge representation. Draws examples and exercises from high-throughput sequence analysis, proteomics and modeling of biological systems. Reinforces key concepts through lectures with live computer demonstrations, weekly readings, and programming exercises. Has students working with a High Performance Compute Cluster and the Amazon cloud.
Course location and modality is found on the JHSPH website (https://www.jhsph.edu/courses/).

Chemistry

AS.030.623. Molecular Synthetic Biology.
Principles and methods for the design and optimization of new biological systems, from a molecular perspective. Topics include: introduction to genetic parts and modern methods for their assembly; synthesis and incorporation of nucleic acids at the level of nucleotides, genes, and genomes; design of genetic programs; library generation and screening; directed evolution and its application to create new proteins and metabolic pathways; computational design of protein and RNA?using physical and bioinformatic approaches; non-canonical amino acids and genetic code expansion. This course will also feature critical evaluation of the primary literature in this fast-paced field, and practical experience with relevant software and computational tools.

Computer Science

EN.601.448. Computational Genomics: Data Analysis. 3 Credits.
Genomic data has the potential to reveal causes of disease, novel drug targets, and relationships among genes and pathways in our cells. However, identifying meaningful patterns from high-dimensional genomic data has required development of new computational tools. This course will cover current approaches in computational analysis of genomic data with a focus on statistical methods and machine learning.Topics will include disease association, prediction tasks, clustering and dimensionality reduction, data integration, and network reconstruction. There will be some programming and a project component. [Applications]Prerequisites: EN.601.226 or other programming experience, probability and statistics, linear algebra or calculus.
Prerequisite(s): Students may receive credit for only one of EN.600.438, EN.600.638, EN.601.448, EN.601.648.
Area: Engineering

EN.601.748. Computational Genomics: Data Analysis. 3 Credits.
Graduate level version of EN.600.438. [Applications] Recommended Course Background: EN.600.226 or other programming experience, probability and statistics, linear algebra or calculus. Students may receive credit for EN.600.438 or EN.600.638 but not both.
Area: Engineering

EN.601.749. Computational Genomics: Applied Comparative Genomics. 3 Credits.
The goal of this course is to study the leading computational and quantitative approaches for comparing and analyzing genomes starting from raw sequencing data. The course will focus on human genomics and human medical applications, but the techniques will be broadly applicable across the tree of life. The topics will include genome assembly & comparative genomics, variant identification & analysis, gene expression & regulation, personal genome analysis, and cancer genomics. The grading will be based on assignments, a midterm & final exam, class presentations, and a significant class project. [Applications] Expected course background: familiarity with UNIX scripting and/or programming.

Extradepartmental Studies

PH.550.630. Public Health Biology. 3 Credits.
Course location and modality is found on the JHSPH website (https://www.jhsph.edu/courses/).

PH.550.631. Biological Basis of Public Health. 3 Credits.
Discusses molecular, biochemical, cellular and immunological methodology and approaches for the mechanistic understanding, treatment and prevention of human diseases, and for understanding disease susceptibility. The focus will be on the application of biological methods and approaches to such critical issues as infectious disease, cancer, neurodegenerative disease, COPD, environmental toxicant effects on early development, and reproductive anomalies and their treatment.
Course location and modality is found on the JHSPH website (https://www.jhsph.edu/courses/).

PH.550.855. Ma Public Health Biology Thesis. 5 - 6 Credits.
Provides an opportunity for students to, in consultation with a faculty mentor from the Dept of Biochem and Molecular Bio, Environmental Health or Molecular Microbiology and Immunology, prepare a critical, scholarly paper on an agreed upon subject area.
Course location and modality is found on the JHSPH website (https://www.jhsph.edu/courses/).

Interdepartmental

AS.360.339. Planets, Life and the Universe. 3 Credits.
This multidisciplinary course explores the origins of life, planet formation, Earth's evolution, extrasolar planets, habitable zones, life in extreme environments, the search for life in the Universe, space missions, and planetary protection. Recommended Course Background: Three upper level (300+) courses in sciences (Biophysics, Biology, Chemistry, Physics, Astronomy, Math, or Computer Science)
Prerequisite(s): Students may not register for this class if they have already received credit for AS.020.334 OR AS.020.616 OR AS.171.333 OR AS.171.699 OR AS 270.335 OR AS.360.671
Area: Natural Sciences

AS.360.671. Planets, Life and the Universe.
This multidisciplinary course explores the origins of life, planet formation, Earth's evolution, extrasolar planets, habitable zones, life in extreme environments, the search for life in the Universe, space missions, and planetary protection. Recommended Course Background: Three upper level courses in sciences and buy textbooks
Prerequisite(s): Students may not register for this class if they have already received credit for AS.020.616 OR AS.020.334 OR AS.171.333 OR AS.171.699 OR AS.270.335 OR AS.360.339.
Area: Natural Sciences

International Health

PH.223.686. Child and Public Health in the Tropics. 4 Credits.
Course location and modality is found on the JHSPH website (https://www.jhsph.edu/courses/).

PH.223.689. Biologic Basis of Vaccine Development. 3 Credits.
Course location and modality is found on the JHSPH website (https://www.jhsph.edu/courses/).

Molecular Microbiology and Immunology

PH.260.844. Causation. 3 Credits.
Acquaints students with fundamental ideas and historic theories about causation. Discusses how cause and effect relationships govern biomedical and public health research. Compares how sub-disciplines of the biomedical and public health sciences approach causation using concrete case examples. Addresses limitations of causal inference in biomedicine and public health. Examines strategies to mitigate the limitations of causal inference.
Course location and modality is found on the JHSPH website (https://www.jhsph.edu/courses/).

Neuroscience

AS.080.301. Behavioral Assessment of Animal Models of Cognition and Neuropsychiatric Disorders. 3 Credits.
What does a rat exploring it's environment tell us about memory? How can a mouse help us better understand schizophrenia? This course will focus on procedures that are routinely used to study behavior in animal models of cognition and neuropsychiatric disorders. Topics will include motor function, emotional and motivational states, disorders such as dementia and schizophrenia, among others. Throughout the course, we will read and discuss original research articles to illustrate and compare some of the measures and results from the various procedures.
Prerequisite(s): Students may not have taken AS.200.302;AS.200.141 OR (AS.080.305 and AS.080.306), OR by instructor permission.
Area: Social and Behavioral Sciences

AS.080.304. Neuroscience Learning and Memory. 3 Credits.
This course is an advanced survey of the scientific study of learning and memory. Different perspectives will be used to review the science of learning and memory including the cellular-molecular basis of synaptic plasticity, the functional circuitry involved in learning and memory and memory systems in the brain. The course is designed to provide a deep understanding of the issues and current debates in learning and memory research and focuses specifically on animal models of memory and memory impairment. This is an interactive lecture course with a strong emphasis on student participation.
Prerequisite(s): AS.200.141 OR (AS.080.305 AND AS.080.306) OR (AS.020.312 AND AS.020.306) or instructor permission.
Area: Natural Sciences

AS.080.305. Neuroscience: Cellular and Systems I. 3 Credits.
(Formerly Nervous Systems I) Neuroscience: Cellular and Systems I is a fully integrated, two-semester course that surveys the cellular and molecular biology of neurons as well as the structure and function of the nervous system. Students must register for Neuroscience: Cellular and Systems II offered in the second term. Course open to JHU undergraduates only.
Prerequisite(s): AS.080.203 OR AS.050.203 OR AS.200.141 OR AS.080.105 OR AS.050.105 or instructor permission.
Area: Natural Sciences

AS.080.308. Neuroeconomics. 3 Credits.
Every day decisions often require us to weigh the costs and benefits of engaging in a particular course of action in order to obtain some expected outcome. Unfortunately, we often lack the information necessary to obtain our desired goal with complete certainty. Economists have long been interested in understanding human decision-making under these circumstances. In parallel, neuroscientists have made great strides at describing the underlying neural basis of simple decision-making. However, despite much progress in both fields, our understanding of how the brain makes decisions is incomplete. In order to strengthen and further research in both fields, the interdisciplinary field of Neuroeconomics arose. This course will survey the field of Neuroeconomics focusing on theoretical concepts developed by economists and the role these theories are playing in guiding current experimental neuroscience.
Prerequisite(s): AS.080.306 OR AS.200.141 OR AS.020.312
Area: Natural Sciences

AS.080.328. Behavioral Neuroscience Lab. 3 Credits.
Class designed to give students first-hand knowledge of the behavioral procedures and techniques used to study behavior in the field of neuroscience. Students will gain hands-on experience by carrying out some of the behavioral tasks used to assess animals under specific behavioral domains, discuss why certain aspects (i.e. genotype, environment conditions, group size, etc.) are important factors to consider when designing, planning, and carrying out such experiments, and learn the relevance of behavioral research in translational medicine.
Prerequisite(s): AS.200.141 OR AS.200.302 OR AS.080.301 OR (AS.080.305 AND AS.080.306) or permission by instructor.
Area: Natural Sciences

AS.080.370. The Cerebellum: Is it just for motor control?. 3 Credits.
The cerebellum is traditionally thought to be involved in movement and motor control, and observations of patients with cerebellar damage do in fact show motor deficits. However, since the proliferation of functional MRI, cerebellar activations have been observed in a surprising number of brain activation studies that were designed to investigate the neural correlates of cognitive function. Over the past 2 decades, an increasing number of investigators have tried to characterize the role of the cerebellum in cognitive function. Through lectures and reading discussions this course will survey cerebellar circuitry, neuroimaging and neuromodulatory methods for investigating the cerebellum, and traditional and non-traditional functions of the cerebellum, including cerebellar involvement in cognitive functions such as language, working memory, and executive control.
Prerequisite(s): (AS.080.306 AND AS.080.203) OR AS.050.203
Area: Natural Sciences, Social and Behavioral Sciences

Psychological Brain Sciences

AS.200.141. Foundations of Brain, Behavior and Cognition. 3 Credits.
A survey of neuropsychology relating the organization of behavior to the integrative action of the nervous system. Cross-listed with Behavioral Biology and Neuroscience.
Area: Natural Sciences, Social and Behavioral Sciences

AS.200.208. Animal Behavior. 3 Credits.
Examines basic principles of animal behavior (orientation, migration, communication, reproduction, parent-offspring relations, ontogeny of behavior and social organization). Evolution and adaptive significance of behavior will be emphasized.
Prerequisite(s): AS.200.141 OR Permission of Instructor.
Area: Natural Sciences, Social and Behavioral Sciences

AS.200.334. Human Memory Psychology. 3 Credits.
This class will survey the behavioral and biological science of human memory. Historical perspectives as well as modern controversies will be discussed. Intersections with other fields such as law, education, medicine, and technology will be highlighted. The course will be a mixture of lectures and group discussions.
Area: Social and Behavioral Sciences

AS.200.344. Behavioral Endocrinology. 3 Credits.
An examination of the effects of hormones on behavior in non-human and human animals. Topics will include the effects of hormones on sexual differentiation, reproductive behavior, parental behavior, homeostasis and biological rhythms, regulation of body weight, learning and memory. Cross-listed with Behavioral Biology and Neuroscience.
Prerequisite(s): (AS.200.141 OR AS.080.306) OR (AS.020.151 AND AS.020.152) or instructor's permission
Area: Natural Sciences, Social and Behavioral Sciences

AS.200.370. Functional Human Neuroanatomy. 3 Credits.
This course examines the general organizing principles of the anatomy of the human central nervous system and how this anatomical organization relates to function, from the level of neural circuits, to systems, to behavior. Students will learn to identify neuroanatomical structures and pathways in dissections and MRI images through computerized exercises. Readings and lectures will emphasize general structure-function relationships and an understanding of the functional roles of particular structures in sensory, motor, and cognitive systems.
Prerequisite(s): AS.080.305 AND AS.080.306 or Instructor Permission
Area: Natural Sciences, Social and Behavioral Sciences

AS.200.376. Neuropsychopharmacology. 3 Credits.
Designed to provide information about how drugs affect the brain and behavior. The course focuses on biological concepts underlying structures and functions of the brain that relate to mental disorders. An introduction to neurobiology and brain function is presented as it applies to the interaction of various classes of drugs with the individual neurotransmitter systems in the brain. A brief historic review is followed by a discussion of clinical relevance. Cross-listed with Behavioral Biology and Neuroscience. Enrollment limited to juniors and seniors.
Prerequisite(s): (AS.080.305 AND AS.080.306) OR AS.020.306 AND AS.020.312) OR (AS.200.141 AND AS.020.306)
Area: Natural Sciences, Social and Behavioral Sciences

AS.200.386. Animal Cognition. 3 Credits.
Examine relations between brain, mind, and behavior in nonhuman animals, focusing on topics such as learning, memory, attention, decision-making, navigation, communication, and awareness. We will take a variety of approaches, including behavioral, computational, evolutionary, neurobiological, and psychological perspectives.
Prerequisite(s): AS.200.141 OR AS.200.208 OR AS.290.101 or Instructor permission.
Area: Social and Behavioral Sciences

For current faculty and contact information go to http://www.bio.jhu.edu/Directory/TenuredPlusTenureTrack.aspx