Washington University in St. Louis

Biology

Biology is an exciting, diverse field that ranges from the molecular biology of individual cells to interactions among entire populations of organisms. Members of the biology faculty are recognized internationally for their research, and they bring a variety of strengths and teaching styles into the classroom. The major program in biology provides a thorough education in the history of scientific discovery in biology, the logical and statistical procedures used to formulate and test biological hypotheses, and the technical skills needed to conduct contemporary biological research.

The biology major program emphasizes the hierarchical nature of biological complexity and the major structures and functions that emerge at the molecular, cellular, organismal, populational and ecosystem levels. Each student masters at least one dimension of contemporary research in sufficient detail to describe the major hypotheses currently being tested and to demonstrate techniques used to test those hypotheses. Mastery of this material is evident in a student's ability to critique published data, to identify ambiguities and uncertainties in the conclusions drawn from those data, and to evaluate the societal importance of the research. Biology majors are prepared to make creative contributions to biology.

The biology major program provides a wide range of research opportunities. Because more than 400 faculty members conduct research in biology and biomedical sciences at Washington University, it is easy to find a project that suits a student's main interests. Many students complete their research projects at the Washington University School of Medicine, one of the top-ranked medical schools in the country. Summer research fellowship programs are available, funded by sources including the Howard Hughes Medical Institute, the Children's Discovery Institute, the National Science Foundation, and the Washington University Office of Undergraduate Research. Detailed information about finding a research mentor is available online.

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Professor of Biology; Dean's Distinguished Professorial Scholar
PhD, The Ohio State University

Professors Emeriti

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PhD, Tokyo Metropolitan University

Alan R. Templeton
PhD, University of Michigan

Robert E. Thach
PhD, Harvard University

Majors

- Biology Major
- Biology Major, Ecology and Evolution Specialization
- Biology Major, Genomics and Computational Biology Specialization
- Biology Major, Microbiology Specialization
- Biology Major, Molecular Biology and Biochemistry Specialization
- Biology Major, Neuroscience Specialization
- Environmental Biology Major

Minors

- Bioinformatics Minor
- Biology Minor

Courses

BIOL 1000 An Introduction to Biology
A one-semester introduction to the principles of biology, designed for students with little or no formal background in the biological sciences. Focus on basic principles of cell biology, genetics, evolution, and ecology. Current public concerns such as AIDS, cancer, and genetic engineering considered in light of these principles. Not intended for students expecting to major in biology or planning to enter health fields. A student may not receive credit for both Bio 100A and 303A.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall, Spring, Summer

BIOL 1010 Principles of Zoology
Introduction to the major principles of zoology with examples drawn from the diversity of the animal kingdom. Topics include principles of Darwinian evolution, systematics, cellular organization, chromosomal theory of inheritance, and molecular genetics. This course is open to students in the Freshman Summer Academic Program only.
Credit 3 units. A&S IQ: NSM
Typical periods offered: Summer

BIOL 1020 Biology of the Brain
Course Has moved to L41 120 This course is for students who wish to learn about the biology of the nervous system, and the scientific process of understanding how it works. Biology of the Brain will include lecture, discussion, and analysis of cutting edge research, so active participation will be important. We will discuss the gross anatomy and cellular composition of the brain. We will analyze how the brain develops, changes with experience to create memories, and recovers from injury. Along the way, we will discuss nervous system dysfunction a range of contexts such as Addiction, Alzheimer's disease, and Parkinson's disease. This course counts as a Natural Science and Mathematics (NSM) distribution requirement.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Summer

BIOL 1103 Topics in Biology: Cancer
Credit 3 units. A&S IQ: NSM
Typical periods offered: Summer

BIOL 1112 First-Year Seminar: Introduction to Problem-Based Learning in Biology
In this course, students take responsibility for their own active, inquiry-based learning on biological problems. Instructors will guide small groups of 8-10 students in researching issues of biological importance using primary literature as their principal resource. Learning to read and interpret research articles from scientific literature is emphasized. Topics covered in this class have included: neurological disorders, infectious diseases, CRISPR, cancer, and stem cell therapy among others. Students should have a strong background in general biology.

They will be challenged to use critical and creative thinking in both independent and group work. Enrollment limited. Intended for but not limited to prospective biology majors. Prerequisite: high school biology, preferably an Honors or AP class. Course is for first-year, non-transfer students only.

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

Typical periods offered: Fall, Summer

BIOL 1122 First Year Seminar: Introduction to Critical Thinking

Official description: This course is for first-year, non-transfer students only. This course uses thought-provoking questions in biology to develop analytical skills, at the same time understanding what level of content is needed to address such questions. Each class will involve discussion of the questions as well as lecture material as background. It will thus provide an early exposure and springboard into the translation of biology content to problem-solving. The skills learned will be applicable to future challenges The course focuses on molecular biology and processes central to all organisms on earth. The last component of the course will focus on microbiological research, gaining knowledge of the research enterprise to generate new knowledge and the primary literature (published manuscripts). Prerequisite: Limited to 10 students. Freshman with an interest in biology career (e.g. graduate or health professions). The course is also designed to help students prepare for Biology 2960, which is offered each spring semester. Intended for students without strong AP Biology preparation, which is helpful for success in Biology 2960. Credit 3 units.

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

Typical periods offered: Fall

BIOL 1123 Special Topics in Biology: Plant-Microbe Interactions

This is a research-based laboratory course offered by Dr. Barbara Kunkel in the Biology Department. The small class size and laboratory setting of the course is intended to foster development of student-professor mentoring relationships. Time commitment (weekly): 2 hours in lab, 1 hour of discussion (1 unit, P/F). Class size: 4 students Prerequisite: Permission of Instructor Research Question. Microbial organisms play very important roles in the lives of plants and animals. For example, in nature as well as in agricultural settings, the communities of microorganisms that grow near or on plants influence the growth and overall health of these plants. These plant-associated microbial communities are highly complex, and are comprised of thousands of different species, including bacteria and fungi. However, neither the role of individual microbial species within the larger microbial community, nor how such a community is beneficial to plants, is well understood. Each year the students in Bio1771 explore a different topic related to interactions between plants and their associated microbes. During the 2020/2021 academic year our research will focus on virulence mechanisms used by the plant pathogen Pseudomonas syringae to promote disease in plants. Recent research in the Kunkel lab has revealed that the plant hormone auxin promotes disease development in interactions between P. syringae strain PtoDC3000 and one of its host, Arabidopsis thaliana, a weedy plant in the mustard family. Auxin acts through at least two different mechanisms to promote disease, including 1) suppressing defense responses in the plant and 2) regulating gene expression in the pathogen. We will investigate this second activity by screening for and characterizing PtoDC3000 mutants that do not properly respond to auxin. Students will spend two hours per week in lab carrying out bacteriological and molecular biology experiments. Over the course of the semester, students will be exposed to a variety of fundamental topics in biology, including: bacteriology, plant growth and development, pathogenic plant-microbe interactions, and key concepts in genetics, molecular biology and biochemistry. The students will also meet with Dr. Kunkel for one hour per week to discuss a variety of topics chosen to explore: i) basic concepts in chemistry, biochemistry and molecular biology, ii) learning and study strategies, and iii) other topics related to thriving at WUSTL.

Credit 1 unit.

Typical periods offered: Spring

BIOL 1171 First-Year Opportunity: Neuroscience Futures 1: How Do We Learn About the Brain?

In this seminar course for first-year students, students learn about how neurobiologists conduct and communicate research. We focus our discussion on primary research papers written by neurobiologists. Discussion then focuses on the formulation of scientific questions, evaluation of evidence, and interpreting data within the context of a broader field. Course is for first-year, non-transfer students only. Must be taken Credit/No Credit.

Credit 1 unit. A&S IQ: NSM Art: NSM

Typical periods offered: Fall, Spring

BIOL 1210 Ampersand: The Science of Biotechnology

Biotechnology is truly interdisciplinary, incorporating a myriad of pieces from biology, chemistry, engineering, physics, computer sciences, management, public policy, and law that apply the scientific process to societal challenges. This course introduces topics for science and engineering majors with an interest in biotech, and it teaches scientific concepts to business students considering careers in biotech management and entrepreneurship. Students whoi complete Biol 2010 understand key science concepts, how discoveries lead to applications addressing global challenges, how to effectively use a variety of resources to explore connections between science and biotech business, how to synthesize information from different fields, and how to exhibit strong teamwork skills and communicate information in written and oral forms. This course also provides a gateway for students interested in the two-year Biotech Explorers Program (BEP). The first two weeks of the course introduce students to the history of biotechnology, the BEP, and the use of case studies. The remainder of the course uses a series of four three-week units that combine lecture material, in-class group assignments, and readings to introduce the science and scope of biotechnology. For each unit, student teams also develop short case studies of St. Louis biotech companies and present their findings to the class. A series of site visits introduce students to the vibrant St. Louis biotech community. This course is for students in the Biotech Explorers Program only.

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

Typical periods offered: Fall

BIOL 1211 Ampersand: Biotechnology Entrepreneurs Seminar

Although the biotech industry is science-based, the risks of product and technology development, legal issues, and market pressures make the landscape full of uncertainty. Lectures and textbooks fall short of delivering true insight about the process and challenges of bringing ideas to real-world products. This second semester freshman seminar course is designed to develop an appreciation of how biotech companies achieve their goals by engaging students through interactions with experienced executives and entrepreneurs, whose shared knowledge and stories add depth and context to the learning process. This 1 credit seminar course introduces students to the basics of innovation and entrepreneurship as a framework for marketable discoveries, builds an appreciation of how biotech companies start, obtain funding, and navigate intellectual property, provides an overview of career options in biotech, and insight on the hiring process. Pre-requiste: Students need to have completed Bio2010: The Science of Biotechnology for enrollment in this course and be currently enrolled in Bio2960: Principles of Biology I. Limited to 20 students.

Credit 1 unit.

Typical periods offered: Spring

BIOL 1212 uSTAR Seminar
This seminar course is designed for students who are part of the uSTAR Program at Washington University. The course will provide a formal setting to guide this population into becoming successful researchers in the academic community, with an additional goal of increasing their PhD pursuits. Students in the course will be exposed to scholarly discussions through student-selected journal readings. The course will discuss the different approaches taken to scientific inquiry and the dissemination of knowledge, in addition to the topic of integrity in research and important ethical issues that impact scientific investigation. Students will be exposed to topics relating not only to their area of study but to that of their peers as well. Student presentations on both scholarly journal readings and their own research will enable them to develop the ability to effectively communicate research to a broad audience. From this course, the uSTAR students will develop the skills to read, understand and critically evaluate publications, and they will build a broad understanding of research in multiple fields within the natural sciences. Students will also come away with a greater understanding of the ethical issues that face the scientific community on a daily basis.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 1213 Research Seminar for Vagelos Fellows
The course will orient Fellows to the specific research environment of their labs and provide them tools to succeed. It will feature short seminars from world-renowned DBBS faculty and DBBS alums. Speakers will emphasize both their science and their career route into academic research, including challenges. This will expose students to multiple paths into and academic careers associated with biosciences graduate training. Diverse speakers will emphasize the desirability and attainability of research training and careers. This course will also include information on the research enterprise, mentorship expectations, rigorous experimental design, quantitative thinking, techniques, rigorous analysis, posing a scientific question, and communication skills. 2.0 units
Credit 2 units. A&S IQ: NSM
Typical periods offered: Spring

BIOL 1260 First-Year Seminar: The Secret Lives of Plants
This course is designed to familiarize undergraduate students with the fascinating lives of plants, their evolution, their remarkable structural and morphological diversity, how they grow, and how they have been modified to feed the planet. Topics include: how plants can survive with just water, minerals and light, how they transport water astonishing distances, their unusual sex lives, why they make seeds, how they can grow nearly forever, how plants survive extreme environments without running to hide, why they synthesize caffeine, nicotine, THC and opiates, how they defend themselves from pathogens without an immune system, how they sense their environment without dedicated sensory organs, how plants have been modified by humans to provide food, fiber and fuel, and how genetically modified (GMO) crops are made and their implications to the environment and society. Overall goals are to enhance an understanding and appreciation of the plant kingdom, to help young scientists understand the primary scientific literature, and as a starting point for possible careers in plant biology. Class includes field trips to the Missouri Botanical Gardens and a local plant biotech company/institute. Where appropriate, the class will also emphasize key differences between plants and animals. This course is primarily for first-year students interested in majoring in biology, with a possible emphasis on plants. This course is also for those that want to know more about where their food comes from, how these amazing creatures survive and flourish, and how GMO crops are engineered. Upper-level students with an interest in food and sustainable agriculture but not necessarily focusing on plants will also be welcome. Course will be lecture/discussion/hands-on format for 2 of the 3 hours per week. Students will present 20-minute papers discussing topics relevant to their interests for the remaining 1 hour (two students per class). Prerequisites: Students must have taken both biology and chemistry in high school and at least one at the AP or IP levels; or have taken Bio 2960 or Chem 111/112. This course can be taken by both first-year and upper-level undergraduates with a preference given to first-year students.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 1442 Ampersand: The Biology of Cancer Part I
Cancer is the second-leading cause of death worldwide. In spite of focused research efforts, cancer still poses a unique biomedical puzzle as it is now recognized that cancer is not a single disease, but rather a collection of many disorders with underlying mechanistic complexities that can affect most tissues in the human body. This interactive 1st-semester course provides an introductory overview of the biology of human cancers. We touch upon background topics in DNA structure and replication, gene regulation and transcription, protein synthesis, mutations and DNA repair, but the primary focus is on the genetic and molecular changes that normal cells undergo during transformation into malignant tumors. Part I highlights the first three (of eight) central characteristics of cancer (known as the hallmarks of cancer) - sustained proliferation, evasion of growth suppression, and replicative immortality. The course is a mix of lectures, student-led discussions/presentations, and activities. Lectures provide an overview of each topic, while activities and discussions of cutting-edge oncology topics in the news and primary literature familiarize students with current trends in cancer research as well as enhance reading and critical analysis skills. Students choose a specific topic/theme within the cancer paradigm for further study and near the end of the semester prepare a presentation to the class on the implications for cancer survivorship. Midterm Exams, which attendance is required, will be administered on Wednesday, October 19, 6:30 - 8:30 pm & Wednesday, November 16, 6:30 - 8:30 pm. Prerequisite: High school biology and chemistry, while completing AP or Honors biology is highly recommended. Enrollment is limited to 20 students and restricted to first-year students in the Hallmarks of Cancer & Patient Care program.
Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 1443 Ampersand: The Biology of Cancer Part II
Cancer is poised to overtake heart disease as the number one cause of death in the United States and represents a significant burden to the U.S. health system. As such, a deeper understanding of the underlying biology of human cancers and their treatment modalities will be important for those pursuing a future in the health sciences. In this interactive 2nd-semester course, we continue our exploration of the "hallmarks of cancer," emphasizing the dysfunction of essential biological processes like cell proliferation, programmed cell death, energy metabolism, and immune surveillance. Classical diagnosis and treatment methods are compared with newer strategies, such as targeted and immune therapies. Finally, the growing role of personalized medicine and "omics" technologies in tumor classification, patient prognosis, and therapy are discussed. The course is a mix of lectures, student-led discussions/presentations, and activities. Lectures provide an overview of each topic, while activities and discussions of cutting-edge oncology topics in the news and primary literature familiarize students with current trends in cancer research/treatment as well as enhance reading and critical analysis skills. Students choose a specific type of cancer for further study and near the end of the semester prepare a presentation to the class on its molecular and cellular etiology, epidemiology, pathology, diagnosis, and current/future treatment options.
Credit 4 units. A&S IQ: NSM
Typical periods offered: Fall, Spring

BIOL 1444 Ampersand: The Language of Cancer
Cancer as a disease has touched countless people in every country and every lifestyle. Cancer is not one single disease; rather, it is a collective scourge of many underlying disorders. Over the years, biomedical research has led to a fuller understanding of cancer etiology and spawned new diagnostic and treatment strategies to better manage and treat this condition. More recently, the launch of the Precision Medicine Initiative by the National Cancer Institute has led to unprecedented insights into the cellular signaling pathways that drive the development and progression of cancer. Furthermore, the current onset of omics technology and high-throughput biological readouts has opened the possibility of precisely identifying molecular changes and affected metabolic pathways in individual cancers, paving the way for precision medicine and patient care. In this second semester, we will build upon our foundational understanding of cancer and explore recent and groundbreaking advances in cancer research and therapies. The course is driven largely by student-led presentations and discussions with a mix of faculty lectures and guest seminars. Students work in teams and take responsibility for their own active, inquiry-based learning by examining various cancer topics using primary literature as the principle resource. Learning to read, interpret, and assemble a presentation from scientific literature and biomedical research is emphasized. Student teams choose a hypothesis-driven topic of interest in the field of oncology for further study and, near the end of the semester. prepare a written report and oral presentation to the class outlining its background, central hypothesis-driven question(s), experimental rationale/strategy, research data, scientific conclusion, and future direction. Prerequisite: BIOL 144. Enrollment is limited to students in the Hallmarks of Cancer & Patient Care program. Limited to 20 students.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall, Spring

BIOL 1499 First-Year Opportunity: Molecular Biology of Genetic Disease
This course is for first-year, non-transfer students only. Students gain a fluency in biological language, methods, and reasoning as applied to human health. We study the molecular, cellular, and physiological perspectives for each health-related topic, and examine data and methods that support this knowledge. We emphasize problem-solving and reasoning as it applies to understanding biological processes. The content and problem-solving work are designed to help students prepare for Biology 2960, which is offered each spring semester. Intended for students without strong AP Biology preparation, which is helpful for success in Biology 2960
Credit 2 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 1530 Special Topics in Biology: Plant-Microbe Interactions
This is a research-based laboratory course offered by Dr. Barbara Kunkel in the Biology Department. The small class size and laboratory setting of the course is intended to foster development of student-professor mentoring relationships. Time commitment (weekly): 2 hours in lab, 1 hour of discussion (1 unit, P/F). Class size: 4 students Prerequisite: Permission of Instructor Research Question. Microbial organisms play very important roles in the lives of plants and animals. For example, in nature as well as in agricultural settings, the communities of microorganisms that grow near or on plants influence the growth and overall health of these plants. These plant-associated microbial communities are highly complex, and are comprised of thousands of different species, including bacteria and fungi. However, neither the role of individual microbial species within the larger microbial community, nor how such a community is beneficial to plants, is well understood. Each year the students in Bio1771 explore a different topic related to interactions between plants and their associated microbes. During the 2020/2021 academic year our research will focus on virulence mechanisms used by the plant pathogen Pseudomonas syringae to promote disease in plants. Recent research in the Kunkel lab has revealed that the plant hormone auxin promotes disease development in interactions between P. syringae strain PtoDC3000 and one of its host, Arabidopsis thaliana, a weedy plant in the mustard family. Auxin acts through at least two different mechanisms to promote disease, including 1) suppressing defense responses in the plant and 2) regulating gene expression in the pathogen. We will investigate this second activity by screening for and characterizing PtoDC3000 mutants that do not properly respond to auxin. Students will spend two hours per week in lab carrying out bacteriological and molecular biology experiments. Over the course of the semester, students will be exposed to a variety of fundamental topics in biology, including: bacteriology, plant growth and development, pathogenic plant-microbe interactions, and key concepts in genetics, molecular biology and biochemistry. The students will also meet with Dr. Kunkel for one hour per week to discuss a variety of topics chosen to explore: i) basic concepts in chemistry, biochemistry and molecular biology, ii) learning and study strategies, and iii) other topics related to thriving at WUSTL.
Credit 1 unit. Art: NSM
Typical periods offered: Fall

BIOL 1531 Biology in the News
Students explore a number of biology topics that are frequently discussed in the media. We begin with an investigation into how to evaluate scientific claims reported in written (e.g., news articles, blogs, social media posts), visual (e.g., YouTube videos, Instagram posts) and audio media (e.g., podcasts). We then explore the topics of genetic modification, GMOs, cloning, and direct-to-consumer home DNA testing kits. Finally, we investigate medical topics, including cancer, vaccines and antibiotic resistance. We emphasize critical thinking and reasoning as it applies to the acceptance or rejection of scientific claims presented in popular media formats. This course is intended for students not majoring in biology and who would like to learn more about scientific topics portrayed in the media as controversial and under debate.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 1770 First-Year Opportunity: The Biology of Dog Breeds
This freshman seminar uses the topic of dog behavior and genetics to teach fundamental scientific tools and to engage students in contributing to the building of an online public resource that summarizes the scientific literature on breeds. Our first task is learning to read and dissect primary scientific literature. We parse out the difference between scientific questions, hypotheses, and predictions through a guided case-study exercise. We then apply the experience to outlining primary research articles, identifying the key components of the author's arguments and summarizing the results and implications. The second half of the semester is spent searching the scientific literature, sorting information into the new dog breed resource, and presenting results to peers around the seminar table. Course is for first-year, non-transfer students only.
Credit 2 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall, Spring

BIOL 1812 First-Year Opportunity: Introduction to Cutting-Edge Research in Biology
A lecture course intended for first-year students that focuses on the practice and culture of biological research. Active researchers describe the biological context of their research, the specific questions they have formulated, the means by which they pursue the answers, and their data and conclusions. The focus is on process: how biologists pursue

their profession, what goes on in a research setting. Additional topics of clinical and contemporary interest are often included. Students are expected to attend all lectures. Enrollment is restricted to first-year, non-transfer students.. Must be taken Credit/No Credit.
Credit 1 unit. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 1910 Ampersand: Phage Hunters
A research-based laboratory class for first years. Students join a national experiment organized by HHMI, with the goal of isolating and characterizing bacteriophage viruses found in the soil in the St. Louis area. Laboratory work includes isolation and purification of your own phage, DNA isolation and restriction mapping, and EM characterization of your phage. Several WU phage are selected for genome sequencing over winter break, and are annotated in the spring in Bio 192, Phage Bioinformatics. Students who successfully isolate and annotate a phage may become co-authors on a scientific paper. Prereqs: High school courses in biology and chemistry, at least one at the AP or International Baccalaureate level; permission of the instructor. One hour lecture, one hour discussion, and 3 hrs lab per week. Course is for first-year students in the Phage Hunters Program only.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 1920 Ampersand: Phage Bioinformatics
A research-based laboratory class for freshmen. Students join a national experiment organized by HHMI, with the goal of genomic characterization of a local phage. Laboratory work focuses on learning computer-based tools for genome analysis followed by annotation and comparative analysis of the genome of a phage (bacterial virus) that was isolated fall semester at WU and sequenced over winter break. Prerequisites: High school courses in biology, chemistry, and physics, at least one at the AP or International Baccalaureate level; permission of the instructor. Limited to 40 students; preference given to those completing Bio 191, Phage Hunters. One hour lecture, one hour discussion, and 3 hrs lab per week.
Credit 3 units. Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 1995 Biology Coursework Completed Abroad
This course is for study abroad credits.
Credit 12 units.
Typical periods offered: Fall, Spring, Summer

BIOL 1996 Elective: 100-Level
This course is for elective or transfer credits.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 2111 Nutrition
This introductory course examines nutrition as an interdisciplinary science. Topics include the chemistry, function, and metabolism of nutrients; regulations of food intake; food habits; digestion and absorption of nutrients; methods of determining the nutrient content of foods and nutrient requirements for humans and animals; comparative nutrition; problems of human malnutrition; relation of nutrition to disease; toxic materials in foodstuffs; economic, nutritional, and social problems involved in feeding the world population; and future possibilities for meeting nutritional needs of the world's population.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall, Spring

BIOL 2150 Introduction to Environmental Biology
Introduction to Environmental Biology is designed to teach important principles of environmental biology and general science literacy skills. We cover the foundational biological principles and contemporary issues within four main topics: human population growth, transfer of energy and carbon in the ecosystem, biodiversity, and food production. We focus on the biological principles involved as we examine these topics in the context of some contentious and confusing issues related to environmental biology in everyday life. The science literacy skills that you master in this course will help you address the issues you face in your everyday life regarding scientific and pseudoscientific claims about the environment and society and will form the foundation for your development as a critical consumer of science information in the media. This course is required for all environmental biology majors and environmental studies minors. We recommend you take this course in your first- or second-year if possible. If your interests align and your schedule allows, we recommend co-enrolling in ENST 215: Introduction to Environmental Humanities.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 2196 Practical Applications
Credit for an internship in Biology.
Credit 3 units.
Typical periods offered: Fall, Spring, Summer

BIOL 2342 Wilderness First Aid
The National Outdoor Leadership School (NOLS) has developed a comprehensive curriculum to instruct individuals in backcountry first aid. This curriculum will be the main content taught in the course. After successfully completing this detailed 18 hour NOLS Wilderness First Aid course, students will be required to write-up a full assessment and treatment plan (5-7 page minimum) for one of the wilderness casualties described in Peter Stark's Last Breath. Students will meet for a half-day seminar during which each will present their case, assessment, underlying physiology, and treatment plan to the group. They will receive feedback from one another, and from the instructor, about their assessment, explanation of the relevant physiology, and action of their proposed intervention.
Credit 1 unit. A&S IQ: NSM
Typical periods offered: Spring

BIOL 2440 Ampersand: The Oncology Healthcare Team
It's news no one wants to hear: You have cancer. A cancer diagnosis can be overwhelming. The physical and emotional effects that come with this disease and its treatment can be significant. People often need the experience and skills of several different medical specialists to navigate and treat cancer. The various medical professionals involved in cancer care make up the oncology healthcare team. In this third-semester course, we will partner with Siteman Cancer Center and its affiliates to explore the multitude of professions that constitute the oncology healthcare team. In bi-weekly rotations, students will be introduced to various aspects of cancer-patient care and treatment through members of the oncology healthcare team, including oncologists, pathologists, surgeons, clinical geneticists, nurses, psychologists, and public health professionals. The course is a mix of guest lectures, discussions, site visits, activities, and shadowing healthcare professionals. Students will reflect on their experiences in weekly journal entries and must submit a final reflection paper that is due at the end of the semester, synthesizing semester experiences with core competencies for individuals desiring to enter a health profession. Prerequisites: Biol 144 and Biol 1441. Enrollment is limited to students in the Hallmarks of Cancer & Patient Care program.
Credit 4 units. A&S IQ: NSM
Typical periods offered: Spring

BIOL 2444 The Language of Cancer
Words matter. This is especially true for the patients (and their families) who hear the diagnosis "cancer," but also so for the physicians who treat these patients, and for the academic researchers who are seeking better treatments. We will begin by considering Illness as Metaphor, the influential 1978 work in which Susan Sontag claims that metaphorical language distorts our understanding of cancer and other illnesses. We will move on to consider both the diction and syntax used with cancer in a sampling of academic papers, creative works, and long-form personal writings. Students will write both analytical and reflective pieces responding to those materials. They will also learn to read, interpret, and assemble presentations from biomedical research. Three presentations over the course of the semester will allow students to develop the skills in oral communication essential to careers in health care.
Credit 3 units. A&S IQ: HUM BU: HUM
Typical periods offered: Fall

BIOL 2501 Introduction to Biological Reasoning
Students will work to develop a fluency in biological language, methods, and reasoning as applied to human health. We will study the molecular, cellular, and physiological perspectives for each health-related topic. We will zoom in to study processes at the molecular level, swing back out again to examine processes at the cell or physiological level, and examine data and methods that support this knowledge. We will emphasize problem-solving and reasoning as they apply to understanding biological processes. This course is for first-year students only. It does not count for credit toward the biology major. Permission of instructor(s) required. Medium-sized class.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 2650 Summer Experiences in Life Sciences
Earn credit for clinical research and other non-classroom learning in the life sciences during the summer. The variety of activities arranged by the student with their WashU faculty mentor have included but are not limited to: participation in clinical research or applied ecological research and report on it; shadow a physician on rounds or in clinic; prepare a paper on an organ system or disease; participate in science outreach teaching, etc. Participants must meet regularly with the faculty mentor or designee and commit to at least 140 hours over two semesters. An application is required each semester which includes a work plan, that must approved prior to registration. A semester Summary Report is due after one semester and a Final Summary Report after two semesters. Bio 265 does not count toward the Biology major/minor. Credit: 1.5 units per semester, contingent upon completion of two semesters. For more information and to access the application, please go to: https://sites.wustl.edu/bio265/. Students are registered by the Biology department after faculty mentor and course master approval is granted. Summer Application Deadline - First Friday of June. Credit/No Credit only.
Credit 1.5 units.
Typical periods offered: Fall

BIOL 2651 MedPrep I-The Lecture Series
MedPrep I (Bio 2651) is a unique lecture series taught by a physician, former medical school course master and member of the Committee on Admissions for the School of Medicine. Through a weekly 2-hour lecture, this course gives students accurate, honest, and detailed information regarding every step of the application and admissions process to medical school, the entire educational process including medical school and residency training and pros and cons of life of a physician. MedPrep I is particularly useful for first-year students and sophomores in that it reviews the common pitfalls encountered by unsuccessful applicants to medical school and outlines the steps to take in each year of college to be a successful applicant when the time comes. There is no outside course work and no exams. Attendance at all classes is required. There is a $10 course fee used for guest speakers stipends, guest speaker travel to St. Louis, AV needs and other course-related items. For more information, please see the MedPrep website: medprep.wustl.edu
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 2661 Experience in the Life Sciences
Earn credit for non-classroom learning in the life sciences in a variety of activities arranged by the student: accompany a WU Faculty physician on rounds and prepare a paper on an organ system or disease, participate in a clinical or applied ecological study and report on it, participate in science outreach teaching, etc. Participants must meet regularly with a supervisor and commit at least 140 hours over two semesters. A work plan is approved prior to registration. A progress report is due after one semester and a final paper after two semesters. Does not count toward the major. Credit: 1.5 units per semester, contingent upon completion of two semesters. For more information on registration, please see: https://sites.wustl.edu/bio265/. Students are registered by the department after approval is granted. Credit/No Credit only. Course Master: Dr. Joan Downey
Credit 1.5 units.
Typical periods offered: Fall, Spring

BIOL 2900 Directed Research in Biology
Introduces first-years and sophomores to research by engaging them in ongoing faculty research projects within the department. Under the direction of a faculty mentor, students take part in tasks that contribute to the mentor's research. Through this hands-on experience, students learn about the research process and build foundational research skills that can benefit their future academic experience and development. Faculty mentors provide regular guidance, training, and feedback to support students' understanding and growth. Students are registered by the department after approval from the faculty member leading the research project. The course may be taken for 1-3 credit hours based on the weekly hours required. Credit/No Credit only
Credit 3 units.

BIOL 2901 Introduction to Research
An introduction to laboratory and field research in biology for first and second year students. Students work under the supervision of a mentor in a setting of established, ongoing research. Prerequisite: less than 60 units completed, permission of mentor and the department. For on-line enrollment instructions see: https://pages.wustl.edu/Bio_200-500_independent_research/register Students are registered by the department after approval is granted. Registration may not appear in Webstac until mid-semester. Pass/No Pass Only. Course may not be taken for a letter grade.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall, Spring

BIOL 2902 Introduction to Research in Neuroscience
This course provides an introduction to research in neuroscience under the supervision of a faculty mentor. Students work under the supervision of a mentor in a setting of established, ongoing research. Prerequisite: less than 60 units completed and permission of the mentor and the department. For online enrollment instructions, visit https://sites.wustl.edu/bio200500independentresearch/. Students are registered by the department after approval is granted. Registration may not appear in WebSTAC until mid-semester. Pass/No Pass Only. Course may not be taken for a letter grade.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 2903 Summer Introduction to Research
Summer research under the supervision of a faculty mentor. Prerequisites: first-year or sophomore standing and permission of mentor and the department. Credit to be determined in each case, usually 3 units/summer; may be repeated for credit in different summers. Credits are received in the fall semester following the summer research. The application deadline and registration information can be found on the Bio 200/500 course website: https://pages.wustl.edu/Bio_200-500_independent_research. Pass/No Pass Only. Course may not be taken for a letter grade. 1-3 units
Credit 3 units. A&S IQ: NSM
Typical periods offered: Fall

BIOL 2904 Summer Introduction to Research in Neuroscience
Summer research in neuroscience under the supervision of a faculty mentor. Prerequisites: first-year or sophomore standing and permission of the mentor and the department. Credit to be determined in each case, usually 3 units/summer. Course may be repeated for credit in different summers. Credits are received in the fall semester following the summer research. The application deadline and registration information can be found on the Biol 200/500 course website: https://sites.wustl.edu/bio200500independentresearch. Pass/No Pass Only. Course may not be taken for a letter grade.
Credit 3 units.
Typical periods offered: Fall

BIOL 2959 MedPrep III - Emergency Care Technician
MedPrep III (Bio 2659) is a new shadowing course that will take place on the inpatient wards of Barnes- Jewish Hospital, the main teaching hospital of the Washington University School of Medicine. For four hours every other week, students shadow physicians on a specialty service and will remain with that service for the duration of the semester. Students will have the opportunity to rank order their preference of specialty but will be assigned based on availability. No guarantees can be made to place a student in their most preferred specialty. In order to participate, students must have one morning a week that they are completely free between 6 am-12 pm. In addition to shadowing, there is a required class session every Wednesday from 6:30-7:30 pm. Because of the orientation material presented, excused absences will not be granted for the first two sessions for any reason whatsoever, including illness or emergency. There is no outside course work and no exams. A $25 course fee as well as HIPAA training and TB testing are required. For more information and to register for this course, please see the MedPrep website at pages.wustl.edu/medprep. Registration is done through the MedPrep website, NOT through WebSTAC. Successful completion of MedPrep I (Bio 2651) and sophomore standing or above are required to take Bio 2659. This course is only offered during the Fall and Spring semesters.
Credit 1 unit.
Typical periods offered: Spring

BIOL 2960 Principles of Biology I
An introduction to biological molecules and biochemical strategies employed by the three domains of life. The flow of genetic information within cells is discussed in the context of cellular structure, organization, and function. Investigation and manipulation of genetic information by molecular genetic technologies, such as recombinant DNA, forms the final phase of the course. Labs reinforce concepts from lectures and explore common laboratory techniques and computer-based resources. Prerequisites: Chem 111 and Chem 112 (concurrently).
Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring, Summer

BIOL 2963 Biology Team Learning for Bio 2960 (BTL)
Bio 2960, Principles of Biology 1, focuses on critical thinking, analysis and problem solving for biology topics. Many students have not approached biology this way in highschool courses. Participation in BTL is designed to help students learn and practice the course material using concept building and critical thinking. Group work on problem solving is emphasized. In-person instruction. Prerequisites: Concurrent enrollment in Bio 2960.1 CR P/F
Credit 1 unit.
Typical periods offered: Spring

BIOL 2964 MedPrep II - The Shadowing Experience: Emergency Medicine
MedPrep II offers students a real world, behind-the-scenes experience of a life in medicine. For three hours every other week, students shadow physicians in the Charles F. Knight Emergency and Trauma Center of Barnes-Jewish Hospital, the main teaching hospital of the Washington University School of Medicine. In addition to the shadowing, there is a required class session every Monday from 5:30-6:20 pm. Because of the orientation material presented, excused absences will not be granted for the first session (special orientation that is 1.5--2 hours) for any reason whatsoever, including illness or emergency. There is no outside course work and no exams. A $25 course fee for MedPrep shirt and other course related items (e.g. AV items and other course-related items) as well as HIPAA training and PPD testing are required. For more information and to register for this course, please see the MedPrep website at medprep.wustl.edu. Registration is done through the website, NOT through Workday. Please do not submit override requests in Workday. You will be manually enrolled after you complete the requirements.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 2965 Pediatric Emergency Medicine Research Associates Program: Experiences in Life Sciences
The Pediatric Emergency Medicine Research Associates Program (PEMRAP) offers undergraduate pre-medical students an opportunity to participate in clinical, patient-oriented research projects in a hospital setting. Students have the opportunity to work in the St. Louis Children's Hospital Emergency Department, a nationally recognized pediatric emergency medicine and trauma care facility. A number of research projects are currently underway in various areas of pediatric emergency medicine. Research Associates are expected to work two 4-hour shifts per week in the St. Louis Children's Hospital Emergency Department and to attend a weekly 2-hour lecture on Tuesdays from 1:30-3:30pm in Conference Room 10A of the Northwest Tower Building (across from Children's Hospital). Lectures are given by Emergency Department faculty members. This program offers students the unique opportunity to be a vital part of the ED research team. In addition, the RA's experience in the ED may help him/her determine if medicine is truly the career path he/she wishes to choose. Registration is done through this website: http://pediatrics.wustl.edu/pemrap. May not be taken concurrently with Bio 2654: MEDPREP II.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 2966 Introduction to Health Professions: Audiology, Occupational Therapy, Pharmacy, and Physical Therapy
This course provides students interested in health professions with an overview of occupational therapy, physical therapy, audiology, and pharmacy. Students gain a better understanding of the scope of practice, markets, and skills required to succeed in these professions. Students learn about graduate and professional education options and how to build a competitive application for these programs. Finally, students participate in self-directed learning experiences (which

may include in-person or virtual shadowing, attending professional presentations, meeting with health care professionals or graduate students, or sitting in on graduate-level classes) and culminate their study with an inter-professional education session with a panel of faculty from the different health professions. Students finish the course with a better understanding of whether a career in health professions is right for them.
Credit 1 unit.
Typical periods offered: Spring

BIOL 2967 Collaborative Phage Bioinformatics
A research-based laboratory for those enrolled in Bio 2960, this class provides an opportunity to join a research team with the goal of genomic characterization of a locally isolated phage (a virus that infects a bacterial host). Similar to Bio 192, but using a condensed format and a larger team to tackle each phage. Lab work focuses on learning computer-based tools for genome analysis, followed by careful annotation of several genes from your phage and in-depth investigation of one gene. Requires concurrent enrollment in Bio 2960 Principles of Biology I; not open to students enrolled in Bio 192. One 2-hr pre-class online review/preparation session, nine 2-hr laboratory sessions, and a final poster presentation. (Lab does not meet in weeks with a scheduled Bio 2960 midterm.) May be taken for a letter grade or Credit/No Credit.
Credit 1 unit. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 2968 Pediatric Emergency Medicine Research Associates Program - Experiences in Life Sciences (PEMRAP II)
PEMRAP II is a continuation of Bio 2652, Pediatric Emergency Medicine Research Associates Program - Experiences in Life Sciences. Returning PEMRAP Research Associates (RAs) actively participate in new and ongoing research projects in various areas of pediatric emergency medicine. RAs assist during the active period of patient enrollment through screening of ED patients for study eligibility, reading information about the studies to the patients, collecting data regarding patient history and certain physical examination findings, and generally facilitating the study enrollment process. PEMRAP Returning RAs are vital members of the Emergency Department research team in the St. Louis Children's Hospital Emergency Department. Returning RAs assist in training and mentoring incoming PEMRAP students (BIO 2652) in ED protocol, work approximately one 4-hour shift per week in the ED, record shift activities and hours worked on a daily Shift Log form, and participate in the physician shadowing program (as offered). Returning RAs are responsible to meet hospital non-appointee requirements and stay current with new study protocols by attending or viewing new study presentations for PEMRAP students. These lectures are given by Pediatric Department faculty members introducing the basics of the clinical research process, specific studies, as well as pediatric illness. The RA position carries with it important responsibility requiring maturity, initiative, diligence and excellent interpersonal skills. There is no outside course work and no exams. Full participation is required. 45 shift hours = 1 credit Students may repeat this course for a maximum of 6 credits. Course may not be taken concurrently with Bio 2651, 2652, or 2654.
Credit 2 units.
Typical periods offered: Fall, Spring

BIOL 2969 Biomolecules in the Third Dimension
A computer-based laboratory for students enrolled in Bio 2960. This class gives students the opportunity to to learn biology in a new way. Students are exposed to experimental data and software visualization tools currently used in cutting edge research. Each week, biomolecules presented in Bio 2960 lecture will downloaded, viewed and manipulated in 3D using the molecular viewer PyMOL. Students will be able to study molecular interactions in greater depth than is possible in lecture. Ultimately, the laboratory is designed to help students develop their visuospatial thinking skills and to gain a deeper understanding of the macromolecules discussed in lecture. The class is highly recommended to students who identify themselves as visual/interactive learners. Topics include: protein and nucleic acid structure, signal transduction, energy transfer, replication, transcription and translation. Requires concurrent enrollment in Bio 2960 Principles of Biology I. Lab does not meet in weeks with a biology exam. Class taken for Credit/No Credit. Credit 1 unit. C. Smith, K. Hafer
Credit 1 unit. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 2970 Principles of Biology II
A broad overview of genetics, including Mendelian assortment, linkage, chromosomal aberrations, variations in chromosome number, mutation, developmental genetics, quantitative genetics, population genetics, mechanisms of evolution, and phylogenetics. Three lecture/problem solving sections and one laboratory period per week. Does not fulfill the laboratory requirement of the biology major. This course must be taken for a grade to count towards the Biology major.
Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall, Summer

BIOL 2995 Biology Coursework Completed Abroad
This course is for study abroad credits.
Credit 12 units.
Typical periods offered: Fall, Spring, Summer

BIOL 2996 Elective: 200-Level
This course is for elective or transfer credits.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 3010 Biotechnology Project
: This second year Biotech Explorers Pathway (BEP) course introduces students to the process used to generate project ideas, write proposals, and evaluate concepts, with peer evaluation applied at all steps of the process. Students completing Bio3010 will gain experience in science proposal writing with peer review, public speaking, team building, and leadership training. The first four weeks of the course will focus on individual pre-proposal brainstorming, writing, and pitching, while the remainder of the course will be dedicated to the development of full proposals by teams of students. This 3-credit project development course complements introductory courses by making connections between fields and building teams of students with experience in the process that nurtures ideas to products. Pre-requisites: Students need to have completed Bio2010: The Science of Biotechnology and Bio2020: Biotech Entreprenuers Seminar for enrollment in this course. Credit only. 3.0 units. Writing Intensive. Limited to 20 students.
Credit 3 units. A&S IQ: NSM, WI Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 3030 Human Biology
How did Elvis, Socrates, and Babe Ruth die? How did David Letterman and Dick Cheney survive? In this course we work towards understanding the biology behind human health and disease. We examine cases from the news, literature and history. We work like detectives to understand how and why the characters were affected, and healed or died. This course is designed for students who do not plan to major in science and no prior science background is expected. Prerequisite: Sophomore standing or permission of instructor. A student may not receive credit for both Bio 303A and Bio 100A, 2960, 2970, or UCollege B320, B3201, B321, B3211.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 3041 Plant Biology and Genetic Engineering
A 4 credit lecture course that provides an introduction to plant development, genetics, physiology and biochemistry with emphasis on processes that can be manipulated or better understood through genetic engineering. The course is divided into 3 sections. The first section of the course discusses basic plant biology, development and genetics. The second part of the course emphasizes gene structure, expression, and cloning as well as methods for introducing foreign DNA into plant cells and regenerating fertile plants in tissue culture. During the third part of the course we will discuss a variety of examples of genetically engineered traits, including: herbicide resistance; fruit ripening; pathogen and/or insect resistance; the use of plants for production of industrial and pharmaceutical compounds. Friday discussion sections focus on critical reading of the primary literature related to the material covered in lecture. Prerequisites: Bio 2960 and Bio 2970.
Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 3057 Physiological Control Systems
Systems physiology with emphasis on human physiology. Must be taken for a letter grade.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 3058 Physiological Control Systems
Systems physiology with emphasis on human physiology. Prereqs: Bio 2960 and Chem 112A.
Credit 2 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 3100 R Workshop in Biology
Biologists in all areas increasingly find that they have the need and opportunity to work with large data sets. The goal of this 1-credit course is to provide students with an opportunity to gain skills in data analysis and presentation using R, a free software environment for statistical computing and graphics (http://www.r-project.org). Topics include an introduction to basic programming in R, data types and manipulation, graphics, hypothesis testing and statistics, and applications to various fields of biology ranging from ecology to genomics. The course consists of ten, two-hour workshops that include a brief introduction to key concepts in R and applications in biology, followed by interactive, hands-on tutorials. Prerequisites: concurrent or prior course in statistics (Math 2200 or Math 3200) or permission of instructor.
Credit 1 unit.
Typical periods offered: Fall

BIOL 3110 Vertebrate Structure Laboratory
A lecture/laboratory course designed to provide an integrative framework for how vertebrate form and function evolved. Weekly lectures emphasize development and the relationship between the structural and functional design of organ systems, the importance of these relationships in maintaining homeostasis while providing opportunity for adaptation, and examples of how vertebrate organ systems communicate to accomplish functional and physiological integration. 1.5 hr lecture and 5 hrs lab each week. Prereq: Bio 2970.
Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 3151 Endocrinology
An overview of mammalian endocrine systems with an emphasis on human physiology and development. The interplay between systemic, local cell, and tissue interactions as well as the cell and molecular events associated with hormone action discussed. Examples of endocrine evolution and pathological conditions related to endocrine imbalances also included. Prerequisite: Bio 2970.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 3172 Biology for Climate Change Solutions
Human-induced climate change poses a pressing and pervasive threat to both human populations and to the biological world. The challenges of climate change are manifest and well known, increasing temperatures, greater variability of weather, sea level rise, leading to a host of consequences. Adapting to and mitigating climate change are essential activities for confronting the threats of climate change. The biological sciences offer great potential for addressing these threats. This course focus on efforts in biological research to adapt and to mitigate climate change. Topics will range across the biological sciences from microbial engineering and biotechnology to zoonotic diseases and one health, to ecosystem function and conservation of biodiversity. The course consists of lectures, discussion of assigned readings, and class projects. Class projects focus on science topics that addresses new approaches to climate adaptation and mitigation and constitute both of a written paper and class presentation. The goals of this class are: (1) to develop an understanding of basic climate science and the biological aspects of climate change, (2) to develop knowledge of the biological efforts towards adaption and mitigation for climate solutions. The class is open to both non-science and science majors. The course does not count for the biology major. 3 units credit. Class cannot be taken pass fail. Small class. Not for biology major credit
Credit 3 units. A&S IQ: NSM
Typical periods offered: Fall

BIOL 3182 History of the Life Sciences in the 20th Century
This course explores the vast changes that the life sciences underwent between 1890 and 2000, from a largely descriptive and qualitative, to a highly experimental and quantitative science. Topics include the rejection of Haeckelian morphology, the rise of experimental embryology, the rediscovery of Mendel and development of the Mendelian-chromosome theory, the new ecology of the Chicago school, the introduction of feedback and control systems in physiology, the synthesis of Mendelism and Darwinism, the rise of biochemistry and molecular biology, and the genomic revolution. In each topic, biological ideas are placed in their historical and social contexts. Prerequisites: At least a high school or preferably, college-level introductory course in biology and/or permission of the instructor.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 3183 A History of Genetics in the 20th Century
After a brief survey of pre-twentieth-century theories of heredity, this course examines the work of Gregor Mendel and its rediscovery in 1900, and its expansion as an interfield theory in combination with the chromosome theory, pioneered beginning in 1910 by T.H. Morgan at Columbia and R.A. Emerson at Cornell, and led to the expansion of classical genetics up to World War II. The beginnings of biochemical and molecular genetics in the 1920s and 1930s developed rapidly after the war with the double-helix theory of DNA and the rise of molecular genetics. The course ends with examination of the Human Genome Project (Initiative) and the ramifications of genetic biotechnology. Throughout, emphasis is placed not only on the technical and theoretical developments comprising genetics as an epistemic field, but also on the economic, social, political and philosophical interconnections between genetics and society. Agriculture, medicine

and the ideology of social control (including such movements as eugenics and Nazi race hygiene) both influenced, and were influenced by genetics, and played an integral part in the construction of the science itself. Readings are drawn from the primary and secondary literature. There is a mid-term, final and periodic student reports. Prereq: Bio 2960 and Bio 2970.

Credit 3 units. A&S IQ: NSM, WI Art: NSM

Typical periods offered: Spring

BIOL 3220 Woody Plants of Missouri

Washington University's Danforth Campus is home to more than 4000 trees and is now a registered arboretum. This urban forest ecosystem has been carefully curated and managed to provide habitat diversity, shade, rainwater mitigation, and aesthetic beauty. In this course, students will study the biology of woody plants in the classroom and in our arboretum. Specifically, students will learn woody plant systematics, physiology, and ecology as well as applied and hands-on techniques. Students will learn to collect forestry data and to identify trees by leaf, bud, bark, fruit and crown. They will learn to plant, propagate, and care for trees and other woody plants. They will also contribute to the ongoing research in our arboretum and to the education of their peers and campus visitors by adding new trees to the arboretum collection and by monitoring the campus trees as they learn to collect data on growth and phenology. Students who successfully complete this course will be eligible to join the Danforth Arboretum Loraxes for the remainder of their time at Washington University. Loraxes will be arboretum ambassadors and will be called upon from time to time to lead tours of the arboretum for prospective students, science outreach, or members of the campus community. Prerequisite: Biol 2960. (Biology Major Area C)

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

Typical periods offered: Fall, Spring

BIOL 3221 Research and Public Education in the Arboretum

Washington University's Danforth Campus is home to more than 4000 trees and is now a registered level II arboretum. This urban forest ecosystem has been carefully curated and managed to provide habitat diversity, shade, rainwater mitigation, as well as aesthetic beauty. The arboretum is also an institutional structure to support education, research and public service. This course combines theory and hands-on practice. In this course you will: Learn about the history and philosophy of public natural history museums, botanical gardens, arboreta, and zoos Learn about arboreta and public gardens around the world Learn field techniques for monitoring the growth and assessing the health of trees o Apply those techniques by contributing to the bio-monitoring and tracking of the trees in the Danforth Campus Arboretum Learn about the pedagogy of public education in museums, zoos and arboreta o Apply the pedagogic practices to development of public education campaigns in the Danforth Campus Arboretum o Apply those practices by serving as an outreach ambassador and leading tours through the Danforth Campus Arboretum Prerequisite: Biology 3220

Credit 3 units. A&S IQ: NSM

Typical periods offered: Spring

BIOL 3240 Human Genetics

Broad coverage of the role of genetics in medicine, with a focus on the application of genomic technologies to the understanding of human disease. Areas covered include the identification of human disease genes, modern cytogenetics, risk assessment in pedigrees, biochemical genetics, imprinting, mitochondrial genetics, gene therapy, complex inheritance, assisted reproduction, prenatal diagnosis, immunity, cancer, and pharmacogenetics. The profound ethical and legal considerations raised by modern genetic technologies are also discussed. (Biology Major Area A)

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

Typical periods offered: Fall

BIOL 3280 Principles in Human Physiology

This course is designed to provide students with an understanding of the function, regulation, and integration of the major organ systems of the body. Course content includes neural and hormonal homeostatic mechanisms, and study of the circulatory, respiratory, digestive, urinary, musculoskeletal, nervous, endocrine, immune and reproductive organ systems. Mechanisms of exercise physiology are integrated throughout the course. Prerequisites: Bio 3058, or equivalent.

Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI

Typical periods offered: Spring

BIOL 3340 Cell Biology

Eukaryotic cell structure and function viewed from the perspective of modern cell biology. Lectures cover such topics as membrane transport, endocytosis, secretion, intracellular trafficking, signal transduction, extracellular matrix, cytoskeleton, motility, cell cycle, and the cellular basis of disease. (Biology Major Area A)

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

Typical periods offered: Spring

BIOL 3371 Eukaryotic Genomes

An advanced exploration of the structure and function of DNA within the eukaryotic nucleus. Lecture and discussion cover topics of chromatin and chromosome structure, control of gene transcription, RNA processing, and DNA replication and repair. The relevance of these topics to the genetic basis of human disease is discussed. Throughout, the experimental data that shape our current understanding are emphasized. Course grades based on exams, problem sets and short papers. Lecture 3 hours per week plus required discussion section meeting every other week. Prerequisites: Bio 2970, Chem 261 (may be taken concurrently). Offered every other fall in even numbered years.

Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI

Typical periods offered: Fall

BIOL 3411 Principles of the Nervous System

This course will provide a broad introduction to neuroscience, starting at the level of cellular and molecular neuroscience, and ultimately ending at systems and theoretical neuroscience, with emphasis on the organization of the mammalian central nervous system. Topics will include neuronal structure, the action potential, information transmission between neurons, sensory/motor systems, emotion, memory, disease, drugs, behavior, and network dynamics. A fundamental goal of this course is to provide students with the ability to approach complex problems using the scientific method and to understand the limits of knowledge. This course will also expose students to some of the neuroscience community at WashU. Bio 2960, Bio 2970 recommended, Bio 3058 recommended or Psych 3401 and permission of instructor. (Biology Major Area B)

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

Typical periods offered: Fall

BIOL 3421 Introduction to Neuroethology

The neural mechanisms of animal behavior from an evolutionary and ecological perspective. Topics include: contributions of model systems to understanding fundamental properties of nervous system structure and function; electrical signals of sensory cells, neurons, and muscle; neural processing of sensory input; neural control of behavioral output; anatomy and physiology of sensory and motor systems; learning and memory; evolution of neural circuits.

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

Typical periods offered: Spring

BIOL 3422 Genes, Brains, and Behavior
Genetic studies of physiological systems underlying animal behavior, including the genetic basis for normal and abnormal behaviors in animals and humans. Topics include: history of behavioral genetics; the ongoing debate about nature vs. nurture; contributions of genetic model systems including the nematode Caenorhabditis elegans, the fruit fly Drosophila melanogaster, zebrafish, the mouse Mus musculus, and other animal models; molecular mechanisms underlying the evolution of behavioral phenotypes; the emerging role of epigenetics in regulating nervous-system functions and behavior; the use of genetic and genomic analyses in studies of human behavior and psychiatric disorders. Prereq: Bio 2970
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 3423 Behavioral Genetics Laboratory
This course introduces students to fundamental concepts of how genes govern behavior by using the model system Drosophila melanogaster. Students learn modern and classic laboratory techniques, including fly crossing, genetic screens, behavioral assays, microscopy, and electrophysiology. Specifically, we use the GAL4/UAS system to assess the role of microRNAs in a variety of fly behaviors. A primary goal of the course is to develop real-world research skills by having students design, propose, and execute a set of novel research questions. Statistical analysis and interpretation of student data are emphasized. To build a solid conceptual background, lectures are given once per week, and students read, analyze, and discuss primary research articles. Understanding is assessed through journal club reports and presentations, research reports, and a final presentation of experimental results. This course is designed for upper-level students who have taken Biol 2960 and Biol 2970.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 3424 Great Discoveries in Neuroscience
A discussion-based course for advanced undergraduates in neuroscience that focuses on discoveries with major impacts on our understandings of how brains function. Readings include:Gordon Shepherd'sbook Creating Modern Neuroscience: The Revolutionary 1950s;papers in neuroscience of Nobel Laureates, Kavli Neuroscience Prize winners, and Brain Prize winners;and papers of great discoveries with the potential to inspire future revolutions in the field. Attendance at class meetings is required. Weekly written assignments include descriptions of course readings and summaries of discussions at class meetings. Course must be taken for a letter grade. Counts toward the Advanced Biology Elective requirement of the Biology: Neuroscience major.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 3430 Plants, Environment and Civilization
Human life, health, and civilization depend on plants. This course introduces basic plant biology, the role of plants in natural ecosystems, and the various uses of plants in both traditional cultures and in developed countries. Topics include the medicinal uses of plants, domestication of plants for agriculture, biotechnology and plant conservation. Does not count toward upper-division credits required for the major.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 3470 Darwin and Evolutionary Controversies
Focus is on controversies in evolutionary biology from Darwin's day to the present. Most of the controversies concern scientific issues such as Kelvin's estimate of age of the earth, Jenkin's argument against blending inheritance, neutral variations, effects of isolation on the role of selection, mass extinction and nemesis, but some address social issues such as evolutionary ethics and scientific creationism. Emphasis in the readings is on primary sources, including Darwin's Origin of Species. Writing Intensive. (Biology Major Area C)
Credit 3 units. A&S IQ: NSM, WI Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 3481 Parasitology
This course introduces students to the fundamentals of parasitism. Throughout the semester, students not only learn about parasite biology (examples: parasite life cycles, host immune responses, parasite evasion mechanisms), but also how parasites make a broader impact (examples: co-evolution of hosts and parasites, parasites as indicators of environmental health, the challenge of parasite control). Topics include, but are not limited to, parasite diversity and classification, life cycles, host evasion mechanisms, pathology, disease, control, types of hosts and their immune responses, and the impact that parasites have on ecology and conservation biology. 3.0 Credit Hours. Prerequisites: Principles of Biology I (Biol 2960) and II (Biol 2970) (Biology Major Area A)
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 3490 Microbiology
This four credit lecture course focuses on the molecular biology of bacteria, archaea, and viruses. Topics include: the bacterial cell cycle, gene regulation, stress response, cell-cell communication, viral and bacterial pathogenesis, microbial ecology, and metabolic diversity. Friday tutorials stress analysis of the primary literature with an emphasis on current research related to material covered in lecture. Prerequisites: Biology 2960, and 2970, or permission of instructor.
Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 3491 Microbiology Laboratory
After introducing students to the basics of bacterial growth and maintenance, this laboratory class employs microscopy, genetics, cell biology, and genomics to explore various aspects of bacterial physiology, structure, and identification. Students will present finding throughout the semester in both written and oral format. Roughly one hour lecture and five hours of laboratory per week. Fulfills the upper - level laboratory requirement for the Biology major.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall, Spring, Summer

BIOL 3492 Laboratory Experiments With Eukaryotic Microbes
This research-intensive course provides an introduction to diverse molecular and cell biology techniques used in model experimental organisms to explore fundamental biological questions. Experiments are performed using selected fungi and protozoans commonly used in major research efforts. Emphasis is placed on choosing the appropriate organism for the question posed using the most current technologies. Each semester, one cellular process is studied in detail and original research is carried out. Prerequisites: Bio 2960 and 2970 and permission of instructor-- contact early to ensure enrollment. One hour of lecture and six hours of laboratory a week. Fulfills the upper-level laboratory requirement for the Biology major. Enrollment limited to 12.
Credit 3 units. A&S IQ: NSM, WI Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 3493 Bacterial Bioprospecting and Biotechnology
Many bacteria are essential in food industry (fermentation of meats, cheeses, and beverages), agriculture (crop protection against weeds, pathogenic bacteria, and fungi), biotechnology (producing fine chemicals, cofactors, amino acids, and industrial enzymes) and the pharmaceutical industry (producing clinical antibiotics, anticancer, antiviral, veterinary, and immunomodulatory drugs). This laboratory course examines how basic biological understanding can lead to discovery of bacterial products, enzymes and activities useful to humankind. We combine core concepts from biochemistry, bacterial genetics, bioinformatics, chemistry and enzymology to study bacteria from the genus Streptomyces and close relatives. Lines of inquiry include environmental isolations, molecular toolbox and host development, plus bioinformatic and laboratory-based analyses of secreted proteins and antibiotics. Prerequisites: Bio 2960 and 2970. One hour of lecture and six hours of laboratory per week. This course fulfills the laboratory requirement for the Biology major. Enrollment limited to 16. Credit 3 units. J. Blodgett
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall, Spring

BIOL 3494 Microbes and the Environment
From the origins of life to global biogeochemical cycling. An examination of microbes (archaea, bacteria, fungi, yeasts, protist and viruses) in the vast array of environments in which they occur, from wetlands and lake sediments, aquifers and deep crustal settings, to polar ice and desert surfaces. Emphasis on the roles that microbes play in biogeochemical cycles, redox processes, contaminant mobility, biodegradation, and ecosystem productivity. The emphasis will be placed on case studies and students will be expected to participate in-class discussions. Prerequisites: Bio 2970: Principles of Biology II (students with only Bio 2960 can contact the instructor for permission to take the course), Chem 106: Introductory General Chemistry II or Chem 112: General Chemistry II, graduate standing, or permission of Dr. Bose. Chem 252:Organic Chemistry II strongly recommended.
Credit 4 units. A&S IQ: NSM
Typical periods offered: Fall

BIOL 3501 Evolution
A general survey of evolutionary biology, covering both micro- and macroevolution. Topics include natural selection, genetic drift, gene flow, sexual selection, kin selection, pathogen evolution, speciation, phylogenetics, molecular evolution and evolutionary-developmental biology. Weekly discussion sections focus on analysis of recent studies related to lecture topics. Prerequisite: Bio 2970. (Biology Major Area C)
Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 3700 Animal Behavior
This course examines animal behavior from an evolutionary perspective and explores the relationships between animal behavior, ecology, and evolution. Topics include foraging behavior, mating systems, sexual selection, predator-prey relationships, cooperation and altruism, competition and parental care. A student may not receive credit for more than one of the courses Biol 370, Biol 372 and Biol 472. Prerequisite: Biol 2970 or permission of instructor. (Biology Major Area C)
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 3730 Laboratory On the Evolution of Animal Behavior (Writing Intensive)
This course explores the costs, benefits and constraints that drive the evolution of animal behavior. It is divided into four modules that cover a range of common empirical and numerical tools in modern evolutionary biology (no prior experience in any of the following topics is necessary): (1) a brief overview of basic statistics and a tutorial in R; (2) an experimental lab on agonistic behavior in crickets; (3) a computer simulation lab on the evolution of animal communication; and (4) a phylogenetic comparative analysis lab exploring the topic of sexual selection. Laboratory modules are hands-on and student driven. They begin with an overview of relevant literature and a discussion of key questions that have been addressed experimentally in that field. Students are then encouraged (and guided) to apply these concepts to the design, execution, and analysis of individual and/or collaborative research projects. In the process, they learn how to apply some of the latest numerical and/or empirical research tools in evolutionary biology. A majority of class time is devoted to active learning through the collection and analysis of data (each lab module lasts four weeks). The course also includes weekly presentations by the instructor and class discussions on topics that help place the students' work into the broader context of evolutionary theory. Prerequisites: Biol 2970 and Psych 100B or permission of instructor. This course is Writing Intensive.
Credit 3 units. A&S IQ: NSM, WI Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 3810 Introduction to Ecology
This course explores the central theories and principles in ecology and evolution, and the use of these principles to study and predict human-induced environmental changes. It emphasizes understanding species interactions and population dynamics in biological communities, and the relationships between communities and their environment. It regularly touches on applications of these principles such as ecological responses to global climate change, consequences of habitat fragmentation, disease ecology, and conservation medicine. Principles of experimental design, quantitative data analysis and interpretation, and mathematical models are critical to the field of ecology and are also emphasized throughout the course. Class meetings will include lectures, class activities, computer simulation labs, and smaller group discussions to familiarize students with peer-reviewed journals, scientific writing, and current issues in ecology. Assignments include regular homework reading, occasional problem sets, participation in tutorials/discussions, and a small term-paper.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall, Spring

BIOL 3900 Science for Agriculture and Environmental Policy
Government policies at the local, state, and national levels determine and regulate activities that range from local farmers markets to U.S. membership in the Paris Climate Agreement. Science can and should play a critical role in developing policy. This course focuses on the biological science behind policies for climate change and agricultural practice as well as the role of various organizations in providing science for policy. Now is a particularly interesting time for science-based policy with the election of a new U.S. President and the elevation of the President's science advisor to Cabinet level. This course is divided into three parts. First, we review how policy is developed and how various agencies and actors affect policy. The next section looks at biological topics that have policy implications. These case studies are presented by expert speakers who have had experience in various science-related roles in the federal government, foundations, professional associations, advisory organizations, and scientific publications. Finally, students conduct individual research projects on a science topic that affects current legislative efforts, either state or national. Students investigate the basic science of their chosen topic and how this could affect proposed legislation. As part of the research project, students give a class presentation, lead a class discussion, and write a term paper

on the foundational biological science. The goals of this course are as follows: (1) to develop an understanding of how science is used to develop policy by examining case studies presented by experts; and (2) to critique a proposed science-based policy either at the state or federal level.

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

Typical periods offered: Fall

BIOL 3990 Undergraduate Teaching

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

Credit 3 units. A&S IQ: NSM

Typical periods offered: Fall

BIOL 3991 Undergraduate Teaching

Exceptional undergraduates serve as teaching assistants for laboratory and/or discussion sections in departmental courses. Normally 2 or 3 units are given per semester, subject to the approval of the instructor and the department. Credit may not be counted toward fulfilling the biology major; application form in Department of Biology Student Affairs office. Prerequisite: permission of instructor. Credit /No Credit only.

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

Typical periods offered: Spring

BIOL 3995 Biology Coursework Completed Abroad

This course is for study abroad credits.

Credit 12 units.

Typical periods offered: Fall, Spring, Summer

BIOL 3996 Elective: 300-Level

This course is for elective or transfer credits.

Credit 3 units.

Typical periods offered: Fall, Spring

BIOL 4000 Introduction to Biochemistry

This course provides a basic understanding of the molecular structure of biomolecules, the metabolic processes by which these molecules are synthesized and degraded, and the energy produced to support cellular processes. It includes a study of enzyme kinetics and metabolic control mechanisms. Prerequisite: Chem 261 (either with lab or lecture only is acceptable) or permission of instructor. Priority given to students enrolled in the Post-Baccalaureate Premedical program.

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

Typical periods offered: Fall, Spring

BIOL 4005 Advances in Cellular & Molecular Biology

will examine some of the fundamental principles of cellular processes at the molecular level. Among the major topics covered are nucleic acid chemistry, gene structure and organization in prokaryotes and eukaryotes, gene expression, and recombinant DNA and transgenic/knockout (including conditional knockout) mouse technology. The topic of the CRISPR/Cas system used for gene editing is also be included. In addition, the idea of genes and genomes will be discussed with an introduction to functional and comparative genomics. In particular, emphasis in the second half of the semester will be on the various modes of regulation of gene expression and protein synthesis, and some of the various methodologies utilized to address these topics. In addition, the concepts of siRNA, miRNA, and the phenomenon of RNA-interference will be covered with the topic of micro-RNA and disease, and the importance of these small non-coding RNA molecules, highlighted by presentation of material from the scientific literature. Also included will be a major publication showing how RNA interference can be used as a tool to unlock the secrets of human embryonic stem cells. A number of commonly used molecular biology and biochemical lab techniques will also be covered, in addition to more recent tools such as RNA seq that can be used to address global changes in transcriptional profiles. Course prerequisites: At least one 100/200 level class in Biology and one 100/200 level class in Chemistry or Biochemistry. This course does not count toward the undergraduate biology major. MA in Biology students should register for the IDENT L41 5005. Undergrads and PBPM students should register for 4005.

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

Typical periods offered: Spring

BIOL 4025 Current Approaches in Plant and Microbial Research

This course is designed to introduce graduate students and upper-division undergraduates to contemporary approaches and paradigms in plant and microbial biology. The course will include lectures, in-class discussions of primary literature and hands-on exploration of computational genomic and phylogenetic tools. Evaluations will include short papers, quizzes, and oral presentations. Over the semester, each student will work on conceptualizing and writing a short NIH-format research proposal. Particular emphasis will be given to the articulation of specific aims and the design of experiments to test these aims, using the approaches taught in class. Students will provide feedback to their classmates on their oral presentations and on their specific aims in a review panel. Fundamentals of Biology II: Genetics (Bio 2970) or permission of the instructor.

Credit 4 units. A&S IQ: NSM Art: NSM

Typical periods offered: Spring

BIOL 4026 How Plants Work: Physiology, Growth, and Metabolism

This course introduces students to the fundamentals of how plants grow, metabolize and respond to their environment. Topics to be covered include the conversion of light energy into chemical energy through photosynthesis and carbon fixation, nitrogen assimilation, water and mineral uptake and transport, source-sink relationships and long-distance transport of carbon and nitrogen, cell growth and expansion, hormone physiology and physiological responses to a changing environment. Prerequisite: Bio 2960 and Bio 2970, or permission of instructors. (Biology Major Area B)

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

Typical periods offered: Fall

BIOL 4027 Viruses and the Diseases They Cause

The goal of this course is to discuss different families of viruses that are important human pathogens. For each of these families of viruses we will discuss the following three aspects as it relates to their clinical significance.

1. The diseases that they cause. The clinical manifestations, the geographic extent of these infections, the consequences of these infections on the populations affected by the virus being discussed.
2. Mechanisms they use to evade host defense mechanisms. Each of these families of viruses have a unique set of factors that they produce that enable them to evade host responses. We will discuss these factors and how they specifically target our responses to the infections they cause.

3. Current therapies used to treat these viral infections. This would include both drug therapies, immunizations and even environmental aspects that predispose a particular geographic region to infection by a specific class of viruses.

Each class will involve both lecture and discussion of relevant publications that are associated with the topic being discussed that class. There will be two exams, a mid-term and a final that will not be cumulative. Note: This course does not count toward the undergraduate Biology major. It is intended for PBPM students.
Credit 3 units.
Typical periods offered: Fall

BIOL 4030 Biological Clocks
Biological clocks are the endogenous oscillators that coordinate physiological and behavioral rhythms in nearly all organisms. This course examines how these rhythms are generated and regulated. The material includes molecular, cellular and systems physiology and the relevance of biological timing to ecology and health in everything from protozoans to plants to people.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 4040 Laboratory of Neurophysiology
Neurophysiology is the study of living neurons. Students record electrical activity of cells to learn principles of the nervous system including sensory transduction and coding, intercellular communication and motor control. The course meets for 9 hours each week. Students may leave the lab for up to 2 hours. Prereq: Bio 3411 or Psych 4411 AND PERMISSION of Student Coordinator, Erin Gerrity. Bio 3411 may be taken concurrently.
Credit 4 units. A&S IQ: NSM, WI Art: NSM
Typical periods offered: Fall

BIOL 4060 Introduction to Biochemistry
This course provides the student with the basics of biomolecules and their structures, bioenergetics, mechanisms, kinetics, and major metabolic processes. The course assumes students have a strong foundational background in biology, general and organic chemistry.
Credit 3 units.
Typical periods offered: Fall

BIOL 4071 Developmental Biology
An introduction to the molecular and cell biology of animal development. The course is divided into three broad sections, which cover 1) an introduction to the major cell-cell signaling systems used during development and their study in model organisms, 2) molecular studies of early vertebrate development, and 3) the biology of stem cells. The focus is on molecular approaches applied to important model systems, but framed in classical concepts. Prereqs.: Principles of Biology II (Biol 2970); Cell Biology (Biol 334) and/or a course in biochemistry recommended. Small Class. Credit 3 units.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 4072 Regenerative and Stem Cell Biology
Regeneration is a very complex, post-embryonic developmental phenomenon, where organisms replace lost body parts and organs upon injury. However, we still know very little about why some animals are so successful at regenerating whole bodies and organs, while other animals (like humans) have limited or no capacity to do so. This course covers regeneration and stem cell biology across different levels of biological organization (e.g. cell, organ, limb regeneration.) and across the animal phylogeny. Students learn about mechanisms of regeneration at the cellular and molecular level, and how these mechanisms vary among organisms. In addition to the general principles of stem cells and regenerative biology, the course will be a good introduction to animal diversity and evolutionary developmental biology (evo-devo). Students will read and discuss primary literature, and write up their own experimental design to test hypotheses. Prerequisites: Bio 2970 (Principles of Biology 2 - Genetics) (Biology Major Area B)
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 4105 Topics in Anthropology: Biomechanics
Humans, like all organisms, live and evolved in a world that is governed by the rules of physics. Such an engineered world has undoubtedly had a profound impact on the human evolutionary trajectory. Biomechanics is the science of understanding the natural world around us in a mechanistic fashion, and it has become a major pillar in investigating the human form and function. Understanding how humans and our closest relatives behave in and interact with a physical world can lead to novel insights into the evolution of complex traits, whether it involves investigating the mechanics of tissues and structures of the human body or understanding the principles of movement and locomotion. Through lectures, discussions and hands-on experiences, this course will explain biomechanical terms and principles to demonstrate how this discipline has contributed to biological anthropology.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 4114 Neuroplasticity: Wiring and Rewiring of the Brain
Neuroplasticity: Wiring and Rewiring of the Brain' discusses the brain's remarkable ability to change, reorganize, and grow its neural networks. Our brains are constantly evolving; new and relevant connections are strengthened while irrelevant ones are eliminated. This phenomenon is known as neuroplasticity. This course examines how the brain reshapes itself at molecular, neural, and systemic levels. It explores both endogenous (internal) and exogenous (external) factors involved in this process, highlighting the significant contributions of this emerging field of neuroscience. Students learn how to rewire the brain more effectively to enhance its plasticity, which can improve cognitive capacity, enhance learning, prevent memory loss, and promote overall brain health. Understanding of this fascinating area of neuroscience is being applied in various fields, including mental wellbeing and behavioral health, neuroprotection against age-related declines, artificial intelligence, and medicine. Students also explore how the systematic reinforcement of sensory environments, healthy sensory inputs, and brain exercises can boost brain capacity by creating new circuits. Conversely, toxic living conditions and unhealthy lifestyles can negatively impact brain function. Additionally, recent research findings, journal articles, and publications in this emerging area of neuroscience will be reviewed.
Credit 3 units. A&S IQ: NSM
Typical periods offered: Fall

BIOL 4139 Global Environmental Change and Thermal Ecology
We are living in an unprecedented period in which global habitats are experiencing massive changes at an alarming rate. Turnover of forest, grassland, and wetland into human-dominated landscapes reduces the availability of habitat to support species. Furthermore, the near unabated release of greenhouse gases is transforming Earth's climate; the world is getting warmer, and patterns of rainfall are shifting. The principles of thermal ecology -- that is, the relationship between temperature and biological processes at different levels of organization -- provides a framework for understanding how organisms

respond to fluctuating temperatures. This course focuses on the thermal challenges organisms face in a warmer world. Topics include evidence of anthropogenic climate change; quantifying the thermal environment; how temperature influences physiological processes and in turn variation in life history traits; population dynamics; and the role of phenotypic plasticity. The course format includes lectures, discussions, and the application of simulations and models to forecast species response to altered environments. Prerequisite: Biol 381.
Credit 3 units. A&S IQ: NSM
Typical periods offered: Fall

BIOL 4181 Population Genetics
An introduction to the basic principles of population and ecological genetics. Mechanisms of microevolutionary processes; integrated ecological and genetic approach to study the adaptive nature of the evolutionary process. Prerequisite: Bio 2970.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall, Spring

BIOL 4182 Macroevolution
An advanced introduction to the study of macroevolutionary patterns and processes with emphasis on the systematic methodology employed. Topics: theories of classification, phylogenetic reconstruction, testing of historical hypotheses, hierarchy theory, adaptation, extinction, speciation, developmental mechanisms of organismal evolution, biogeography.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 4183 Molecular Evolution
A rigorous introduction to the study of evolution at the molecular level. Topics include the origin, amount, distribution and significance of molecular genetic variation within species, and use of molecular data in systematics and in testing macroevolutionary hypotheses. Prerequisite: Bio 2970, or permission of instructor.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall, Spring

BIOL 4191 Biology Field Course in Ecology
This course includes filed coursework in Biology.
Credit 3 units.
Typical periods offered: Summer

BIOL 4193 Experimental Ecology Laboratory
The goal of this course is to provide skills in the design, interpretation, and written presentation of ecological and evolutionary experiments, with emphasis on sampling methodology, hypothesis testing, and data analysis. A key objective of this course is to familiarize students with the importance of statistics and experimental design as unified tool, rather than two separate processes. We will practice how to abstract theories, hypotheses, predictions, mathematically, how to contrast them with data, and interpret the results. The course does not seek to be exhaustive of all experimental designs or statistical techniques, nor intensive in any given one. Rather, its focus is on providing the tools and concepts for the critical evaluation, choice, interpretation and further independent learning of the experimental and statistical tools needed for research. Practical analysis of data will be taught in program R, but no prior knowledge is required. During the course, students will plan and execute their own ecological studies, within the limitations of the current pandemic. This is a writing intensive course and grades are based on written assignments, including final projects, and in-class participation. This course fulfills the upper-level laboratory requirement for the Biology major. Prereq: Permission of instructor and at least one of the following: Bio Bio 3501, Bio 372, Bio 381, Bio 419, or Bio 472. Enrollment is limited to 10 students. Credit 4 units.
Credit 4 units. A&S IQ: NSM, WI Art: NSM
Typical periods offered: Fall, Spring

BIOL 4195 Disease Ecology
Disease ecology is an interdisciplinary field that bridges concepts from fields including population ecology, community ecology, landscape ecology, and evolutionary biology. This course provides an introduction to the study of infectious diseases with an emphasis on theoretical, experimental, and quantitative approaches. The course will integrate studies of infectious diseases from across disciplines including human epidemiology, veterinary medicine, wildlife epidemiology, plant pathology, parasitology, and ecology. Principles of Biology II (Bio 2970) required, Introduction to Ecology (Bio 381) recommended, or permission of instructor.
Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 4197 Community Ecology
Community ecology is an interdisciplinary field that bridges concepts in biodiversity science, biogeography, evolution and conservation. This course provides an introduction to the study of pattern and process in ecological communities with an emphasis on theoretical, statistical and experimental approaches. Topics include: ecological and evolutionary processes that create and maintain patterns of biodiversity; biodiversity and ecosystem function; island biogeography, metacommunity dynamics, niche and neutral theory; species interactions (competition, predation, food webs), species coexistence and environmental change. The class format includes lectures, discussions, and computer labs focused on analysis, modeling and presentation of ecological data using the statistical program R. Prereq: Bio 2970 required, Bio 381 recommended, or permission of instructor. (Biology Major Area C)
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 4220 Practical Bioinformatics
From medicine to genomics to ecology, all fields of biology are now generating large and complex datasets that can only be analyzed using computational approaches. This course introduces computational techniques and perspectives to biologists that are new to computational thinking. Students will learn how to design research workflows, decompose complex problems into simpler solvable units, and apply scientific computing principles to research. In addition, students will practice foundational computing skills, such as using the UNIX operating system on research clusters, writing custom analysis programs with shell scripts and with Python, and summarizing and visualizing analysis output. The laboratory exercises build on one another, culminating in the construction of a bioinformatics pipeline that can process and analyze molecular data. Students will apply their newly learned computational skills and use their pipeline to analyze virus sequence evolution and explore evolutionary models. Prerequisites: Biol 2970; Math 132 (Calculus II); Math 223 (Calculus III) or Math 2200 (Elementary Probability); CSE 131 (Computer Science I; suggested course); permission of instructor. Credit/no credit.
Credit 4 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 4240 Immunology
Basic molecular and cellular aspects of the vertebrate immune system with emphasis upon the interrelationships of non-specific and specific host defense against disease, the nature of immunological specificity and its underlying molecular biology. Includes complement systems,

immunochemistry, the nature of cellular activation and effector generation, immunodeficiency, tolerance, tissue transplantation, hypersensitivity, immune regulation and specific diseases illustrative of the successes and failures of the immune system. Case studies will be presented by the students on an array of immune system disease. Prerequisites: Bio 2970 and Chem 262. Interested Juniors in their second semester are particularly encouraged to register for this course.
Credit 4 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall, Spring

BIOL 4242 Virology
Viruses are all around us and play key roles in health, evolution, ecology, agriculture, and can even completely disrupt societies. In this course, we explore the wide array of viruses, the basics of their structure, the infection cycle, their role in human health, and how we can adapt viruses for uses in research, agriculture, and biotechnology. Emphasis is on animal viruses, specifically medically relevant viruses, including HIV and SARS-CoV-2, and recent advances in virology. While primarily a lecture-based course, students present on a relevant virus and read primary literature. Prerequisite(s): Either BIOL349 (Fundamentals of Microbiology) or BIOL334 (Cell Biology).
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 4243 Immunology Laboratory
The Immunology Laboratory will introduce students to a variety of common, broadly useful immunological techniques and then allow each student to employ most of the learned techniques in addressing a current research question. Experiments will employ mouse cells in vitro and will emphasize quantitative analysis of the data. Prereq: Bio 424 and permission of instructor.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall, Spring

BIOL 4244 Advances in Immunology
The goal of this course is to provide students with an overview of the mammalian immune system.

1. We will begin with a general overview of the immune system.
2. We will then discuss the specific cells and factors that constitute the immune system.
3. We will describe how the immune system detects and defends us against attack by pathogenic microbes.
4. We will describe how foreign tissues are recognized, rejected and what therapies for preventing that from taking place.
5. We will discuss aberrant immune responses that would result in under-responsiveness or over-responsiveness.
6. We will finally cover how the immune system responds to malignant tumor growth and how those cancers evade detection and destruction as well as what therapies are available to aid the immune system to attack the cancer.

The class will run for 2 hours and 50 minutes and consist of a 75 to 120 minute lecture that is followed by student presented discussions of relevant publications to that topic being discussed that lecture. This will be for those students who select that option for their individual responsibility (see below). In the event that there are no student presentations scheduled for a particular class period, the instructor will present an article associated with that lectures topic. Note: this course does not count toward the undergraduate Biology major, it is intended for PBPM students.
Credit 3 units. A&S IQ: NSM
Typical periods offered: Fall

BIOL 4270 Problem Based Learning in Biomedical Sciences
Groups of 5-8 students are presented with medical case studies that are then researched and discussed under faculty guidance. Students take major responsibility for their own learning within their team. Prerequisite: Bio 2970; some experience in molecular biology. A biology or science background is required. Same content as discontinued course Bio 427, but not Writing Intensive. Not available to students who have credit for Bio 427.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Spring

BIOL 4271 The Science of Cats
This capstone-style course will give students the opportunity to apply what they've learned in topics as diverse as speciation, molecular evolution, community ecology and animal behavior to investigate and analyze questions concerning the biology of a species near and dear to the hearts of many, Felis catus, the domestic cat. Over the last several decades, scientists have studied cats in the same way they have studied lizards, birds, flies and many other species. This cat research allows questions of broad scientific interest to be addressed using cutting-edge methods, including (but not limited to): what is a species? How do new species arise? How do we determine when, where and from what species the cat evolved? How do we determine if a trait (e.g., response to catnip) evolved as an adaptation driven by natural selection? How do we determine the impact of an invasive species on local ecosystems? How does domestication occur and is the cat actually domesticated? Is the behavior of domestic cats a legacy of their evolutionary past or does it represent adaptation to living with humans? What role, if any, can genetic engineering play in decreasing feral cat populations and developing new breeds of cats with desirable traits.
Credit 3 units. A&S IQ: NSM
Typical periods offered: Spring

BIOL 4290 Cellular Transformations
Cellular Transformations is a course developed for students interested in using emerging technologies and cross-disciplinary approaches in design production and implementation. This course allows each student to develop abstract thinking and learn modern design and fabrication processes including digital media and 3D technologies. In this course, students learn the basic principles underlying biological architecture, with a particular emphasis on structures and processes responsible for complex architectures within cells. Students then use biological design principles as inspiration for their individual projects. Through digital modeling and scanning of biological structures, each student will develop a transformation process that analyzes the performative aspects of a new emerging design. These designs will be modeled through CADCAM (laser cutting) and Rapid Prototyping (3D Printing) for physical outputs. Prerequisites: Bio 2970 or Bio 334, 3 units.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 4310 Biology of Aging
This course provides concepts and examples of the biology of aging. We discuss current literature with emphasis on theoretical causes of aging and the practical implications of these theories. Major topics include the biochemical processes of aging, cell cycle senescence, age-related organ dysfunction, interventions to alter the aging process, and medical illnesses associated with aging (e.g., Alzheimer's disease, the dementias). We also study animal and human models for extending longevity, and current approaches for dealing with the aging process are included. Prerequisites: Biol 2960 and Biol 2970 or equivalent; Chem 105 and Chem 106 or equivalent are recommended.

Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 4342 Research Explorations in Genomics
A collaborative laboratory investigation of a problem in comparative genomics, utilizing a variety of bioinformatics tools to manage and investigate large data sets (currently including genomic sequences, gene predictions, sequence conservation, gene expression). In spring '18 the research problem involves improving the sequence of a region of the Drosophila eugracilis genome, and working with one of these sequences to examine patterns of genome organization, gene structure and gene regulation. Prerequisites: Bio 297A, Chemistry 111/112, 151/152. While Bio 3371 or Bio 437, and some familiarity with computers would be advantageous, this is NOT required. Fulfills the upper-level laboratory requirement for the Biology major.
Credit 4 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 4343 Research Explorations in Genomics (Writing-Intensive)
Content equivalent to Bio 4342. Students electing the writing option are required to revise each of three papers (on finishing of their fosmid; gene finding in a human/chip comparison; and annotating their fosmid) at least once.
Credit 4 units. A&S IQ: NSM, WI Art: NSM
Typical periods offered: Spring

BIOL 4345 Epigenetics
Introductory course in epigenetics - the layer of chemical information that sits on top of the genome - that switch genes 'on' or 'off'. Will introduce how the epigenome, in collaboration with the genome, controls versatile biological processes and cell fates. Will also cover the latest advances of how humans can control their own epigenetic destiny by lifestyle, diet, and other environmental factors. Learning Objectives: Recognize and summarize the difference between genetics and epigenetics, Apply the basic knowledge of epigenetic mechanism and illustrate how their misregulations cause abnormal development and diseases, Critically review and discuss epigenetic literature, Design epigenetic experiments and interpret the results of those experiments, Graduate student specific: Demonstrate the ability to clearly communicate epigenetic research in both oral and written formats. Prerequisite: (Biology Major Area A)
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 4346 Next-Gen Genetics: Merging Genetics With Genomic Insights
Forward genetics is a research approach that starts with identifying phenotypic variation (an observable trait or characteristic) and then works towards discovering the genetic basis responsible for that variation. In the dynamic era of genomics, the field of forward genetics offers a powerful approach to uncovering the genetic basis of phenotypic variation across a wide array of organisms. Next-Gen Genetics is a cutting-edge upper-level laboratory course that bridges traditional genetic analysis with modern genomic techniques. The course emphasizes the universality and applicability of forward genetics methods in various research systems including animals, plants, and microbes. In this course we will use plants as a model system to explore forward genetic approaches. Through a blend of engaging lectures, interactive bioinformatics labs, and hands-on greenhouse and wet lab sessions, students will journey from the fundamentals of genetic variation and trait inheritance to the forefront of genomic technology. Using next-generation sequencing (NGS) together with bioinformatics tools, participants will experience the thrill of discovery by identifying new trait loci associated with phenotypic traits in a novel research project. This course is an invitation to explore the genetic complexities of living organisms in the genomic age. Whether you're aiming to revolutionize plant breeding, uncover the genetic underpinnings of disease in humans, or explore the vast diversity of microbial life, Next-Gen Genetics offers the tools and insights to propel your scientific journey. By the end of this course, students will have designed and carried out an experiment, phenotyped a segregating population of tomato plants, extracted DNA and sent it to be sequenced. Students will then analyze genomic sequences and perform their own Bulk Segregant Analysis experiment to identify genetic loci associated with chosen phenotypes.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 4370 Laboratory On DNA Manipulation
This course provides investigation-driven research on experimental manipulation of DNA and RNA molecules. This includes the construction, isolation and analysis of plasmids, RNA, PCR products and DNA sequencing. Molecular cloning (genetic engineering), gene knockouts (mutants), RNA isolation, RT-PCR, and microarray projects are performed. Prerequisite: Bio 2960 and Bio 2970. One hour of lecture and six hours of laboratory each week. This course fulfills the upper-level laboratory requirement for the Biology major. Enrollment is limited to 12. A laboratory fee is required for students who are not full-time Washington University undergraduates.
Credit 4 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall, Spring

BIOL 4381 Cell-Based Tissue Engineering and Regenerative Medicine
This course focuses on how new directions in cellular, molecular and developmental biology are interfacing with advances in biomaterials tissue engineering, innovative devices, and advanced technologies (such as 3D printing and CRISPR) to replace, restore, and/or correct genetic, acquired, or damaged tissues and organs. Coverage includes the rapidly expanding use of types of stem cells and their preparation alone or in concert with biomaterial scaffolds, nanomaterials, and growth factors. Tissue engineered therapies for cancer, diabetes, autoimmune disorders and other conditions are reviewed. Examples of tissue engineering approaches for regeneration of nerves, cardiovascular, kidney, cartilage, bone, ligament, tendons, and skin are discussed in some detail. Regulatory issues, ethical guidelines, and commercial perspectives will be woven into our discussions. Prerequisites: Biol 2970, Biol 3058, Biol 334. (Biology Major Area B)
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 4438 Principles of Virology
The goal of this course is to provide students with an overview of the biology of viruses. We will emphasize the nature of viruses on a molecular level. In so doing we will: 1.We will discuss how viruses gain access to cells, replicate themselves, and then leave the cell to infect new cells. 2.We will also describe differences and similarities that the different categories of viruses have. 3.We will discuss how viruses participate in host-virus interaction with emphasis on what immune responses are generated and how viruses attempt to avoid those responses. 4.We will also specifically discuss both HIV and tumorigenic viruses. 5.Finally we will discuss vaccination and drug therapies that have been developed to defeat viruses. Each class will involve both lecture and discussion of relevant publications to that topic. There will be two exams, a mid-term and a final exam. Keep in mind that the course is designed so that each class, to one degree or another, builds on the previous material and so it is important to fully understand what we have already covered. This course does not count toward the undergraduate biology major. MA in Biology students should register for the IDENT 5438. Undergrads and PBPM students should register for 4438.

Credit 3 units. A&S IQ: NSM

Typical periods offered: Spring

BIOL 4479 Fundamentals of Parasitology

This course covers a variety of clinically relevant parasitic organisms and their importance to human disease. During this course we will: 1.The Semester is divided into two halves. a.The first half will discuss clinically relevant worm parasites. b.The second half will discuss protozoan parasites that cause multiple types of diseases. 2.For each of the parasitic classes discussed we will present general characteristics of the parasite as follows: a.The lifecycle of the particular parasite. b.The clinical disease profile. c.Interactions of parasites with the host immune response both in terms of mechanisms whereby the host resists infections by these organisms and also how these parasites circumvent the host's ability to eliminate them. d.Because so much of the clinical importance of parasites has to do with this interaction, we will also cover general aspects of the workings of the immune system. There will be an emphasis on the nature of the host-parasite interaction on a molecular level. e.Finally we will discuss what available therapies are available and what potential therapies are being developed. 3.These lectures will include discussions of recent literature concerning parasites and their interactions with the host. This class does not count toward the undergraduate biology major. MA in Biology students should register for the IDENT 5479. Undergrads and PBPM students should register for 4479.

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

Typical periods offered: Spring

BIOL 4490 Microbial Physiology and Biochemstry

This course covers the physiology and biochemistry of prokaryotes. The emergence of new and drug-resistant infectious diseases has required scientists to understand in depth how bacteria grow and survive. With recent research showing that microbes thrive in diverse habitats ranging from the antarctic to volcanos to our own stomachs (with pH of 2), a natural question is how? In this course, basic tenets on cell structure and growth are discussed as well as the diversity of metabolic pathways that allow the prokaryotes to inhabit the extreme limits of our environment on earth and in humans. No textbook is required but primary literature and reviews will be used on selected, important topics in the field. Students will learn how to read, review and write scientific papers, reports, and grant proposals. One hour per week TBA will be a required flex time meeting with instructor. Prereq: Bio 349 or a 400 - level Biochemistry course (grade B or better) or graduate student standing. 4 credit hours. WI

Credit 4 units. A&S IQ: NSM

Typical periods offered: Spring

BIOL 4492 Infectious Diseases: History, Pathology, and Prevention

Leveraging the primary research literature, this course examines the history and pathology of infectious disease, the development of antibiotics and vaccines, the rise of antibiotic resistance, and the emergence and reemergence of diseases including Zika virus, Malaria, and Tuberculosis. In addition to gaining insights into the underlying causes and treatment of infectious disease, students will hone their ability to identify important biological questions, develop testable hypotheses, design experiments tailored to particular questions, and evaluate results. Through a series of written and oral assignments, students develop the skills to communicate about science effectively to both the research community and the general public. Prerequisites: One semester of Biology 500: Independent Research or equivalent is REQUIRED. Preference will be given to students who have completed Biology 349, Fundamentals of Microbiology. Area A. 3.0 units. Writing Intensive. P. Levin.

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

Typical periods offered: Fall

BIOL 4510 General Biochemistry

A study of structure-function relationships as applied to carbohydrates, proteins, and lipids; intermediary metabolism of principal cellular components; and general aspects of regulation. Prereqs: Biol 2970 and Chem 262 and permission of department. Recommended for students who have achieved grades of B or better in the prerequisites. Students may not receive credit for both Biol 4801 and Biol 451.

Credit 4 units. A&S IQ: NSM Art: NSM BU: SCI

Typical periods offered: Fall, Summer

BIOL 4519 Protein Function in Model Cellular Systems

The goal of this 3-credit laboratory course is to train students in the scientific method. Throughout this course, they will study a protein involved in a cellular process. Students, working in small groups, will use bioinformatics to identify this protein in a number of species, then use this information to hypothesize which residues of the protein are important for its function. Over the course of the semester, students will test their hypotheses in two model systems for studying cellular function - the unicellular eukaryote Saccharomyces cerevisiae and the multicellular eukaryote Physcomitrella patens. The weekly lecture will give students the background necessary to understand and perform their experiments, including information on a variety of bioinformatics tools, phylogeny, protein structure, molecular techniques, cell biology, and microscopy. In addition, students will use primary literature to understand the role their assigned protein plays in their cellular process. Prereq: Bio 2960 and Bio 2970.

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

Typical periods offered: Fall

BIOL 4522 Laboratory in Protein Analysis, Proteomics, and Protein Structure

In this laboratory course, students learn principles and methods of protein quantitation, protein purification, assessment of purity using SDS-polyacrylamide gel electrophoresis, separation of complex protein mixtures by two-dimensional gel electrophoresis, definition of units of enzymatic activity, and identification of proteins using antibodies and/or mass spectrometry. The final part of the course introduces students to concepts of structural biology including protein crystallization, x-ray crystallography and computer modeling of protein structures. Fulfills the upper-level laboratory requirement for the Biology major. Prerequisites: Chem 252 and either Bio 451 or Bio 4501/Chem 456. Permission of instructor required. Limit: 8 students. Eight hours of laboratory/lecture per week.

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

Typical periods offered: Spring

BIOL 4523 Molecular Methods in Enzyme Analysis

Understanding enzyme structure and function is essential for many important drug-design projects. This course focuses on common methods used to investigate enzyme active sites to elucidate binding interactions between small molecules and enzymes. Students use three-dimensional protein viewing software to design and model modifications to an enzyme active site, and they then perform those modifications using recombinant DNA technology and site-directed mutagenesis. This course also introduces other commonly used methods to assay active-site metals, characterize inhibitors, overexpress and purify proteins, and use ultraviolet spectroscopy to analyze enzyme activity. This is an investigative course in which students complete collaborative research projects in small groups. It fulfills the upper-level laboratory requirement for the generic biology major and the biochemistry track; intended for students who have no other courses that fulfill these requirements. Prerequisite: Biol 2970. Limit 12 students.

Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 4525 Structural Bioinformatics of Proteins (Writing Intensive)
In this investigative laboratory course, students will be given high-quality, experimentally determined, three-dimensional structural coordinates and will use cutting-edge bioinformatics tools and methods to evaluate and analyze these datasets. Some topics include: structural validation, protein-structure prediction, domain and motif recognition, secondary structure prediction, protein-protein and protein-ligand interactions, protein and structure-based sequence alignments, inferring protein function from structure, electrostatic interactions, and threading and homology modeling. Upon completing their analyses, students will be responsible for writing a manuscript that will be submitted to a scientific journal for publication. Prerequisites: Bio 2960 and Chem 262. Fulfills upper-level laboratory requirement for the biology major.
Credit 4 units. A&S IQ: NSM, WI Art: NSM BU: SCI
Typical periods offered: Fall, Spring

BIOL 4584 Essentials of Biomedical Writing and Presenting
This course will provide the most fundamental techniques for effectively reviewing, writing and presenting scientific information. The goal of this course is to help students understand scientific communication better. They will become familiar with the structure of scientific papers, grants and presentations and will learn to critically evaluate each form of communication. Students will learn the characteristics of outstanding scientific writing and presenting, including academic style, coherence, clear data presentation and word choice through classroom exercises and mock presentations. Classes will consist of a lecture followed by a classroom exercise. Students will be graded on classroom exercises and writing assignments. This class does not count toward the undergraduate biology major. MA in Biology students should register for the IDENT 5584. Undergrads and PBPM students should register for 4584.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 4715 Basic Cancer Biology
More than two thirds of all people know someone who has cancer. This course provides students with a more extensive understanding of what cancer is and how it affects the human body. We will discuss the history of cancer research, the many different types of human cancers, and basic chemotherapeutics. The topics will be presented in a basic scientific nature, with an emphasis on gaining a broad understanding of the subjects. Prerequisite: Biol 2960 or equivalent. Not available to students who have credit for Biol 144 or Biol 1440.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI
Typical periods offered: Fall

BIOL 4716 Advanced Cancer Biology
This advanced course provides students with a more in-depth understanding of the molecular mechanisms of cancer. We will discuss tumor suppressors, oncogenes, signaling pathways, animal models in cancer, and novel targeted cancer therapies being developed by biotechnology and pharmaceutical companies. Prerequisite: Biol 144, Biol 1440 or Biol 4715.
Credit 3 units. A&S IQ: NSM BU: SCI
Typical periods offered: Spring

BIOL 4720 Behavioral Ecology
This course examines animal behavior from an evolutionary perspective and explores the relationships between animal behavior, ecology, and evolution. Topics include mating systems, sexual selection, parental care, kin selection, and cooperation. There is a strong active - learning component. Prerequisite: Bio 2970 or permission of instructor.
Credit 4 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall, Spring

BIOL 4722 The Biology of Membranes
Biomembrane composition and structure determine its function. This class examines membrane components, their organization into general cell membrane structures/domains, and functions. You will appreciate the various roles membrane lipids play in constructing membranes and in signal transduction. Cholesterol is an important membrane lipid that is linked to biomembranes structurally and functionally. Misregulation of transport or trafficking of lipids, including cholesterol, contributes to many human diseases. You will learn historical background and recent advances in membrane biology, following the path taken by cholesterol and other lipids. You will also learn how to critically evaluate primary research and literature reviews on membrane biology.
Credit 3 units. A&S IQ: NSM
Typical periods offered: Fall

BIOL 4834 Bioenergy
A broad overview of the flow of energy, captured from sunlight during photosynthesis, in biological systems, and current approaches to utilize the metabolic potentials of microbes and plants to produce biofuels and other valuable chemical products. An overall emphasis is placed on the use of large-scale genomic, transcriptomic and metabolomic datasets in biochemistry. The topics covered include photosynthesis, central metabolism, structure and degradation of plant lignocellulose, and microbial production of liquid alcohol, biodiesel, hydrogen & other advanced fuels. Course meets during the second half of the spring semester. Prereqs: Biol 4810 or permission of instructor.
Credit 2 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 4933 Molecular Biology On the Cutting Edge
Recent biomedical discoveries have been greatly advanced through the development of innovative, state-of-the-art techniques. For example, Nuclear Magnetic Resonance (NMR) has proved to be an invaluable tool in both efforts to determine the atomic structure of proteins and small molecules as well as in clinical settings, as MRI to identify tumors that would otherwise go unnoticed. This course will introduce students to a variety of cutting-edge laboratory techniques, and discuss the impact of these techniques on biology and medicine. Students will have the unique opportunity to learn from graduate students employing these approaches in their doctoral studies. Topics to be covered include: high-throughput sequencing of genetic disorders, x-ray crystallography, and single molecule force spectroscopy by AFM. Weekly classes will consist of a 30-45 minute presentation on a particular technique, followed by 60-minute discussion of the assigned readings.
Credit 2 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 4934 Neuroscience Futures 2
Students in this course engage with the neuroscience community both at WUSTL and beyond by attending, summarizing, and discussing neuroscience seminars on campus throughout the semester. Specifically, students are expected to attend three neuroscience seminars over the course of the semester, and submit summaries of each seminar. Students meet twice during the semester, in week 5 and week 11, for guided discussion of the science in the seminars they

attended. Additionally, students in this seminar attend two combined classes with Neuroscience Futures 1 during the first and last weeks of the semester. In both meetings, students have an opportunity to give brief presentations on their own research. The last class combines short student presentations with a keynote address from an invited speaker from within or outside the WUSTL neuroscience community.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 4935 Research Perspectives
Critical reading, writing, statistics, and effective communication are all part of research and are the focus of this course, with topics changing each semester but always including a poster presentation and weekly writing. Enrollment is by permission only from Joan Strassmann.
2 credits. Credit. Joan Strassmann, David Queller, and selected postdoctoral fellows
Credit 2 units. A&S IQ: NSM
Typical periods offered: Fall, Spring

BIOL 4936 Seminars in Ecology and Evolution
What: At least once a week there are seminars from researchers in ecology or evolution. These seminars are given by local people and by visitors. This semester there are also a number of presentations by job candidates. The point of these seminars is to learn about exciting research. What questions are they asking? What are they discovering? What new scientific stories can we hear about ecology or evolution? What makes up these fields anyway? The seminars are often followed by receptions which are a chance to get to know each other better and to ask questions. This course invites undergraduates to listen to these presentations and write about them. After all, this is a major part of the ideas climate at Wash U. It would be a great idea to get in the habit of going to seminars, with this course, or without. In addition to attending seminars, we will meet three times during the semester, early on and a couple of times later. When: Most seminars are 4:00 on Thursdays, though some are on other days. The three meetings will be arranged at a time that works for the students in the course. Small class. No final.
Credit 1.0 units
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 4938 Journal Club On Current Topics in Microbiology and Infectious Disease
We read, analyze, and discuss recent primary literature drawn from the field of microbiology. These papers represent the seven broad Topics of microbiology, as defined by the American Society for Microbiology (https://asm.org/): -Antimicrobial Agents & Resistance -Applied & Environmental Microbiology -Clinical & Public Health Microbiology -Clinical Infections & Vaccines -Ecology, Evolution, & Biodiversity -Host-Microbe Biology -Molecular Biology & Physiology Each week we discuss a single primary research paper, with special emphasis placed on analyzing and interpreting data and figures. Some assignments include supplementary videos or readings to provide the background knowledge required to understand a particular paper. To ensure that students have sufficient prior exposure to microbiological concepts, Biology 349: Foundations of Microbiology is a prerequisite for this course. At the conclusion of the semester, students should have achieved the following objectives: 1. Gain insight into the breadth of research performed within the field of microbiology. 2. Develop skills required to comprehend and to analyze primary research literature.
Credit 1 unit.
Typical periods offered: Fall

BIOL 4940 Seminar in Advanced Biology
In special cases, credit may be given for individual study. Topics of study and credit must be arranged with a faculty sponsor and approved by the Department.
Credit 4 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall, Spring

BIOL 4990 Undergraduate Teaching
Exceptional undergraduates serve as teaching assistants for laboratory and/or discussion sections in departmental courses. Normally 2 or 3 units are given per semester, subject to the approval of the instructor and the department. Credit may not be counted toward fulfilling the biology major; application form in Department of Biology Student Affairs office. Prerequisite: permission of instructor. Credit /No Credit only.
Credit 3 units.
Typical periods offered: Fall

BIOL 4991 Undergraduate Teaching
Exceptional undergraduates serve as teaching assistants for laboratory and/or discussion sections in departmental courses. Normally 2 or 3 units are given per semester, subject to the approval of the instructor and the department. Credit may not be counted toward fulfilling the biology major; application form in Department of Biology Student Affairs office. Prerequisite: permission of instructor. Credit /No Credit only.
Credit 3 units.
Typical periods offered: Spring

BIOL 4995 Biology Coursework Completed Abroad
This course is for study abroad credits.
Credit 12 units.
Typical periods offered: Fall, Spring, Summer

BIOL 4996 Elective: 400-Level
This course is for elective or transfer credits.
Credit 3 units.
Typical periods offered: Fall, Spring