AS.020 (BIOLOGY)

Courses

AS.020.108. Population Genomics: Evolution, Extinction & Disease. 1 Credit.
Population genomics is the study of the structure, function, and variability of the entire genetic complement of organisms considered on a population scale. By examining how gene variants change in structure and frequency in populations over time, we can study the process of evolution and how it contributes to biodiversity and the formation of new species; this information can be used to increase the efficacy of conservation efforts. By studying gene variants underlying diseases at the scale of populations, we can better diagnose complex polygenic diseases like cancer. This course introduces the fundamentals of population genomics and provides an overview of the subfields of evolutionary genomics, conservation genomics, and medical genomics. This course is offered in summer terms only.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

AS.020.120. Introduction to Laboratory Research. 1 Credit.
In this program, you will be introduced 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, you will visit a variety of biological laboratories to observe actual research projects.Recommended Course Background in Chemistry and Biology is strongly recommended. This course is offered in summer terms only.
Distribution Area: Natural Sciences

AS.020.126. Microbial Mysteries: Genomics from Ground to Gut. 3 Credits.
Microorganisms surround us, from the microbes in our soil to the bacteria in our digestive systems. This Course-based Undergraduate Research Experience will introduce computational tools to analyze metagenomic datasets and provide students the opportunity to pursue independent projects. This course is open to all students, regardless of major. no prior computational experience necessary.
AS Foundational Abilities: Science and Data (FA2)

AS.020.132. Medical School Intensive. 1 Credit.
Learn the basic knowledge and techniques related to surgery, internal medicine, pediatrics, emergency medicine, and biomedical science by participating in interactive lectures and labs. You and your fellow high-school students will explore new aspects of this critical field at one of the nation's leading institutions as you are taught and guided by experts in the field of medicine. This course is offered in summer terms only.
AS Foundational Abilities: Science and Data (FA2)

AS.020.134. Introduction to Surgery. 1 Credit.
Students will be introduced to the fundamentals of a surgical practice. Students will also acquire skills used in the assessment and treatment of surgical conditions.This course is offered in summer terms only.
AS Foundational Abilities: Science and Data (FA2)

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 course is offered in fall and summer terms only.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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. This course is offered in spring and summer terms only.
Prerequisite(s): AS.020.151
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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. This course is offered in fall terms 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 Laboratory Safety Introductory Course in the Search Box to access the proper course. Click here to access the Laboratory Safety Introductory Course (https://johnshopkins.csod.com/ui/lms-learning-details/app/curriculum/66847e20-c695-4e54-a6be-8c94465b8a70/);AS.020.151 can be taken prior to or at the same time as AS.020.153.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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. This course is offered in spring terms only.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 ASEN in the Search Box to access the proper course. Click here to access the Laboratory Safety Introductory Course (https://johnshopkins.csod.com/ui/lms-learning-details/app/curriculum/66847e20-c695-4e54-a6be-8c94465b8a70/)
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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. This course is offered in fall terms only.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Citizens and Society (FA4)

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. This course is offered in spring terms only.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Citizens and Society (FA4)

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. This course is offered in spring and summer terms only.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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. This course does not fulfill the elective requirement for biology or molecular and cellular biology majors. This course is offered in fall terms only.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Ethics and Foundations (FA5)

AS.020.305. Biochemistry. 3 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. This course is offered in fall, spring and summer terms only.
Prerequisite(s): AS.030.205 OR AS.030.212 OR EN.540.202, may be taken concurrently.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

AS.020.306. Cell Biology. 3 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. This course is offered in spring terms only.
Prerequisite(s): Cell Biology restriction: students who have completed EN.540.307 may not enroll..
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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. This course is offered in spring terms only.
Prerequisite(s): AS.020.306 OR EN.540.307
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

AS.020.314. The Biology of Disease. 3 Credits.
Explore the current understanding of the biology of diseases in this upper-level elective! Each week, a new faculty member will present one class in a lecture style, followed by one class in an interactive discussion style. The faculty member will describe a disease and the fundamental biology relating to that disease and discuss the current state of the field, how their research influenced understanding of the disease, and progress towards treatments. The topics will build upon the basic concepts covered in genetics, cell biology, and molecular biology, and introduce topics related to biochemistry and developmental biology. The class will discuss a wide range of diseases including vision disorders, neurodegenerative diseases, and cancer. Class assessment will be based on homework involving asking questions about the seminar, writing brief summaries of seminars and discussions, and a final project related to topics and techniques from the semester. Open to juniors and seniors. This course is offered in fall terms only.
Prerequisite(s): AS.020.303 AND AS.020.306
Distribution Area: Natural Sciences
AS Foundational Abilities: Writing and Communication (FA1), Science and Data (FA2)

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.This course is offered in fall and spring terms 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 Laboratory Safety Introductory Course in the Search Box to access the proper course. Click here to access the Laboratory Safety Introductory Course (https://johnshopkins.csod.com/ui/lms-learning-details/app/curriculum/66847e20-c695-4e54-a6be-8c94465b8a70/);AS.020.305 OR AS.250.307 OR AS.250.315. These may be taken concurrently.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

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. This course is offered in fall and spring terms 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 Laboratory Safety Introductory Course in the Search Box to access the proper course. Click here to access the Laboratory Safety Introductory Course (https://johnshopkins.csod.com/ui/lms-learning-details/app/curriculum/66847e20-c695-4e54-a6be-8c94465b8a70/);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.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

AS.020.317. Great Experiments in Biology. 3 Credits.
In this course, we discuss classic experiments in the history of biology and compare them to modern studies. Each week, students will present two papers, a classic paper selected by the instructors and a modern paper selected by the students. Grading will be based on student presentations, short student summaries of papers, and class participation.
AS Foundational Abilities: Science and Data (FA2)

AS.020.319. Human Genome Variation. 3 Credits.
Human Genome Variate (HGV) exposes students to the power of genomics for understanding human evolutionary history, biological traits, and medical conditions. HGV incorporates basic population genetics, direct-to-consumer DNA tests, and emerging research on human populations and their ancestors. Social and ethical issues related to the use of genetic information are also discussed. This course is offered in spring terms only.
Prerequisite(s): AS.020.303
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Ethics and Foundations (FA5)

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. This course is offered in spring terms only.
Prerequisite(s): AS.020.306
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

AS.020.321. Human Genome Variation Computational Lab. 1 Credit.
This option combines the main course and computational lab components of HGV. HGV exposes students to the power of genomic studies for understanding human evolutionary history, biological traits, and genetic conditions. HGV incorporates basic population genetics, direct-to-consumer DNA tests, and emerging research on human populations and their ancestors. What does real human genomic data look like? How are these data analyzed in practice? Supplementing the main course, the computational lab component will explore public datasets and bioinformatic 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. This course is offered in spring terms only.
Prerequisite(s): AS.020.319, students may enroll concurrently.;AS.020.303
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

AS.020.325. Scientific Research Process and Practice. 3 Credits.
This course is an introduction to doing great research and is designed to prepare students for successful independent research in biology. Students will learn how to find, read, and understand scientific papers, develop scientific questions, and effectively communicate their knowledge and the significance of their research in the format of a written proposal. Students will complete a short project on protein structure/interactions using computational methods to provide preliminary data for the written proposal. This course is taught by multiple co-instructors.
Prerequisite(s): AS.020.304 and AS.020.305
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

AS.020.326. RNA Biology during Development. 3 Credits.
The development of all animals relies on the precise migration of cells to their correct locations within the developing body. Among these crucial cell types are germ cells, which ultimately give rise to sperm and oocytes. The migration of these cells is orchestrated by proteins that facilitate cell communication and provide guidance during their journey.In this course, we will delve into the role of mRNA localization in facilitating germ cell migration. Specifically, we will identify mRNAs that code for proteins essential for cell-to-cell communication and cell migration.Through a combination of theoretical learning and hands-on laboratory experiences, students will gain insight into the mechanisms underlying germ cell development. Experimental investigations will allow us to test hypotheses generated during class discussions. At the culmination of the course, students will present their experimental findings in the form of a poster, providing an opportunity to showcase their understanding and contributions to the field.
Prerequisite(s): AS.020.303 AND AS.020.304 AND AS.020.306
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

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 This course is offered in spring and some fall terms only.
Prerequisite(s): AS.020.306
Distribution Area: Natural Sciences
AS Foundational Abilities: Writing and Communication (FA1), Science and Data (FA2)
Writing Intensive

AS.020.331. Human Genetics. 3 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. This course is offered in fall terms only
Prerequisite(s): AS.020.303
Distribution Area: Natural Sciences, Social and Behavioral Sciences
AS Foundational Abilities: Science and Data (FA2), Ethics and Foundations (FA5)

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. This course is offered in spring terms only.
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.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Ethics and Foundations (FA5)

AS.020.340. Developmental Genetics Lab. 3 Credits.
CRISPR (clustered regularly-interspaced short palindromic repeat) is one of the greatest advances in biology in the past decade, providing researchers with the tools to precisely and affordably edit genomes and physicians a new tool to cure disease. However, the ability to edit plant and animal genomes, including human genomes, comes with significant ethical considerations. This course will utilize a hybrid classroom-laboratory approach to provide students with both a comprehensive knowledge of the CRISPR system and a deeper understanding of how gene function is studied. At the end of the semester, you will not only understand how CRISPR works, but also have a better understanding of the power of genetics to illuminate molecular mechanisms of protein function. This course is offered in fall, spring and some summer terms 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 Laboratory Safety Introductory Course in the Search Box to access the proper course. Click here to access the Laboratory Safety Introductory Course (https://johnshopkins.csod.com/ui/lms-learning-details/app/curriculum/66847e20-c695-4e54-a6be-8c94465b8a70/);AS.020.303 can be taken prior to or during enrollment in AS.020.340.
AS Foundational Abilities: Science and Data (FA2)

AS.020.347. AIDS. 3 Credits.
AIDS is the world's deadliest infectious disease. This fast-paced survey course provides an in-depth treatment of topics of relevance to AIDS. We 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. The changing social implications of chronic HIV infection are discussed throughout the semester. Recommended Course Background: AS.020.304, AS.020.305 and AS.020.306. This course is offered in spring terms only.
Prerequisite(s): AS.020.305 and AS.020.306
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Citizens and Society (FA4)
EN Foundational Abilities: Engagement with Society (FA4)

AS.020.350. Introduction to Clinical Medicine. 2 Credits.
Perm. Req'd. Post-Bac Students Only. This course is offered in fall terms only.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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. This course is offered in fall terms only.
Prerequisite(s): Cell Biology 020.306 or permission of instructor
Distribution Area: Natural Sciences
AS Foundational Abilities: Writing and Communication (FA1), Science and Data (FA2)
Writing Intensive

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. This course is offered in spring terms only.
Prerequisite(s): AS.020.306 AND (AS.020.330 OR AS.020.303)
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

AS.020.364. Molecular and Cellular Mechanisms of Reproduction. 2 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. This course is offered in some fall and some spring terms only.
Prerequisite(s): AS.020.306
Distribution Area: Natural Sciences
AS Foundational Abilities: Writing and Communication (FA1), Science and Data (FA2)
Writing Intensive

AS.020.369. Population Genetics Modeling. 3 Credits.
The size, composition, and genetics of populations fluctuate over time. These fluctuations are the product of dynamics between individuals, the interactions between populations, and the context of a population within a broader ecological landscape. The quantitative tools developed to study population genetics allow biologists to discover the simple fundamental principles that govern these complex systems. This course will introduce the basic theory of population genetics while teaching students the fundamental skills of programming in the R programming language, which will allow them to directly implement and visualize theoretical concepts. Students will model and simulate theoretical populations and analyze population-scale genomic data. This course will examine evolution on a variety of scales, ranging from the competition between cells within a single organism, to population dynamics in conservation biology that span decades, to the evolution of contemporary human populations over hundreds of thousands of years.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

AS.020.374. Comparative 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. This course is offered in fall and spring terms only.
Prerequisite(s): AS.020.305
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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. This course is offered in spring terms 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 ASEN in the Search Box to access the proper course. Click here to access the Laboratory Safety Introductory Course (https://johnshopkins.csod.com/ui/lms-learning-details/app/curriculum/66847e20-c695-4e54-a6be-8c94465b8a70/);AS.020.374, students may enroll concurrently.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

AS.020.383. Genetic Analysis. 3 Credits.
With the advent of whole-genome sequencing, many students wonder whether genetics is "solved" because we can "find the gene" for any human trait. In this course, we will build from the first principles of genetics up to human genetics in families and populations. Our goal will be to show that genetics and genetic thinking are critical to understanding human disease and a quickly growing area of modern biology. We will cover Mendelian transmission genetics to quantitative genetics using model organisms throughout to best show proofs of principle. The course will have weekly lectures, problem-solving sessions, two midterms, and a final.
Prerequisite(s): AS.020.303
AS Foundational Abilities: Science and Data (FA2)

AS.020.385. Epigenetics. 3 Credits.
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.
Prerequisite(s): AS.020.303 OR AS.020.305 OR AS.020.306
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)
Writing Intensive

AS.020.410. Teaching and Learning in Biology. 1 Credit.
This course is by instructor permission only and exclusively for students who are invited and accepted to be learning assistants for other Biology courses. The course will focus on discussing education and application of current best teaching practices to Biology classes.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2), Citizens and Society (FA4)

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
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

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, create study materials for students, 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.
Distribution Area: Natural Sciences
AS Foundational Abilities: Science and Data (FA2)

AS.020.503. Independent Research in Biology. 1 - 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 Customized Academic Learning using the Customized Academic Learning form found in Student Self-Service: Registration > Online Forms.
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

AS.020.505. Internship - Biology. 1 Credit.
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 Customized Academic Learning using the Customized Academic Learning form found in Student Self-Service: Registration > Online Forms.
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

AS.020.506. Internship - Biology. 1 Credit.
For students undertaking internships that focus on biology fields or topics. Students wishing to enroll in this course must consult with the director of undergraduate studies or their major advisor before submitting an Independent Study Request in SIS.
Prerequisite(s): You must request Customized Academic Learning using the Customized Academic Learning form found in Student Self-Service: Registration > Online Forms.
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

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 Customized Academic Learning using the Customized Academic Learning form found in Student Self-Service: Registration > Online Forms.
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

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 Customized Academic Learning using the Customized Academic Learning form found in Student Self-Service: Registration > Online Forms.
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

AS.020.553. Mentored Research. 9 Credits.
BA/MS candidates only.
Prerequisite(s): You must request Customized Academic Learning using the Customized Academic Learning form found in Student Self-Service: Registration > Online Forms.
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

AS.020.597. Research. 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 Customized Academic Learning using the Customized Academic Learning form found in Student Self-Service: Registration > Online Forms.
AS Foundational Abilities: Science and Data (FA2), Projects and Methods (FA6)

AS.020.601. Current Research in Bioscience. 1 Credit.
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.020.602. 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.
Distribution Area: Natural Sciences

AS.020.603. 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.
Distribution Area: Natural Sciences

AS.020.605. Computational Simulation and Analysis of Protein Stability and Interactions. 2 Credits.
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.
Distribution Area: Natural Sciences

AS.020.607. Quantitative Biology Bootcamp. 3 Credits.
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.

AS.020.608. Graduate Course in Optical Microscopy. 3 Credits.
An introduction to optical microscopy from basic principles to advanced techniques. The course will involve both lectures and practical experience on a number optical microscopes available within the IIC, other core facilities and labs in the university.
Distribution Area: Natural Sciences

AS.020.609. Managing the Medical School Portfolio I. 2 Credits.
Post-Bac Students Only. This is the first semester of a year-long course that leads students through a series of topics and exercises designed to understand medical school expectations, develop a strategic plan, cultivate relevant skills/characteristics, and ultimately prepare a successful journey to medical school.

AS.020.610. Managing the Medical School Portfolio II. 3 Credits.
This is an upper-level course focused upon the cellular and molecular mechanisms underlying nervous system development. Topics include the specification of neural tissues, genesis and differentiation of individual neurons, extension of axons and axon guidance, formation of synaptic connections, maturation of neuronal circuits, and plasticity of neuronal circuits in the adult nervous system. The format of the course will be a mix of lectures and discussions of papers. Reading will include selected articles from the recent literature.Cross-listed with Neuroscience

AS.020.612. 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 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.020.615. Great Experiments in Biology. 3 Credits.
In this course, we discuss classic experiments in the history of biology and compare them to modern studies. Each week, students will present two papers, a classic paper selected by the instructors and a modern paper selected by the students. Grading will be based on student presentations, short student summaries of papers, and class participation.
Writing Intensive

AS.020.617. Quantitative Biology Lab 1. 3 Credits.
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 Laboratory Safety Introductory Course in the Search Box to access the proper course. Click here to access the Laboratory Safety Introductory Course (https://johnshopkins.csod.com/ui/lms-learning-details/app/curriculum/66847e20-c695-4e54-a6be-8c94465b8a70/)

AS.020.618. Quantitative Biology Lab II. 3 Credits.
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 ASEN in the Search Box to access the proper course. Click here to access the Laboratory Safety Introductory Course (https://johnshopkins.csod.com/ui/lms-learning-details/app/curriculum/66847e20-c695-4e54-a6be-8c94465b8a70/)

AS.020.619. Thesis Proposal Preparation. 1 Credit.
This is an elective course for 2nd year PhD students in the CMDB program only. The goal of the course is to help students prepare written thesis proposals. Students will also gain practical experience in peer review, with additional lectures on using their proposals to prepare applications for the NIH National Research Service Award (F31). Because of the considerable time commitment required, students may not enroll in the course without explicit approval from their thesis advisors.
Writing Intensive

AS.020.629. Microbiology. 3 Credits.
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. 3 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.
Distribution Area: Natural Sciences, Social and Behavioral Sciences

AS.020.637. Genomes & Development. 3 Credits.
This course covers gametogenesis, embryogenesis, post-embryonic development, genetic analysis, developmental genetics, model developmental systems, and cell determination. Biology PhD students only.

AS.020.643. Graduate 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, and SARS-CoV-2.

AS.020.662. 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.
Distribution Area: Natural Sciences

AS.020.668. Advanced Genetics and Molecular Biology. 3 Credits.
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. 4 Credits.
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.020.683. Genetic Analysis. 3 Credits.
With the advent of whole-genome sequencing, many students wonder whether genetics is “solved” because we can “find the gene” for any human trait. In this course, we will build from the first principles of genetics up to human genetics in families and populations. Our goal will be to show that genetics and genetic thinking are critical to understanding human disease and a quickly growing area of modern biology. We will cover Mendelian transmission genetics to quantitative genetics using model organisms throughout to best show proofs of principle. The course will have weekly lectures, problem-solving sessions, two midterms, and a final.

AS.020.686. Advanced Cell Biology. 3 Credits.
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.020.688. PhD Excels. 2 Credits.
This course provides foundational and multi-tiered training in career strategy and professional development. Through synchronous and asynchronous classes, students will learn to assess and develop the skills needed to transition into a career and align them to their strengths, values and interests. By engaging in small group discussions, experiential learning activities and networking with alumni experts, students will enhance self-knowledge and confidence to explore wider career opportunities.

AS.020.689. PhD Excels II. 2 Credits.
This is the second course in a two-part series that provides foundational and multi-tiered training in career strategy and professional development. Through synchronous and asynchronous classes, students will learn to assess and develop the skills needed to transition into a career and align them to their strengths, values and interests. By engaging in small group discussions, experiential learning activities and networking with alumni experts, students will enhance self-knowledge and confidence to explore wider career opportunities. This course provides in-depth understanding of specific career paths based on the career exploration covered in 020.688. Biology 3rd year and above students only.
Prerequisite(s): AS.020.688

AS.020.699. CMDB Responsible Conduct in Research. 1 Credit.
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.020.801. Research – Biological Problems. 10 - 20 Credits.
Independent research for the Ph.D. dissertation. Biology Ph.D. students only

AS.020.802. Research-Biological Problems. 9 - 20 Credits.
Independent research. Biology Graduate students only.

AS.020.803. Summer Graduate Research. 9 Credits.
Summer independent research for CMDB graduate students only.

AS.020.804. Teaching Practicum. 3 Credits.
PhD students will gain valuable teaching experience, working closely with their assigned faculty supervisor. Successful completion of this course counts towards the PhD teaching requirement. (2nd year grad students & 1st year GPP students) Permission required.

AS.020.805. Teaching Practicum - Masters. 3 Credits.
Masters students will gain valuable teaching experience, working closely with their assigned faculty supervisor. Successful completion of this course counts towards the MS teaching requirement. Students in the Biology BS/MS program only. Permission required.

AS.020.806. Teaching Practicum - Masters II. 3 Credits.
Masters students will gain valuable teaching experience, working closely with their assigned faculty supervisor. Successful completion of this course counts towards the MS teaching requirement. Students in the Biology BS/MS program only. Permission required.

AS.020.823. Introduction to Biology Research. 5 Credits.
Rotation 1 of 4. The laboratory rotation system has been designed to expose students to a variety of research projects, techniques and research approaches. Rotations are an opportunity to preview a potential thesis research laboratory and to be exposed to diverse fields of research. During the first year, students are required to do rotations in at least four different laboratories; this is accomplished through two rotation periods in the Fall Semester and two rotation periods in the Spring Semester. First year Biology Graduate Students only

AS.020.824. Introduction to Biology Research. 5 Credits.
Rotation 2 of 4. The laboratory rotation system has been designed to expose students to a variety of research projects, techniques and research approaches. Rotations are an opportunity to preview a potential thesis research laboratory and to be exposed to diverse fields of research. During the first year, students are required to do rotations in at least four different laboratories; this is accomplished through two rotation periods in the Fall Semester and two rotation periods in the Spring Semester. First year Biology Graduate Students only

AS.020.825. Introduction to Research. 1 - 5 Credits.
Rotation 3 of 4. The laboratory rotation system has been designed to expose students to a variety of research projects, techniques and research approaches. Rotations are an opportunity to preview a potential thesis research laboratory and to be exposed to diverse fields of research. During the first year, students are required to do rotations in at least four different laboratories; this is accomplished through two rotation periods in the Fall Semester and two rotation periods in the Spring Semester.

AS.020.826. Introduction to Biology Research. 1 - 5 Credits.
Rotation 4 of 4. The laboratory rotation system has been designed to expose students to a variety of research projects, techniques and research approaches. Rotations are an opportunity to preview a potential thesis research laboratory and to be exposed to diverse fields of research. During the first year, students are required to do rotations in at least four different laboratories; this is accomplished through two rotation periods in the Fall Semester and two rotation periods in the Spring Semester. First year Biology Graduate Students only