Biology

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Courses

BIOL 500 Independent Research
Research under the supervision of a faculty mentor. Prerequisites: junior or senior standing and permission of mentor and the department. Credit/No Credit or Audit grade options; credit to be determined in each case, usually 3 units/semester and not to exceed 3 units/semester; may be repeated for credit. Because this course has a large number of sections, some sections are listed and enrolled as Bio 500A. If work is to be submitted for Latin honors, see p. 3 of the Department of Biology Handbook for Majors, Latin Honors Through a Biology Major Program. The handbook can be found online at: https://wustl.app.box.com/s/d63rx5o0kygqtsv899eyhax5v31gvy1a. Arrangements for registration should be completed during the preregistration period through the Bio 500 course website https://pages.wustl.edu/Bio_200-500_independent_research.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 5000 Independent Laboratory Work
Credit 3 units.
Typical periods offered: Spring

BIOL 5001 Independent Study in Biology for the Master's in Biology Program
Research under the supervision of a faculty mentor. Can be repeated to complete a Master's Thesis which requires 6 total units of independent study. Prerequisite: Must be enrolled in The Master's in Biology Program in the School of Arts and Sciences.
Credit 3 units.
Typical periods offered: Fall

BIOL 5002 Capstone Experience for the Master's in Biology Program
Students may use this course to expand on any 5xxx level Biology course by completing extra work approved by that course's instructor. The guidelines for this effort will be up to the course instructor but may include special writing assignments, literature reviews, or interviewing local scientists and or clinical researchers involved in related projects. Alternative options will be considered, such as attending a local symposium approved by the instructor and reporting on that experience. Prerequisite: Must be enrolled in The Master's in Biology Program in the School of Arts and Sciences.
Credit 3 units.
Typical periods offered: Fall

BIOL 5003 Independent Research
Research under the supervision of a faculty mentor. Prerequisites: junior or senior standing and permission of mentor and the department. Credit/No Credit or Audit grade options; credit to be determined in each case, usually 3 units/semester and not to exceed 3 units/semester; may be repeated for credit. 500A is equivalent to Bio 500. If work is to be submitted for Latin honors, see p. 3 of the Department of Biology Handbook for Majors, Latin Honors Through a Biology Major Program. The handbook can be found online at: https://wustl.app.box.com/s/d63rx5o0kygqtsv899eyhax5v31gvy1a. Arrangements for registration should be completed during the preregistration period through the Bio 500 course website: https://pages.wustl.edu/Bio_200-500_independent_research.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 5004 Independent Research in Genetics
Credit 10 units.
Typical periods offered: Fall

BIOL 5005 Independent Research in Neuroscience
Research in neuroscience under the supervision of a faculty mentor. Prerequisites: junior or senior standing and permission of mentor and the department. Credit/No Credit or Audit grade options; credit to be determined in each case, usually 3 units/semester and not to exceed 3 units/semester; may be repeated for credit. If work is to be submitted for Latin honors, see p. 3 of the Department of Biology Handbook for Majors, Latin Honors Through a Biology Major Program. The handbook can be found online at: https://wustl.app.box.com/s/d63rx5o0kygqtsv899eyhax5v31gvy1a. Arrangements for registration should be completed during the preregistration period through the Bio 500 course website: https://pages.wustl.edu/Bio_200-500_independent_research.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 5006 Summer Independent Research
Summer research under the supervision of a faculty mentor. Prerequisites: junior or senior 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. Because this course has a large number of sections, some sections are listed and enrolled as Bio 500T. Credits are received in the fall semester following the summer research. If work is to be submitted for Latin honors, see p. 3 of the Department of Biology Handbook for Majors, Latin Honors Through a Biology Major Program. The handbook can be found online at: https://wustl.app.box.com/s/d63rx5o0kygqtsv899eyhax5v31gvy1a. Arrangements for registration should be completed no later than the end of Summer Session I through the Bio 500 course website: https://pages.wustl.edu/Bio_200-500_independent_research. Credit/No Credit or Audit grade options. Course may not be taken for a letter grade. 1-3 units
Credit 3 units.
Typical periods offered: Fall

BIOL 5007 Summer Independent Research in Neuroscience
Summer research in neuroscience under the supervision of a faculty mentor. Prerequisites: junior or senior 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. If work is to be submitted for Latin honors, see p. 3 of the Department of Biology Handbook for Majors, Latin Honors Through a Biology Major Program. The handbook can be found online at: https://wustl.app.box.com/s/d63rx5o0kygqtsv899eyhax5v31gvy1a. Arrangements for registration should be completed no later than the end of Summer Session I through the Bio 500 course website: https://pages.wustl.edu/Bio_200-500_independent_research. Credit/No Credit or Audit grade options. Course may not be taken for a letter grade. 1-3 units
Credit 3 units.
Typical periods offered: Fall

BIOL 5010 Human Anatomy & Development
Study of the human body primarily by dissection; extensive use of X-rays and CT scans. Emphasis on functional and clinical aspects of anatomy. Prerequisite: This course is restricted to first year medical students.
Credit 6 units.
Typical periods offered: Fall

BIOL 5011 Ethics & Research Science
Exploration of ethical issues which research scientists encounter in their professional activities. Topics will include, but are not limited to: student-mentor relationships, allegations of fraud, collaborators' rights and responsibilities, conflicts of interest, confidentiality, publications. Case study and scenario presentations will provide focus for discussions. Prerequisite, open to graduate students engaged in research. Six 90 minute sessions.
Credit 1 unit.
Typical periods offered: Spring, Summer

BIOL 5014 Biotech Industry Innovators
Late one Friday afternoon in April 1976, the late venture capitalist Robert Swanson met with biochemist Herb Boyer, PhD, at his UCSF lab. Swanson had requested 10 minutes of Boyer's time; when the meeting ended, three hours later, the foundations had been laid for the formation of Genentech, the first biotechnology company, and the beginnings of the biotechnology industry. This course, The Basics of Bio-Entrepreneurship, investigates issues and choices that inventor/scientists encounter when considering the applications and commercialization of early stage scientific discoveries. This course is intended for anyone interested in working in the medical device, life-, bio-, or pharma-sciences industries as a founder, scientist, entrepreneur, manager, consultant, or investor. It focuses on the decision processes and issues that researchers and their business partners face when considering how a discovery might best be moved from academia to successful commercialization.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 5020 General Physiology
This course applies the fundamental physiological mechanisms of cell biology to the functions of the major organ systems of the body, namely, the cardiovascular, renal, respiratory, gastrointestinal, and endocrine systems. The course is intended primarily for first-year medical students. The Physiology and Microscopic Anatomy courses are closely coordinated within the same schedule. Course continues into the spring semester with a different schedule. Prerequisite, Biol 5061 or the equivalent and permission of course director.
Credit 6 units.
Typical periods offered: Fall

BIOL 5023 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 2970, or permission of instructors.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 5026 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: the diseases that they cause, the clinical manifestations, the geographic extent of these infections, the consequences of these infections on the populations affected, and 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 their infection and 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.
Credit 3 units.
Typical periods offered: Fall

BIOL 5053 Immunobiology I
Immunobiology I and II are a series of two courses taught by the faculty members of the Immunology Program. These courses cover in depth modern immunology and are based on Janeway's Immunobiology 8th Edition textbook. In Immunobiology I, the topics include: basic concepts in immunology, innate immunity: the first lines of defense, the induce responses of innate immunity, antigen recognition by B-cell and T-cell receptors, the generation of lymphocyte antigen receptors, antigen presentation to T lymphocytes and signaling through immune system receptors. In Immunobiogy II the topics include: the development and survival of lymphocytes, T cell-mediated immunity, the humoral immune response, dynamics of adaptive immunity, the mucosal immune system, failures of host defense mechanisms, allergy and allergic diseases, autoimmunity and transplantation, and manipulation of the immune response. These courses are open to graduate students. Advanced undergraduate students may take these courses upon permission of the coursemaster. Prereq: DBBS students and advanced undergraduates with permission.
Credit 4 units.
Typical periods offered: Fall

BIOL 5054 Immunobiology II
Immunobiology I and II are a series of two courses taught by the faculty members of the Immunology Program. These courses cover in depth modern immunology and are based on Janeway's Immunobiology 8th Edition textbook. In Immunobiology I, the topics include: basic concepts in immunology, innate immunity: the first lines of defense, the induce responses of innate immunity, antigen recognition by B-cell and T-cell receptors, the generation of lymphocyte antigen receptors, antigen presentation to T lymphocytes and signaling through immune system receptors. In Immunobiogy II the topics include: the development and survival of lymphocytes, T cell-mediated immunity, the humoral immune response, dynamics of adaptive immunity, the mucosal immune system, failures of host defense mechanisms, allergy and allergic diseases, autoimmunity and transplantation, and manipulation of the immune response. These courses are open to graduate students. Advanced undergraduate students may take these courses upon permission of the coursemaster. Prereq: DBBS students and advanced undergraduates with permission.
Credit 4 units.
Typical periods offered: Spring

BIOL 5068 Fundamentals of Molecular Cell Biology
This is a core course for incoming graduate students in Cell and Molecular Biology programs to learn about research and experimental strategies used to dissect molecular mechanisms that underlie cell structure and function, including techniques of protein biochemistry. Enrolling students should have backgrounds in cell biology and

biochemistry, such as courses comparable to L41 Biol 334 and L41 Biol 4501. The format is two lectures and one small group discussion section per week. Discussion section focuses on original research articles. Same as M15 5068 and M04 5068.

Credit 4 units.

Typical periods offered: Fall

BIOL 5075 Fundamentals of Biostatistics for Graduate Students

This course is designed for first-year DBBS students who have had little to no prior experience in programming or statistics. The course will cover common statistical practices and concepts in the life sciences, such as error bars, summary statistics, probability and distributions, and hypothesis testing. The class will also teach students basic programming skills for statistical computation, enabling them to retrieve and analyze small and large data sets forom online databases and other sources.

Credit 2 units.

Typical periods offered: Fall

BIOL 5077 Pharmaceutical Research and Development: Case Studies

The course will provide an overview of the history of pharmaceutical research and development activities, with emphasis upon understanding a blend of the scientific, public health, regulatory and business decisions that have shaped the pharmaceutical industry over the past eight decades. Particular emphasis will be placed on understanding how past trends have raised questions about the sustainability of the enterprise. Although no prerequisites are formally requires, the course will blend basic understanding of scientific and medical terminology with an understanding of the commercial and policy decision-making processes that govern the pharmaceutical and biotechnology enterprises. The course will provide an overview of the history of pharmaceutical research and development activities, with emphasis upon understanding a blend of the scientific, public health, regulatory and business decisions that have shaped the pharmaceutical industry over the past eight decades. Particular emphasis will be placed on understanding how past trends have raised questions about the sustainability of the enterprise. Although no prerequisites are formally requires, the course will blend basic understanding of scientific and medical terminology with an understanding of the commercial and policy decision-making processes that govern the pharmaceutical and biotechnology enterprises.

Credit 2 units.

Typical periods offered: Fall

BIOL 5079 The Science, Medicine and Business of Drugs & Vaccines

The course will provide an overview of the history of research and development in the biotechnology and pharmaceutical industries, with emphasis upon understanding a blend of the scientific, public health, regulatory and business decisions that have shaped the pharmaceutical industry over the past eight decades. Particular emphasis will be placed on understanding how past and ongoing trends have raised questions about the sustainability of the enterprise. Although no prerequisites are formally required, the course will blend basic understanding of scientific and medical terminology with an understanding of the commercial and policy decision-making processes that govern the pharmaceutical and biotechnology enterprises.

Credit 2 units.

Typical periods offered: Fall

BIOL 5084 Single Molecule Biophysics Journal Club

Molecular motors in the cell harness chemical energy to generate mechanical work in a host of processes including cell motility, DNA replication and repair, cell division, transcriptional regulation, and intracellular transport. The purpose of this course is to discuss recent advances in the field of molecular motors. Special emphasis will be placed on understanding and criticially evaluating single molecule studies. The course will consist of both journal club presentations and small group discussions.

Credit 1 unit.

Typical periods offered: Spring

BIOL 5098 Graduate Research Fundamentals

This course introduces first-year Ph.D. students to the foundational skills, knowledge, and habits of mind required of successful independent biological scientists: 1) Social dynamics in the scientific research enterprise 2) Epistemology and ethics of bioresearch methods 3) Development and communication of research questions and results 4) Interdisciplinary scientific thinking. Class sessions and homework introduce these topics; major assignments prompt student to connect them with the broader scope of graduate training in lab rotations, course work, and interdisiplinary scientific seminars. the interactive, student-driven class structure facilitates autodidactic development while integrating small group activities and peer mentoring from advanced DBBS students. Prerequisite: Students must be enrolled in a graduate program through the Division of Biology & Biomedical Sciences.

Credit 0.5 units.

Typical periods offered: Fall

BIOL 5123 Experimental Hematopoiesis Journal Club

Journal club in which papers that describe significant advances in the field of experimental hematopoiesis are discussed. Students are expected to present one paper per semester and attend the weekly (1 hour) session. No prerequisites.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5128 Cell Biology of Extracellular Matrix Journal Club

This journal club covers a broad range of topics related to extracellular matrix and cell-cell communication, including the fields of biochemistry, molecular biology, cell biology, and developmental biology. Speakers give a brief background to introduce the topic and then focus on one paper from the current literature. Presentations are given by students, faculty, and post-doctorates. Students receive 1 unit of credit for regular participation and for making one presentation.

Credit 1 unit.

Typical periods offered: Fall

BIOL 5137 Ion Channels Journal Club

Weekly presentations of recent papers on mechanisms of ion channel function and membrane excitability, as well as the role of channel defects in human and model diseases, with lively group discussions the norm! Once per semester, each participant will choose a paper and present it to the group.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5138 Journal Club for the Molecular Mechanism of Aging

Why do we age? What causes aging? How is our life span determined? This journal club will address such fundamental, but challenging questions of aging and longevity. Recent studies on aging and longevity are now unveiling regulatory mechanisms of the complex biological phenomenon. We'll cover the latest progress in this exciting field

and stimulate discussions on a variety of topics including aging-related diseases. One hour of paper presentation or research talk and discussion per every two weeks. Prerequisite: Basic knowledge of molecular biology and genetics of model organisms, such as yeast, C. elegans, Drosophila and mouse. Registered students are expected to have at least one presentation for 1 unit credit.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5140 Plant Diveristy and Evolution
This course is an in-depth exploration of the diversity and evolution of vascular plants. The course focuses mainly on flowering plants because of their dominant role on our planet, but lycophytes, ferns, and gymnosperms are studied as well. A phylogeny of vascular plants provides the framework for their evolution and diversification. Related subjects, including phylogenetics, biogeography, herbaria, nomenclature, species concepts, and pollination biology are also presented. The weekly lectures/discussions and (three hour) lab function in tandem and it is the responsibility for the student to integrate information from the lectures with the abundant materials presented in lab. The lecture will take place on main campus at WashU, and the lab sessions will make use the abundant and exceptional living and preserved materials at the Missouri Botanical Garden. The intended audience is advanced undergraduates and graduate students. Prerequisite: Bio 2970 or Permission of Instructor. Small Class. Credit.
Credit 3 units. A&S IQ: NSM
Typical periods offered: Fall

BIOL 5146 Principles and Applications of Biological Imaging
Principles and Applications of Biological Imaging will introduce the interdisciplinary nature of the imaging sciences and conduct a comprehensive survey of the array of interrelated topics that define biological imaging. The course will cover the basics of the optical, magnetic resonance, CT, SPECT and PET imaging modalities, and microscopy, while focusing on applications of imaging to different disease states, such as oncology, neurology, cardiology and pulmonary diseases. Prereqs. One year each of Biology, Chemistry, Physics and Calculus.
Credit 3 units.
Typical periods offered: Fall

BIOL 5147 Contrast Agents for Biological Imaging
Contrast Agents in Biological Imaging will build the chemistry foundations for the design and use of contrast agents in imaging applications such as nuclear medicine, magnetic resonance imaging (MRI) and optical imaging. The course will include lectures on the design of radiopharmaceuticals for gamma scintigraphy and positron emission tomography, MRI contrast agents and agents for optical imaging, including bioluminescence and fluorescence microscopy. Prereqs: one year of general chemistry, one semester of organic chemistry.
Credit 3 units.
Typical periods offered: Spring

BIOL 5148 Metabolism Journal Club
The purpose of the Metabolism Journal Club is to introduce the graduate students to advanced topics spanning the biochemistry, cell biology and genetics of cellular and whole body metabolism. Under the guidance of the course directors (Drs. Ory and Schaffer), students will select recent topical articles for discussion in the weekly journal club. Students will be expected to provide a succinct introduction to the topic and lead discussion of the data presented in the journal article. Students will be evaluated on the basis of their presentation and their participation in the seminar throughout the semester. Prerequisites: Successful completion of Fundamentals of Molecular Cell Biology (Bio 5068) and Nucleic Acids and Protein Biosynthesis (Bio 548).
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5150 Environmental Medicine
Environmental Medicine explores the interactions between the environment and human health, focusing on the role of the environment in causing or mediating disease. Environmental hazards are examined in terms of toxicology, epidemiology, exposure assessment, risk assessment, individual susceptibility, adaptation/maladaptation, and the total load concept. Students enrolled in the 500-level must also complete a term paper and oral presentation. Prerequisites: General Biology I or permission of instructor.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 5151 RNA Biology Journal Club
The purpose of the RNA Biology Journal Club is to introduce the graduate students to advanced topics spanning the bioinformatics, biochemistry, cell biology and genetics of RNA biology. Under the guidance of the course directors (Drs. Ory and Schaffer), students will select recent topical articles for discussion in the weekly journal club. Students will be expected to provide a succinct introduction to the topic and lead discussion of the data presented in the journal article. Students will be evaluated on the basis of their presentation and their participation in the seminar throughout the semester. Prerequisites: Successful completion of Fundamentals of Molecular Cell Biology (Bio 5068) and Nucleic Acids and Protein Biosynthesis (Bio 548).
Credit 1 unit.
Typical periods offered: Fall

BIOL 5152 Rad Journal Club (Regeneration, Aging, and Development)
Focuses on developing a dialog around current topics in developmental and regenerative biology at the molecular, cellular and systems levels.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5171 Medical Immunology
An introduction to basic concepts in immunology and immunopathology. Lectures focus on antigen-antibody interactions, immunoglobulin structure and genetics, the cellular basis of the immune response and immune regulation, T cell effector mechanisms, the inflammatory response, complement, the positive and negative roles of hypersensitivity, and immune deficiency. Prerequisite, some background in biochemistry and genetics helpful. Restricted to medical students only except in unusual circumstances, with permission of coursemaster. Offered during the first half of the second medical semester. Three-four lecture hours a week, two 2-hour lab periods, four 1-hour clinical discussion groups.
Credit 3 units.
Typical periods offered: Spring

BIOL 5172 Human Immunobiology Pathway
The goals of the course is to enhance one's understanding of human immunologic diseases. Students will have the opportunity to accompany a physician scientist to observe the clinical manifestations and molecular basis of therapy for a variety of autoimmune and infectious disorders. Prerequisite, satisfactory completion of Bio 5261.
Credit 1 unit.

Typical periods offered: Spring

BIOL 5181 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: Spring

BIOL 5191 Pathobiology of Human Disease States
Three human disease states will be discussed in detail. Topics will include background clinical and epidemiological information, followed by a detailed examination of the molecular and cellular events that underlie the disease state. Examples of pertinent topics include Alzheimer's disease, AIDS, leukemia, cystic fibrosis, sickle cell anemia, diabetes, etc. Prerequisite: Must be a Markey Pathway student.
Credit 2 units.
Typical periods offered: Fall

BIOL 5192 Cancer Biology Journal Club
This journal club covers current papers in molecular oncology, cancer genetics and contemporary molecular biology. Presentations will be given by students, post-docs and faculty, then discussed.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5194 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 5195 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 5196 Special Emphasis Pathway in Cancer Biology
This course is designed to present pre- and postdoctoral trainees with an organized educational format to explore major contemporary topics in cancer biology. The elective will provide an integrated view of cancer research including basic science, translational science, and clinical investigation. Approximately 60 minutes will be devoted to a didactic presentation by a faculty member with interaction by the participants. The remaining 30 minutes will be used to discuss a pivotal research paper from this field, preselected by the faculty member. Outside reading (30-60 min/week) will be required.
Credit 2 units.
Typical periods offered: Spring

BIOL 5201 Membrane Protein Biophysics Journal Club
Cells are encapsulated by lipid bilayers providing a physical barrier for the passage of charged molecules and ions in and out of the cell. the proteins that reside within this layer of oil are called membrane proteins, and they act as the molecular gatekeepers, controlling the passage of ions, nutrients, waste products and signaling elements, across cell membranes. This journal club focuses on examining key literature in the field that investigates how membrane proteins fold, adopt certain structures, and how they function inside of the strange envrionment of the lipid membrane. The papers will be selected from biophysical studies that combine new and notable research with key historical work, for a broad perspective of the science being conducted in this complex and emerging field. Special emphasis will be placed on emerging topics, such as regulation of protein function by lipid composition, membrane protein synthesis and folding, cutting-edge developments in membrane biophysics. The course will consist of both journal club presentations, as well as small group discussions in the form of chalk-talks.
Credit 1 unit.
Typical periods offered: Spring

BIOL 5217 Special Topics in Microbial Pathogenesis
Primarily for graduate and MSTP students, this course involves oral presentation and discussion of current research articles on pathogenic microorganisms (bacteria, viruses, parasites, and fungi). Discussion will include design of specific aims for research proposals. Emphasis will be on literature that addresses the cellular and molecular basis of host-pathogen interactions. Students are expected to prepare all articles covered and to participate actively in each discussion. Prerequisite: advanced elective course Molecular Microbiology and Pathogenesis or permission of instructors. Class meets twice per week for 1.5 hours each.
Credit 2 units.
Typical periods offered: Spring

BIOL 5220 Practical Bioinformatics
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 how to use the UNIX operating system on research clusters, write custom analysis programs with shell scripts and with Python, and summarize and visualize 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.
Credit 4 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 5224 Molecular, Cell and Organ Systems
This course will introduce Ph.D. and MSTP students to fundamental problems in cell and molecular biology at the systems level. The course is divided into 5 themes: 1) microbial systems; 2) organ development and repair; 3) cardiovascular system and disease; 4) tumor & host systems; and 5) metabolic systems and disease. Topics within each

theme highlight current research concepts, questions, approaches and findings at the molecular, cellular and physiological levels. Students will write an original research grant proposal on a topic of their choosing in one of the 5 themes. Students will critique proposals anonymously in an NIH-like study section. Prereqs; Fundamentals of Molecular Cell Biology and Nucleic Acids and Protein Synthesis.

Credit 3 units.

Typical periods offered: Spring

BIOL 5232 Plant Diversity and Evolution

This course is an in-depth exploration of the diversity and evolution of vascular plants. The course focuses mainly on flowering plants because of their dominant role on our planet, but lycophytes, ferns, and gymnosperms are studied as well. A phylogeny of vascular plants provides the framework for their evolution and diversification. Related subjects, including phylogenetics, biogeography, herbaria, nomenclature, species concepts, and pollination biology are also presented. The weekly lectures/discussions and (three hour) lab function in tandem and it is the responsibility for the student to integrate information from the lectures with the abundant materials presented in lab. The lecture will take place on main campus at WashU, and the lab sessions will make use the abundant and exceptional living and preserved materials at the Missouri Botanical Garden. The intended audience is advanced undergraduates and graduate students. Prerequisite: Bio 2970 or Permission of Instructor. Small Class. Credit.

Credit 3 units. A&S IQ: NSM

Typical periods offered: Fall

BIOL 5235 Genetics Journal Club

This journal club will be focused on the Genetics department seminar series. Students will present one or a few recent papers by the seminar speaker scheduled for that week. Students will provide a brief written evaluation (on a form that will be provided) of their peers' presentations, and the faculty advisors will meet with each student after the presentation to provide feedback.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5241 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: Spring

BIOL 5244 Advances in Immunology

One of life's greatest challenges is how do we best survive in a world that is constantly challenging us to survive the many and varied types of infections that would threaten our survival. The main way in which we survive is the immune system that we possess. As a consequence, this course covers basic molecular and cellular aspects of the vertebrate immune system emphasizing specific and nonspecific host defense against disease. In so doing, we will discuss the nature of immunological specificity, and its underlying molecular genetics. We also cover how our immune system responds to foreign invaders by describing the nature of cell activation, the results of such activation in the form of both cellular activities and the impact of factors released by these cells. Finally, we will consider the role that the immune response plays in tolerance. autoimmunity, allergic reactions, transplantation reactions, immunodeficiency, and how it responds to cancer. In so doing, you will have a better understanding as to how we respond to the world in which we live. Prerequisites: it is recommended, but not required, that you have some knowledge of: Biochemistry, Cell Biology, Molecular Biology/Nucleic Acids, Microbiology/Virology, Pathology/Pathobiology.

Credit 3 units.

Typical periods offered: Fall

BIOL 5255 Experimental Skeletal Biology Journal Club

The journal club, which meets weekly, focuses on cellular and molecular biology of the skeleton. Emphasis is placed on gaining insights into normal skeletal homeostasis as well as systemic disorders of bone. Papers presented for review are selected from the most competitive journals. Participants are encouraged to think outside of the box and discuss novel molecular discoveries that may impact bone cell function. Prerequisite, permission of instructor.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5265 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 5272 Advanced Topics in Immunology

This course uses a journal club format to discuss contemporary issues in the cell and molecular biology of the immune system. Discussions focus on the use of current approaches to analyze the cellular and molecular basis of immunity. Topics include mechanisms of antigenic specificity, diversity, cell communication, differentiation, activation, and effector activity. Prerequisite, Bio 5051 and permission of instructor.

Credit 2 units.

Typical periods offered: Fall

BIOL 5282 Chromatin Structure and Gene Expression

This special topics course will use Epigenetics ed. By Allis, Jenuwein, Reinberg, and Caparros (2007, Cold Spring Harbor Laboratory Press) as the organizing text. Each week a faculty member will provide a background lecture on an important topic or model system, and a student will present and lead discussion of a paper from the current scientific literature related to the previous week's background lecture. Topics to be considered will include background on chromatin structure, histone modifications and histone variants; epigenetic regulation in yeast, other fungi, ciliates, flies, mammals and plants; dosage compensation in different systems; DNA methylation and

imprinting in mammals; stem cells, nuclear transplantation and reprogramming; and the epigenetics of cancer and other human diseases (some variation in topics in different years). Students enrolled in the course will be required to present one paper and to come prepared to each session, with a question for discussion. Prerequisite, BIO 548 Nucleic Acids and Protein Biosynthesis.

Credit 2 units.

Typical periods offered: Spring

BIOL 5284 Current Research in Chromatin, Epigenetics and Nuclear Organization

This journal club considers papers from the current literature on chromatin structure and function, with an emphasis on regulation of transcription, epigenetics and genomics. Presentations are given by students, postdocs and faculty, with discussion by all. Students enrolled for credit are expected to attend regularly, and to present a minimum of one paper during the term, with consultation and critique from the faculty.

Credit 1 unit.

Typical periods offered: Spring

BIOL 5285 Current Topics in Human and Mammalian Genetics

This course aims to provide both biologists and those with mathematical backgrounds with a basis in mammalian genetics. The course will include the following modules: Nucleic acid biochemistry; Gene and chromosome organization; Introduction to Human Genetics; Mutations and DNA repair; Cancer Genetics; Genomic methodologies; Biochemical genetics; Murine Genetics; Epigenetics; Neurodegenerative diseases; Mitochondrial disorders; Pharmacogenetics; Introduction to human population genetics; Applications of modern human genetics; Introduction to web-based informatics tools for molecular genetics. One of the required courses in the Quantitative Human Statistical Genetics graduate program.

Credit 3 units.

Typical periods offered: Fall

BIOL 5288 Special Topics in Molecular Genetics

A special topics course with lectures and discussion on the molecular basis of cancer including cell cycle regulation, tumor suppressor genes, tumor invasion, angiogenesis, immune evasion, resistance to apoptosis, signaling, imaging, gene expression, chromosomal translocations, and viral oncology.

Credit 2 units.

Typical periods offered: Spring

BIOL 5303 Protein NMR Journal Club

This journal club covers the recent literature on protein NMR with a focus on using NMR to study protein function, NMR dynamics, and novel methods that expand the range of systems accessible to solution NMR studies. Students, postdocs and faculty discuss a recent paper and present background information on the relevant technical aspects of NMR. Students receive 1 credit for participation and presenting one paper.

Credit 1 unit.

Typical periods offered: Fall

BIOL 5304 Introduction to Biomedical Data Science I

This course is designed primarily for individuals who wish to learn the research tools and approaches required for biomedical informatics-based research and who have little or no computational experience using command line shells, programming, and databases.

Credit 4 units.

Typical periods offered: Fall

BIOL 5309 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 5311 Dynamics in Mesoscopic Molecular Systems

This course will provide a background in the theory of the dynamics of mesoscopic systems and introduction to methods for measuring the dynamics of these systems. It will include measurement methods, some of which are in common use and others that have only recently been introduced. This course would be useful for biophysics students and others that are interested in molecular processes and mechanisms in small systems such as cells. Prerequisites, Physical Chemistry.

Credit 3 units.

Typical periods offered: Spring

BIOL 5312 Macromolecular Interactions

This course will cover equilibria, kinetics and mechanisms of macromolecular interactions from a quantitative perspective. Thermodynamics, multiple binding equilibria (binding polynomials), linkage phenomena, cooperativity, allostery, macromolecular assembly, analysis of binding isotherms, enzyme catalysis and mechanism, steady-state and pre-steady-state kinetics, kinetic simulation, and isotope effects. Prerequisite, physical chemistry, biochemistry, calculus, and organic chemistry. 3 class hours per week.

Credit 3 units.

Typical periods offered: Spring

BIOL 5318 DNA Repair

This course is an advanced graduate course that explores all aspects of DNA damage and the cellular responses to DNA damage. It is designed for graduate students who have a working knowledge of Chemistry, Molecular Biology and Cellular Biology, and for interested postdocs and researchers. Specific topics that will be covered are: The chemical basis of DNA damage, specific DNA repair mechanisms, cell cycle responses to damage, translesion DNA replication and mutagenesis, and human diseases related to defects in DNA damage response. The course consists of a lecture module, open to all, and a discussion module for registered students. In addition, several invited speakers in the field of DNA repair will give seminars and meet with registered students for discussion. Students will present and discuss research papers. Grades will be given based on student presentation and participation. Prerequisite; Permission of instructor.

Credit 2 units.

Typical periods offered: Spring

BIOL 5319 Molecular Foundations of Medicine

This course will cover fundamental aspects of biochemistry and cell biology from a medical perspective. The course begins with a treatment of protein structure and the function of proteins in the cytoskeleton and cell motility. The principles of enzyme kinetics and regulation are then discussed and basic pathways for the synthesis and metabolism of carbohydrates and lipids are introduced. This leads in to a discussion of membrane structure and the function cellular organelles in biological processes including energy production, protein degradation and

protein trafficking. Prerequisite: Two semesters of organic chemistry. Coursemaster approval is required. Please note: This course is given on the medical school schedule and so it begins 8 days before the grad school schedule.
Credit 3 units.
Typical periods offered: Fall

BIOL 5327 Optical Spectroscopy: Theory and Applications
Spectroscopic methods to be covered include fluorescence, both ensemble and single molecule, and absorption (circular dichroism); fluorescence correlation spectroscopy will also be discussed. The quantum chemistry /physics behind these methods will be reviewed. Prerequisite: Consent of instructor.
Credit 2 units.
Typical periods offered: Fall

BIOL 5328 Structural Biology Journal Club
Multi-laboratory research colloquia for DBBS graduate students focused on structural biology and complementary biophysical techniques. Course credit requires student presentation for credit.
Credit 1 unit.
Typical periods offered: Spring

BIOL 5336 Computational Biophysics Journal Club
This course covers a combination of classic and recent publications on computational methods for studying biomolecules. Students participating for credit will be required to present at least once.
Credit 1 unit.
Typical periods offered: Spring

BIOL 5337 Conservation Biology & Biodiversity
In this course we will examine biodiversity and discuss its value, threats to it, and solutions for conservation. We will explore and discuss real-world examples of issues involving threats to biodiversity, ecological economics and nature conservation, habitat degradation and loss, habitat fragmentation, overexploitation, species invasions, biological impacts of climate change, conservation genetics, species, landscape and ecosystem approaches to conservation, and restoration of damaged ecosystems. Students enrolled in the 5000-level must also complete a term paper and oral presentation. This course is hybrid, meeting once per week for 1.5 hours, and additional work will be completed for 1.5 hours each week asynchronously as assigned by the instructor. Prerequisites: General Biology I or permission of instructor
Credit 3 units.
Typical periods offered: Fall

BIOL 5343 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 2960 and Biology 2970 (or consent of instructor) (Biology Major Area A)
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Fall

BIOL 5352 Developmental Biology
Analysis of a selected set of key processes in development, such as pattern formation, cell-cell signaling, morphogenesis, etc. The focus is on molecular approaches applied to important model systems, but framed in classical concepts. The discussion section provides instruction in presenting a journal club and writing a research proposal. Prerequisites, Molecular Cell Biology (Bio 5068) and Nucleic Acids (548).
Credit 3 units.
Typical periods offered: Spring

BIOL 5357 Chemistry and Physics of Biomolecules
This course covers three major types of biomolecular structures: proteins, nucleic acids, and membranes. Basic structural chemistry is presented as well as the biophysical techniques used to probe each type of structure. Selected topics covered include protein folding, protein design, X-ray crystallography, NMR spectroscopy, nucleic acid bending and supercoiling, nucleic acid:protein interactions, RNA folding, membrane organization, fluidity, permeability and transport, and membrane channels. The weekly discussion section will cover problem sets and present current research papers. This is one of the required courses for the biochemistry and for the molecular biophysics graduate programs. Prior course work in biochemistry and physical chemistry is recommended but not required.
Credit 3 units.
Typical periods offered: Fall

BIOL 5358 Biochemical and Biophysical Investigations of Infectious Diseases Journal Club
Biochemical and biophysical approaches continue to advance as powerful approaches to the understanding of human disease processes. This journal club covers recent papers in which these approaches address aspects of infectious diseases or inflammation. Students who enroll for credit will be expected to participate in weekly presentations and to present one to two papers along with accompanying background information. Prerequisites:Graduate standing in DBBS; prior introductory course work in biochemistry, physical chemistry, or Chemistry and Physics of Biomolecules (Biol 5357). Course work in microbiology or immunology is not required.
Credit 1 unit.
Typical periods offered: Spring

BIOL 5360 Neural Basis of Behavior
This course provides an overview of how the nervous system works from a biological perspective. We will begin by studying how nerve cells function, focusing on how they transmit signals and communicate with one another through specialized connections called synapses. We will further examine the anatomy of the nervous system to discover how nerve cells are organized into circuits and how these circuits develop. We will investigate how the specialized properties of our nerve cells allow us to interact with our environment through an in-depth study of our motor and sensory systems. In our 500 level course, we will apply our learning objectives to a scientific research presentation using peer reviewed literature.
Credit 3 units.
Typical periods offered: Fall

BIOL 5392 Molecular Microbiology & Pathogenesis
Course is devoted to studying microorganisms, particularly those that cause disease, with an emphasis on the molecular interactions between pathogens and hosts. First third of the course focuses on virology, second third on bacteriology and the last third on eukaryotic pathogens. Prereq, first semester core curriculum for Programs in Cell and Molecular Biology.

Credit 3 units.

Typical periods offered: Fall, Spring

BIOL 5393 Molecular Virology Journal Club

Journal club covering a broad range of topics in virology with an emphasis on pathogenesis or molecular biology of medically important viruses. A minimum of one student presentation with faculty critique. Prerequisite: Permission of instructor.

Credit 0.5 units.

Typical periods offered: Fall, Spring

BIOL 5397 Current Literature in Microbiology

Presentations by students on a broad range of topics of current interest in microbiology. The course will emphasize presentations and discussion skills. Credit requires attendance and participation at all sessions and one presentation. Prerequisites: L41 Biology and Biomedical Science Microbiology (349) and laboratory (3491).

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5401 Introduction to Bioinformatics I

This year-long course for first-year BIDS PhD students introduces a broad spectrum of biomedical informatics theories and methods that support and enable translational research and, ultimately, precision health care. The course is organized into modules spanning levels of inquiry from biomolecules to patients to populations. For each module, a relevant set of biomedical informatics frameworks will be introduced and then demonstrated via experiential learning involving the analysis of a variety of biological, clinical, and population-level data sets.

Credit 4 units.

Typical periods offered: Fall

BIOL 5403 Introduction to Biomedical Data Science I

This course provides a hands-on introduction to fundamental principles of informatics and data analysis tools and methods. It is designed primarily for individuals who wish to learn the research tools and approaches required for biomedical informatics-based research and who have little or no computational experience using command line shells, programming, and databases.

Credit 4 units.

Typical periods offered: Fall

BIOL 5412 Tropical and Molecular Parasitology

Graduate level seminar course focusing on current scientific literature in molecular parasitology. The journal club will meet biweekly during the Fall and Spring semesters. Students will attend both semesters in order to receive one credit. The seminar series will run jointly with a research conference in Tropical and Molecular Parasitology. Outside speakers will be invited for the seminar series to emphasize important developments in tropical medicine and molecular parasitology. In advance of the invited speakers, topics will focus on their previous research publications. Prerequisites, BIO 5392 Molecular Microbiology & Pathogenesis.

Credit 0.5 units.

Typical periods offered: Fall

BIOL 5417 Hematology Division Journal Club: Current Topics in Biochemistry, Cellular, and Molecular Biology

This journal club covers a broad range of topics of current interest, including the fields of biochemistry, molecular biology, cell biology, developmental biology, and immunology. Speakers usually give a brief background to introduce the topic and then focus on one-two papers from the current literature. Presentations are given by graduate students, post-doctorates, and faculty. Each attendee presents two-three times per year. Participants are expected to attend all the sessions. This journal club was founded in 1966.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5425 Immunology of Infectious Diseases Journal Club

The goal of this Journal Club (JC) is to provide 2nd year students in MMMP program a platform to discuss new and emerging concepts on mechanisms by which host immune responses mediate protection against infectious diseases. This exercise will also enable the student who attend the fundamental Immunology course to apply their knowledge to understand the basis for immunology of infectious diseases. The format will include faculty who will select cutting-edge papers and head the discussion during the JC session.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5426 ID Gateway: Translational and Public Health Aspects of Basic Infectious Disease Research

This course provides an opportunity for students, postdoctoral fellows, infectious disease fellows and faculty to explore issues at the interface between patient care, public health and basic research in the area of microbial pathogenesis. Prerequisites, Application and L41 Bio 5392 or M30 526, or permission of instructor.

Credit 2 units.

Typical periods offered: Spring

BIOL 5438 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. 5438 is for MA in Biology students. Undergraduates and PBPM students should register for 4438. This course does not count toward the undergraduate biology major.

Credit 3 units.

Typical periods offered: Fall, Spring

BIOL 5445 DNA Metabolism Journal Club

Presentation of current research papers in DNA replication, DNA repair, and DNA recombination, with an emphasis on basic biochemical and biophysical approaches.

Credit 1 unit.

Typical periods offered: Spring

BIOL 5456 Advanced Crystallography

The advanced course in Protein Crystallography will address all aspects of modern protein crystallography including fundamentals of crystallography, the derivation of the structure factor and electron density equation, symmetry and space groups, direct methods,

isomorphous replacement, molecular replacement, data collection, and crystal growing theory and techniques. Prerequisite, Physical Chemistry & Bio 5325 Protein Structure and Function. Two class hours per week.

Credit 2 units.

Typical periods offered: Spring

BIOL 5466 Current Topics in Biochemistry

Special topics course offered every other week involving the discussion of research papers covering a broad range of topics in the field of biochemistry. Papers selected from the primary literature will be presented and discussed by students with guidance from the instructor. Emphasis will be placed on papers that illustrate the application of chemical approaches to important biological processes. Designed primarily for first- and second-year graduate students in the Biochemistry Ph.D. program. Prerequisites: coursemaster permission.

Credit 0.5 units.

Typical periods offered: Spring

BIOL 5469 Biochemistry, Biophysics, and Structural Biology Seminar

Student presentation of Biochemistry, Biophysics or Structural Biology topic. Second Year Students present from literature; senior students give formal research seminar. Attendance required of all BBSB Graduate Students. Prerequisites: BBSB Graduate Student.

Credit 0.5 units.

Typical periods offered: Fall, Spring

BIOL 5479 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. 5479 is for MA in Biology students. Undergraduates should register for 4479. This course does not count toward the undergraduate biology major.

Credit 3 units.

Typical periods offered: Spring

BIOL 5480 Nucleic Acids & Protein Biosynthesis

Fundamental aspects of the structure, biosynthesis, and function of nucleic acids and the biosynthesis of proteins. Emphasis on mechanisms involved in the biosynthetic processes and the regulation thereof. Lecture course supplemented with student discussions of research papers. Prerequisites: Biol 3371, Biol 451, Chem 481 or equivalent, or permission of instructor.

Credit 3 units.

Typical periods offered: Fall

BIOL 5483 Human Genetic Analysis

Basic Genetic concepts: meiosis, inheritance, Hardy-Weinberg Equilibrium, Linkage, segregation analysis; Linkage analysis: definition, crossing over, map functions, phase, LOD scores, penetrance, phenocopies, liability classes, multi-point analysis, non-parametric analysis (sibpairs and pedigrees), quantitative trait analysis, determination of power for mendelian and complex trait analysis; Linkage Disequilibrium analyses: allelic association (case control designs and family bases studies), QQ and Manhattan plots, whole genome association analysis; population stratification; Quantitative Trait Analysis: measured genotypes and variance components. Hands-on computer lab experience doing parametric linkage analysis with the program LINKAGE, model free linkage analyses with Genehunter and Merlin, power computations with SLINK, quantitative trait anaylses with SOLAR, LD computations with Haploview and WGAViewer, and family-based and case-control association anaylses with PLINK and SAS. The methods and exercises are coordinated with the lectures and students are expected to understand underlying assumptions and limitations and the basic calculations performed by these computer programs. Auditors will not have access to the computer lab sessions. Prerequisite: M21-515 Fundamentals of Genetic Epidemiology. For details, to register and to receive the required permission of the Coursemaster contact the MSIBS Program Manager (biostat-msibs@email.wustl.edu or telephone 362-1384).

Credit 3 units.

Typical periods offered: Fall

BIOL 5484 Genetics and Development of C. Elegans Journal Club

Students will present a research paper (or present their current thesis research) and the appropriate background material.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5487 Genetics and Genomics of Disease

The course will cover the use of genomic and genetic information in the diagnosis and treatment of disease, with an emphasis on current practice and existing gaps to be filled to achieve precision medicine. Areas of discussion include: bioinformatics methods; assessment of pathogenicity; use and curation of disease variant databases; discovery of incidental findings; genomics applications in Mendelian disease, complex traits, cancer, pharmacogenomics, and infectious disease; design of clinical trials with genetic data; ethical and policy issues. Prerequisites: Genomics (Bio 5488), Advanced Genetics (Bio 5491), or Fundamentals of Mammalian Genetics (Bio 5285) or equivalent (permission from instructor)

Credit 2 units.

Typical periods offered: Fall, Spring

BIOL 5488 Genomics

This course is designed for beginning students who want to become familiar with the basic concepts and applications of genomics. The course covers a wide range of topics including how genomes are mapped and sequenced as well as the latest computational and experimental techniques for predicting genes, splice sites, and promoter elements. High throughput techniques for ascribing function to DNA, RNA, and protein sequences including microarrays, mass spectrometry, interspecies genome comparisons and genome-wide knock-out collections will also be discussed. Finally, the use of genomic techniques and resources for studies of human disease will be discussed. A heavy emphasis will be put on students acquiring the basic skills needed to navigate databases that archive sequence data, expression data and other types of genome-wide data. Through problem sets the students will learn to manipulate and analyze the large data sets that accompany genomic analyses by writing simple computer scripts. While students will become sophisticated users of computational tools and databases, programming and the

theory behind it are covered elsewhere, in Michael Brent's class, Bio 5495 Computational Molecular Biology. Because of limited space in our teaching lab, enrollment for lab credit will be limited to 24 students. Priority will be given to students in the DBBS program. Others interested in the course may enroll for the lectures only. If you have previous experience in computer programming, we ask that you do not enroll for the laboratory credit. Prerequisites, Molecular Cell Biology (Bio 5068), Nucleic Acids (Bio 548) or by permission of instructor. Lecture 3 units of credit; lab 1 additional unit, space limited.
Credit 4 units.
Typical periods offered: Spring

BIOL 5489 Human Genetics Journal Club
In this biweekly journal club on Human Genetics we will present and discuss current cutting edge papers in human and mammalian molecular genetics. Students learn presentation skills, how to critique a paper and how to interact with a very active and critical audience. Prerequisites; Any person interested in the current state of the art in Human Genetics may attend this course. It is a requirement that all students wishing to earn credit in this course must present a 1.5 hour journal club talk and must regularly attend and participate in the journal club throughout the year.
Credit 0.5 units.
Typical periods offered: Fall, Spring

BIOL 5491 Advanced Genetics
Fundamental aspects of organismal genetics with emphasis on experimental studies that have contributed to the molecular analysis of complex biological problems. Examples are drawn primarily from yeast, nematodes, fruit flies, mouse, and humans. Students will conceive and write an original research proposal with a substantial genetics component; the learning goal is to build skills in developing hypotheses from the literature and designing experimental approaches to test those hypotheses. Prerequisite, graduate standing or permission of instructor. Credit 3 units.
Credit 3 units.
Typical periods offered: Spring

BIOL 5495 Computational Molecular Biology
This course is a survey of algorithms and mathematical methods in biological sequence analysis (with a strong emphasis on probabilistic methods) and systems biology. Sequence analysis topics include introduction to probability, probabilistic inference in missing data problems, hidden Markov models (HMMs), profile HMMs, sequence alignment, and identification of transcription-factor binding sites. Systems biology topics include the discovery of gene regulatory networks, quantitative modeling of gene regulatory networks, synthetic biology, and (in some years) quantitative modeling of metabolism. Prerequisite: CSE 131 or CSE 501N.
Credit 3 units.
Typical periods offered: Fall

BIOL 5496 Seminar in Computational Molecular Biology
Students present current research papers and the appropriate background material in the field of Computational Biology. **Arts and Sciences students must take this course for credit; Engineering students must take this course Pass/Fail.**
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5499 Cancer Informatics Journal Club
This journal club will explore current topics in cancer informatics. Current literature will be reviewed for advanced cancer genome analysis methods, statistics, algorithms, tools, databases, and other informatics resources.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5500 Medical Genetics
A significant portion of the first-year course in basic medical genetics devoted to human and clinical genetics, with emphasis on how genomic information will transform the practice of medicine. Topics covered include population genetics; molecular basis of mutations; human functional genomics; mouse models of human disease; pharmacogenomics; metabolic defects. Lectures, small group discussions, patient information session. Prereq, an introductory genetics course and permission of the instructor.
Credit 2 units.
Typical periods offered: Spring

BIOL 5501 The Biology and Pathology of the Visual System
The purpose of the course is to provide a fascinating view of vertebrate eye development, anatomy, physiology and pathology. Topics to be covered include the molecules that control eye formation, ocular stem cells, the physiology of transparency, hereditary ocular diseases, phototransduction, the neurobiology of the retina and central visual pathways, age-related eye diseases, and many others. The course is open to all second year graduates students and above. Ophthalmology residents and postdocs with an interest in vision are strongly encouraged to attend.
Credit 3 units.
Typical periods offered: Fall

BIOL 5505 Independent Study in Fundamentals of Molecular and Microbial Genetics
This literature-based course will introduce students to seminal and current studies in molecular and microbial genetics. Students will read and present a minimum of 12 landmark papers that helped shape our understanding of molecular and microbial genetics. Emphasis will be placed on students' ability to comprehend and explain these studies via chalk talks. All presentations will be given by students. Prerequisites: L41 5491 Advanced Genetics and permission from instructor.
Credit 2 units.
Typical periods offered: Fall, Spring

BIOL 5507 Genome Engineering Methods and Applications
This course will cover the basic principles of genome engineering with emphasis on Cas9/CRISPR technology. It will consist of discussion sessions in which students will present assigned manuscripts followed by a general discussion of the topic directed by the instructor. The course will cover the mechanisms of genome editing using host DNA repair systems, the function of Cas9, and how Cas9 can be harnessed to introduce defined mutations into almost any genome. The use of Cas9 to activate or repress genes, alter chromatin modifications, and the application of these Cas9 systems to conducting genome-scale screens in mammalian cells as well as its use in studying cell fate will be highlighted. Finally, we will study how Cas9 methodologies can be used to introduce disease-associated variants into pluripotent stem cells (e.g. iPSCs) that can be differentiated into disease-relevant cell for use in functional genomic studies.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5510 ITVS Advanced Techniques
The Advanced Methods in Vision Science course provides ITVS students the opportunity to learn about advanced methods utilized in studies of the visual systems from the experts who perform the studies. These methods emerged from different disciplines (molecular biology, imaging, electrophysiology, machine learning), but provide critical details for understanding how the visual systems focuses and processes light stimuli. The course has two components. 1) A series of 90-minute structured discussions of advanced methods via foundational papers and recent applications of these methods. 2) A choice of two hands-on experiences with these methods in the instructor laboratories. We open the discussion section of the course to all students, postdocs, and faculty members (in this order) but cap the class size at 12 participants to facilitate interactions. Hands-on experiences are restricted to ITVS students. For hands-on experiences, each ITVS student chooses two techniques and spends a day in the laboratory of the respective instructor to gain practical experience with the experiments and analysis pipelines and discuss pitfalls and applications of the methods in detail. Through these components, the Advanced Methods in Vision Science course tries to accomplish three goals: 1) enable students to critically assess the literature through an understanding of strengths and limitations of advanced methods, 2) help students plan experiments involving these methods, and 3) facilitate collaborations with experts in the field that could enhance the science of the ITVS students.
Credit 3 units.
Typical periods offered: Spring

BIOL 5512 Diseases of Membrane Transport & Excitability
Classes will consider the molecular basis of the disease as well as animal models and current clinical studies. Addressing studies from the level of basic biophysical and molecular properties of the underlying ion channels/transporters, to the cellular deflects, to organ and animal outcomes and therapies., which will encourage and force sutdents to develop their ability to integrate understanding at multiple levels. Students will be introduced to emerging ideas in clinical diagnosis, management and treatment, when appropriate, clinical specialists will allow student participants to directly observe and participate in the clinical experiences. Prerequisites, Bio 5068 Fundamentals of Molecular Cell Biology.
Credit 2 units.
Typical periods offered: Spring

BIOL 5513 ITVS Project Building
The overall goal is to have intense guidance to construct a grant/fellowship application. Students should expect to have a near completed F30/F31 application by the end of this course Students will study previous F30/F31 applications and sit on a mock panel to review real world grants from their peers. They will use this experience to understand the reviewers perspective when writing fellowships and grants in the future. Students will draft all portions of a research proposal with feedback from their peers, the course instructor and faculty mentors.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5523 Laboratory in Protein Analysis, Proteomics, and Protein Structure
This laboratory class is structured around a biochemical question of relevance to the research community. Students will design and generate mutants of an enzyme to test hypotheses about its mechanism and kinetics. The course consists of three sections: molecular biology, protein biochemistry, and structural biology. In the first section, students the learn the principles of DNA manipulation, cloning, mutagenesis, and DNA sequencing and apply them to design and generate mutant constructs of the protein of interest. In the second section, students learn the principles of heterologous expression of proteins in bacteria, protein purification, SDS-PAGE, protein quantification, and kinetic analysis of enzyme activity. These methods are applied to test the students' hypotheses by assaying the activity of their mutant enzymes. The final section of the course introduces students to concepts of structural biology including protein crystallization, x-ray diffraction, and computer modeling of protein structures. Fulfills the upper-level laboratory requirement for the Biology major. Prerequisites: Chem 262 and either Bio 451 or Bio 4810/Chem 481. Suggested to be taken concurrently with Bio4820/Chem482. Enrollment limit is set at zero, and students are enrolled from the waitlist. Graduating seniors who need an upper-level laboratory to complete requirements of a biology major program have priority.
Credit 3 units. A&S IQ: NSM Art: NSM BU: SCI

BIOL 5540 Neural Sciences
An integrated course dealing with the structure, function and development of the nervous system. The course will be offered in the Spring of the first year Medical School calendar. Prerequisite: Biol 3411 or Biol 501 and approval of the instructor.
Credit 5 units.
Typical periods offered: Spring

BIOL 5543 Oral Presentation of Scientific Data
Practical course on how to prepare and present scientific data to an audience. Prerequisite: First year neuroscience program courses. Meets once a week for 90 minutes.
Credit 1 unit.
Typical periods offered: Spring

BIOL 5571 Cellular Neurobiology
This course will present a fully integrated overview of nerve cell structure, function and development at the molecular and cellular level. Broad topics to be covered include gene structure and regulation in the nervous system, quantitative analysis of voltage- and chemically-gated ion channels, presynaptic and postsynaptic mechanisms of chemical neurotransmission, sensory transduction, neurogenesis and migration, axon guidance and synapse formation. Two lectures plus one hour of discussion per week for 14 weeks. There will be three exams, as well as homework problems and summaries of discussion papers. Prerequisites: graduate standing or permission of the instructor.
Credit 6 units.
Typical periods offered: Fall

BIOL 5573 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.
Credit 3 units.
Typical periods offered: Fall

BIOL 5577 Synapses Journal Club
Synaptic function and malleability are fundamental to nervous sytem function and disease. This is an advanced seminar in the development, structure, and function of the synapse in health and disease. It is a natural extension of topics covered in Bio 5571. It may be primarily of interest to students in the Neurosciences Program, but also to students in MCB, Development, Biochemistry, Computational Biology, and Molecular Biophysics. Generally a topic for the semester helps

focus the group; past topics have included Synapses and Disease, Neurotransmitter Transporters, Glutamate Receptors, Dendrites, GABA receptors. Participants (students, postdocs, and faculty) alternate responsibility for leading critical discussion of a current paper. Active participation offers the opportunity for students to hone their critical thinking and presentation skills. Students enrolling for credit will be expected to attend each week, to lead discussion once per semester and to provide written critiques (1-2 pages each) of two papers. Prerequisites, Graduate standing in DBBS; Bio 5571 preferred.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5582 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. Prerequisite: permission of instructor.
Credit 3 units. A&S IQ: NSM Art: NSM
Typical periods offered: Spring

BIOL 5584 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. 5584 is for MA in Biology students. Undergraduates and PBPM students should register for 4584. This class does not count toward the undergraduate biology major.
Credit 3 units.
Typical periods offered: Spring

BIOL 5617 Development Biology PhD Program Seminar
In response to student feedback for additional training in Developmental Biology obtained from surveys and group meetings, we propose a new seminar course in Developmental Biology. This once a week course will introduce student in the Developmental, Regenerative, and Stem Cell Biology PhD Program both to the classical embryological experiments that deined key concepts in developmental biology, such as cellular fields, equivalence groups, cytoplasmic determinants, and the more modern experiments that uncovered the genetic and molecular basis of these processes. In general, the classes will be individual sessions on professional development, such as scientific presentation, how to navigate graduate school, etc.
Credit 1 unit.
Typical periods offered: Fall

BIOL 5619 Advanced Cognitive, Computational, and Systems Neuroscience
This course will develop critical thinking and analysis skills with regard to topics in Cognitive, Computational and Systems Neuroscience. Course format will be a series of modules composed of intensive, faculty-led case studies on interdisciplinary topics at the intersection of psychology, computation and neuroscience. The goal will be to highlight the benefits of integrative, interdisciplinary approaches, by delving into a small set of topics from a variety of perspectives, rather than providing a survey-level introduction to a broader set of topic areas. Modules will involve a combination of lectures and student-led discussion groups, with students further expected to complete a multi-disciplinary integrative final review paper. Case-study topics will vary somewhat from year to year, but are likely to include some of the following: temporal coding as a mechanism for information processing, coordinate transformations in sensory-motor integration, mechanisms of cognitive control, motor control strategies including application to neural prosthetics, and memory systems in health and disease.
Credit 3 units.
Typical periods offered: Fall

BIOL 5622 Cognitive, Computational, and Systems Neuroscience Project Building
The goal of this course is to help students in the CCSN Pathway develop the critical thinking skills necessary to develop and implement high quality, interdisciplinary research projects. Throughout the course of the semester, each student will develop a research plan in their chosen area of interest. The plan will be developed in consultation with at least two faculty members (from at least two different subdisciplines within the pathway) as well as the other students and faculty participating in the course. The culmination of this course will be for each student to produce an NIH-style grant proposal on the research project of their choosing. For most students, this will serve either as their thesis proposal or a solid precursor to the thesis proposal. The course will be designed to help facilitate the development of such a research plan through didactic work, class presentations, class discussion, and constructive feedback on written work. The course will begin with a review of written examples of outstanding research proposals, primarily in the form of grant submissions similar to those that the students are expected to develop (i.e., NRSA style proposals, R03 proposals). Review of these proposals will serve as a stimulus to promote discussion about the critical elements of good research proposals and designs in different areas. Each student will be expected to give three presentations throughout the semester that will provide opportunities to receive constructive feedback on the development and implementation of research aims. The first presentation (towards the beginning of the semester) will involve presentation of the student's general topic of interest and preliminary formulation of research questions. Feedback will emphasize ways to focus and develop the research hypotheses into well-formulated questions and experiments. The second presentation will involve a more detailed presentation of specific research questions (along the lines of NIH-style Specific Aims) and an initial outline of research methods. The final presentation will involve a fuller presentation of research questions and proposed methods. Feedback, didactic work, and group discussion throughout the semester will include guidance on critical components of the development of a research plan, including how to perform literature searches, formulate testable hypotheses, write critical literature summaries, and design experiments and analyses. The course will meet once a week, with faculty members from different tracks within the Pathway present at each meeting. This will allow students to receive feedback from several perspectives.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 5623 Interdisciplinary Training in Vision Science - Translation in Vision Science
This course introduces students to the translation of basic science and pre-clinical research to the biopharma industry and/or clinics to benefit patients. The class will introduce how patient genetics can guide disease research in animal models and how patient tissue can be used to model disease progression/outcomes. Students will learn how results from these types of studies impact patient lives through the development of drug/treatment candidates and/or clinical trials.

Students will be connected to clinicians to witness the profound impact of blinding diseases on patient lives and how scientific advances in disease research can motivate philanthropic funding of subsequent research.

Credit 1 unit.

Typical periods offered: Spring

BIOL 5624 Applied Bioinformatics for Genomics I

This course is designed to follow Applied Bioinformatics for Genomics I, in the fall semester. The fall semester course is not required as a prerequisite. Students who need fundamental skills for computational genomics can access the fall semester lectures online. This course is for those who want to 1) expand fundamentals skills for computational genomics, 2) use this information to improve and expedite their research and 3) improve their knowledge by hearing from experts in specific technologies and practices. The course meets once a week throughout the Spring semester, covering a variety of best practices methods, technology, and knowledge in focused short lectures coupled with hands-on exercises.

Credit 1 unit.

Typical periods offered: Fall

BIOL 5625 Applied Bioinformatics for Genomics II

This course is designed to follow Applied Bioinformatics for Genomics I, in the fall semester. The fall semester course is not required as a prerequisite. Students who need fundamental skills for computational genomics can access the fall semester lectures online. This course is for those who want to 1) expand fundamentals skills for computational genomics, 2) use this information to improve and expedite their research and 3) improve their knowledge by hearing from experts in specific technologies and practices. The course meets once a week throughout the Spring semester, covering a variety of best practices methods, technology, and knowledge in focused short lectures coupled with hands-on exercises.

Credit 1 unit.

Typical periods offered: Spring

BIOL 5646 First-Year Fundamentals

This course will provide a two-part introduction to neuroscience research fundamentals. Namely, it will introduce elementary statistical analysis for neuroscience research as well as grant writing to support neuroscience-related research. Enrollment is limited to first-year neuroscience students.

Credit 0.5 units.

Typical periods offered: Spring

BIOL 5648 Coding and Statistical Thinking in the Neurosciences

Students are introduced to scientific programming in Python. Students will learn common programming constructs and how to visualize and analyze data. Coding will be integrated into a statistics curriculum introducing summary statistics, probability distributions, simulation and hypothesis testing, and power analysis for experimental design.

Credit 3 units.

Typical periods offered: Fall, Spring

BIOL 5651 Neural Systems

The course will consist of lectures and discussions of the sensory, motor and integrative systems of the brain and spinal cord, together with a weekly lab. The lectures will present aspects of most neural systems, and will be given by faculty members who have specific expertise on each topic. The discussions will include faculty led group discussions and papers presented and discussed by students. The labs will include human brain dissections, examination of histological slides, physiological recordings, behavioral methods, computational modeling, and functional neural imaging.

Credit 4 units.

Typical periods offered: Spring

BIOL 5663 Neurobiology of Disease

This is an advanced graduate course on the pathology of nervous system disorders. This course is primarily intended to acquaint Neuroscience graduate students with a spectrum of neurological diseases, and to consider how advanced neuroscientific approaches may be applied to promoting recovery in the brain. Topics will be presented by Washington University faculty members and include: neurooncology, stroke, retinal disease, perinatal brain injury, neurodegenerative disorders, neuroinflammation, epilepsy, and psychiatric disorders. The class will meet for 2 hours each week. Each session will be led by a faculty guest with expertise in a specific neurological or psychiatric disease. In the first hour, the speaker will discuss clinical manifestations and pathophysiology. Where possible, the clinical presentation will be supplemented with a patient demonstration or videotape. After a 30 minute break for pizza and soda, the second hour will follow a journal club format. Two or three students will review current papers assigned by the speaker or course director. This course is offered in alternate years. Prerequisite: Introductory neuroscience course at the graduate or medical school level.

Credit 2 units.

Typical periods offered: Spring

BIOL 5678 Clocksclub

Clocksclub focuses on recent advances in the study of biological timing including sleep and circadian rhythms. Participants discuss new publications and data on the molecules, cells and circuits underlying daily rhythms and their synchronization to the local environment. Students registered for this journal club will lead a discussion once during the semester. Prerequisites: BIO 2970 or permission of instructor.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5702 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 includes lectures, in-class discussions of primary literature and hands-on exploration of computational genomic and phylogenetic tools. Evaluations include short papers, quizzes, and oral presentations. Over the semester, each student works on conceptualizing and writing a short NIH-format research proposal. Particular emphasis is given to the articulation of specific aims and the design of experiments to test these aims, using the approaches taught in class. Students provide feedback to their classmates on their oral presentations and on their specific aims in a review panel.

Credit 4 units.

Typical periods offered: Spring

BIOL 5703 Experimental Design and Analysis in Biological Research

In-depth exploration of landmark and current papers in genetics, molecular and cell biology, with an emphasis on prokaryotes and eukaryotic microbes. Class discussions will center on such key discoveries as the chemical nature of genetic material, the genetic code, oxygen producing light-spectrum, cell-cell signaling, transcriptional regulation, the random nature of mutation, and cell cycle regulation. Emphasis will be placed on what makes a good

question or hypothesis, expedient ways to address scientific problems, and creative thinking. The last third of the course will consist of student-run seminars on selected topics to increase proficiency in the synthesis of new material and public presentation skills.
Credit 2 units.
Typical periods offered: Fall

BIOL 5715 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 5716 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. This course is an IDENT for L41 4716. Undergrads should register for 4716, grad students should register for 5716.
Credit 3 units.

BIOL 5722 The Biology of Membranes
Biomembrane composition and structures determine its functions. 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.
Typical periods offered: Fall

BIOL 5723 Seminar in Plant and Microbial Bioscience
This course emphasizing presentation skill and critical analysis counts towards the PMB Graduate Program's journal club course requirement. Students will be responsible for dividing and presenting 30 current research publications selected by the course masters. In addition to assembling brief PowerPoint presentations providing background and significance for their assigned articles, students are expected to provide classmates with a 1 page primer and short list of relevant references
Credit 2 units.
Typical periods offered: Fall, Spring

BIOL 5772 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: Spring

BIOL 5800 Seminar in Population Biology
This weekly seminar, covering different topics each semester, should be taken by graduate students in the program. Prerequisite: graduate standing or permission of the instructors.
Credit 3 units.
Typical periods offered: Fall, Spring

BIOL 5801 Biochemistry & Molecular Biophysics Seminar Journal Club
This will be a journal club-based seminar course mirroring the topics covered by Biochemistry and Molecular Biophysics (BMB) seminar speakers during the concurrent semester. Students will present a paper published by one of the BMB seminar speakers one-week ahead of that speaker's seminar. This will allow students and faculty to become more familiar with the research programs of BMB invited speakers, likely stimulating discussion within the Q&A period after the seminar, as well as during informal meet-the-speaker lunch sessions. Students will be evaluated on their journal club presentation, attendance and class participation.
Credit 1 unit.
Typical periods offered: Spring

BIOL 5840 Climate Change Reading Group
The Climate Change Reading Group is made up of multi-disciplinary faculty and students from multiple institutions in St Louis: WUSTL, UMSL, SLU, Missouri Botanical Garden, Danforth Center, and more. Many of us in different labs, departments, and institutions around STL are actively investigating aspects and effects of climate change; this reading group provides a venue for interacting with others in the community. Subject matter within the context of Climate Change will be chosen each week by a different presenter. Students can join this reading group for 1 credit if they agree to read all papers, actively participate in discussions, find and present one high quality scientific paper on climate change in the field of their choice and moderate the discussion of this paper. The students will be evaluated on their participation, their understanding of the issues, and their presentation. Prerequisites: Contact the course coordinator.
Credit 1 unit.
Typical periods offered: Spring

BIOL 5850 Seminar in Floristic Taxonomy
This weekly seminar provides an introduction to/overview of Plants, each semester progressively covering orders and families in a sequence derived from the Angiosperm Phylogeny Website (http://www.mobot.org/MOBOT/Research/APweb/welcome.html); in Spring 2015, the seminar will cover several crown orders of the monocots, including grasses and relatives. Weekly presentations include a summary of all relevant information (molecular, chemical, anatomical, embryological, morphological, ecological, geographical, historical/paleontological, etc.) about the plant group under consideration, review of the classification/phylogeny of the group, examination of fresh and/or preserved specimens, and discussion of relationships, human uses, and other relevant aspects of the biology of that group. Credit will be contingent on one (or two) seminar presentation(s) per student, regular attendance and active participation in group discussions.
Credit 1 unit.
Typical periods offered: Fall, Spring

BIOL 5862 Seminar On Professional Development for Graduate Students in Ecology, Evolution & Population Biology

This is a weekly discussion seminar course in which advanced graduate students and postdocs in STEM will discuss the practices of scientific teaching and basic professional development skills. Topics covered will include scientific teaching, active learning, assessment driven instruction, creation inclusive classrooms, preparing for job interviews, preparing grant proposals, and balancing family and work. There will be several panel discussions with invited speakers on a range of potential career options to STEM PhDs. Students will prepare or revise their professional portfolio materials over the course of the semester. The course is open to all DBBS graduate students and is required for GAANN fellows. Prerequisite: Graduate student status in the DBBS or permission of instructor.

Credit 1 unit.

Typical periods offered: Spring

BIOL 5866 Communicating Science: Writing for Multiple Audiences

This course introduces strategies for writing effectively and communicating scientific research to a variety of audiences. Students will learn to reduce jargon, explain scientific concepts in common language, write clearly and concisely, and use sentence structure to maximum efficiency. Written assignments emphasize the significance and innovation in scientific research that appeal to broad audiences, including: the general public, students, policy makers, grant reviewers, and journal editors. This course meets biweekly and consists of lectures and small group sessions. You must enroll in both the lecture session (section 1) and a small group (section A, B, C, or D).

Credit 1 unit.

Typical periods offered: Spring

BIOL 5867 Career Planning for Biological Scientists

This course will guide you through nationally recognized and evidence-based career exploration curricula. It is intended for DBBS Ph.D. students and bioscience postdocs who want to jump-start career planning and professional skills needed for a broad range of scientific careers. Topics include self-assessment, career exploration, and goal-setting for long-term success. You will work on a team to research the scientific career path of your choice. Each team will study the specific required knowledge, skills, and attributes of their career interest or employment sector. As part of this research project, you will complete a simulated job exercise and network with alumni or local leaders in your chosen field, gaining valuable real-world insights and creating essential professional connections.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5900 Research

Enrolled students will meet in-person with faculty for a minimum of 1 hour per week. Pass/No Pass Only.

Credit 12 units.

Typical periods offered: Fall, Spring, Summer

BIOL 5902 Introduction to the Scholarship of Teaching and Learning

In this course, advanced graduate students and postdocs in STEM will 1) learn the fundamentals of the Scholarship of Teaching and Learning (SoTL)-which is the practice of developing, reflecting on, and evaluating teaching methods to improve student learning, 2) Develop a working knowledge of SoTL, which draws on research in education, STEM education, and cognitive science, 3) Understand how SoTL can lead to the dissemination of new knowledge to a broad audience of educators through publication and presentations., and 4) Develop the central elements of a SoTL project. These elements include articulating questions about classroom teaching that can be addressed in a SoTL research project; developing working hypotheses in response to the questions; designing an evaluative plan, including specific research methods, the type of data to be collected, and how the data will be analyzed in relation to the hypotheses; identifying and understanding necessary procedures to obtain IRB approval for the research. Prereqs: Must be an advanced graduate student or a postdoctoral appointee with some teaching experience, and must have completed 4 STEM Pedagogies workshops (2 are foundational topics) offered by The Teaching Center or received approval from one of the instructors. Same as U29 Bio 4902.

Credit 1 unit.

Typical periods offered: Spring

BIOL 5911 Seminar in Biology & Biomedical Sciences

These seminars cover the recent literature in various areas not included in other courses, or in more depth than other courses. Prerequisite: permission of instructor. Credit to be arranged.

Credit 12 units.

Typical periods offered: Spring

BIOL 5915 Teaching Practice in Biology & Biomedical Sciences

Students serve as teaching assistants for undergraduate and graduate level courses. Faculty-supervised activities include: lecture preparation and presentation; leading discussion and problem-solving sessions; laboratory instruction. Prerequisite: restricted to graduate students in the Division of Biology & Biomedical Sciences.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5922 Entering Mentoring

This course is a series of facilitated discussions aimed at developing and improving mentoring skills for those involved in supervising undergraduate research experiences. It is designed for postdocs and graduate students who are or will be 'bench mentors' for undergraduates doing Bio 500 and/or Summer Research. Participants will receive Entering Mentoring materials, including articles and worksheets to facilitate mentoring interactions with their mentee, plus several resource books relevant to mentoring. They will develop a mentoring philosophy statement, work on specific assignments designed to improve their relationship with their mentee and share their present and past experiences as mentors and mentees. Bench mentors will be eligible for a travel award to help defray expenses for attending a meeting with their mentee, if that student wins one of the HHMI SURF travel awards (4-5 awarded annually) or is otherwise being supported to present at a scientific meeting. Prerequisite: open to graduate students and postdocs, with priority for those who plan to mentor undergraduates in summer research experiences. Graduate students and postdocs do NOT need to be mentoring a student at the time of the course; it is open to all with an interest in mentoring now or in the future. Note: The sessions will be held either at the beginning of the day or the end of the day at the Danforth campus. Once registration closes, an email will be sent to those registered to poll for the best days & times.

Credit 1 unit.

Typical periods offered: Fall, Spring

BIOL 5923 Foundations in Cancer Biology

This basic cancer biology class is designed to provide a didactic foundation into cancer biology principles. These will include tumor suppressors & oncogenes, DNA damage pathways, protein modifications, tumor progression, metastasis, tumor microenvironment and numerous other topics relevant to cancer biology.

Credit 3 units.

Typical periods offered: Fall

BIOL 5928 Experimental Cancer Biology

This basic cancer biology class is meant to coincide with the Foundation course. Topics will be discussed in parallel with Foundation course topics but from the perspective of the laboratory experimentalist. Experimental details will provide the basis for understanding how to ask and answer important questions in the cancer biology laboratory.
Credit 3 units.

Typical periods offered: Fall

BIOL 5936 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: Spring

BIOL 5937 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 5940 Foundations in Cancer Biology and Experimental Cancer Biology

This advanced course will teach the clinical perspective of cancer biology using topics from oncology, radiation biology, radiology, pathology, immunology and surgery. Students will learn to write a grant proposal that includes a clinical trial element while also shadowing physicians in a real cancer clinical setting.
Credit 3 units.

Typical periods offered: Spring

BIOL 5980 Topics in Evolution, Ecology and Population Biology

This course will meet weekly to discuss ongoing research and future directions of the Evolution, Ecology, and Population Biology (EEPB) graduate program. A different EEPB faculty member will present each week. This course introduces new EEPB students to the diversity of research questions and approaches undertaken by laboratories in the EEPB program; it will also introduce new students to faculty and vice versa. The course will educate the students about the breadth of research in evolution, ecology, and behavior. It will also provide knowledge that students can use when choosing lab rotations and interdisciplinary exposure to enhance creativity in research.
Credit 1 unit.

Typical periods offered: Fall

BIOL 5989 Advanced Topics in Neuroscience

This course will expose upper-level and postdoctoral students to advanced topics and methods in neuroscience. The course will rapidly fill gaps in student knowledge in areas that may be relevant to new directions in thesis work or interest areas. Each section of the course will be offered asynchronously, sometimes in coordination with existing journal clubs and other seminars. Each section will meet for two hours per week for three weeks. Sections may start with a didactic component or a review paper, but they will quickly delve into the discussion of primary papers curated by faculty and covering a focused topic. It is expected that papers will cover both historical and current contexts. Some sections will focus on technique; others will be conceptually focused. Each section will be led by a faculty member drawn from the Neuroscience program in an area of their expertise. Objectives include deepening critical thinking, statistical knowledge, experimental design, and technical prowess.
Credit 0.5-1 units.

Typical periods offered: Fall, Spring

BIOL 5992 Biodiversity Journal Club

Students in this journal club will meet weekly to discuss published research relevant to biodiversity science. Collectively, papers selected for discussion during any single semester will cover a broad range of topics in ecology, evolution, systematics and conservation biology (for examples, see: http://mobot-diversity-jc.weebly.com/previous-semesters.html). Journal club attendees include students, postdocs, faculty and researchs from Washington University, UM-St. Louis, St. Louis University, and Missouri Botanical Garden. Enrolled students will attend journal club every week and once per semester will choose a paper and lead the discussion; evaluations will be based on participation and performance.
Credit 1 unit.

Typical periods offered: Spring

BIOL 5993 Decision Neuroscience

This is an advanced, reading-intensive graduate course. We will meet once a week for 3 hrs and focus primarily on discussing the literature on decision making from various perspecitves. Decision making is a cantral object of study in multiple diciplines including neuroscience, cognitive psychology, and economics. Within systems neuroscience, research in the past 20 years has developed in two main areas - namely perceptual

decisions and economic (value-based) decisions. Each week we will discuss a specific topic and/or research question. Discussion topics will originate from perceptual decisions or economic decisions, and often be relevant to both. Readings will include experimental papers and computational/theoretical papers. Every week, students are expected to read the assigned papers and to write a short comment before class. In class, we will discuss the papers and the weekly topic in a journal-club format. Participation of PhD students from different programs is encouraged, pending permission from the instructor. The goal of the class is to bring graduate students from different disciplines up-to-date on the current debate(s) in decision neuroscience, and to inspire and support their future research.

Credit 3 units.

Typical periods offered: Fall

BIOL 5999 Independent Work

This course is designed for individual students wishing to explore indepth specialized areas of literature or technology with one or more faculty members. Credit will vary with the amount of work and discussion, but cannot be more than 3 credits.

Credit 3 units.

Typical periods offered: Fall, Spring

BIOL 6201 Computational Statistical Genetics

This course covers the theory and application of both classical and advanced algorithms for estimating parameters and testing genomic hypotheses connecting genotype to phenotype. Students learn the key methods by writing their own program to do (simplified) linkage analysis in pedigrees for a simulated dataset provided by the coursemaster. Topics covered in the course include Maximum Likelihood theory for pedigrees and unrelated individuals, Maximization routines such as Newton-Raphson and the E-M Algorithm, Path analysis, Variance components, Mixed model algorithms, the Elston-Stewart and Lander-Green Algorithms, Simulated Annealing and the Metropolis Hastings algorithm, Bayesian and MCMC methods, Hidden Markov Models, Coalescent Theory, Haplotyping Algorithms, Genetic Imputation Algorithms, Permutation/Randomization Tests, classification and Data Mining Algorithms, Population Stratification and Admixture Mapping Methods, Loss of Heterozygosity models, Gene Networks, Copy Number Variation methods, Multiple comparisons corrections and Power and Monte-carlo simulation experiments. Course not available to auditors. Prerequisite: M21-560 Biostatistics I and M21-570 Biostatistics II or, with permission of the Course Master, the equivalents.

Credit 3 units.

Typical periods offered: Spring

BIOL 8830 Master's Continuing Student Status

This course is for continuing students in the Biology Master's program.

Credit 0 units.

Typical periods offered: Fall, Summer

BIOL 8840 Doctoral Continuing Student Status

This course is for continuing students in the Biology Doctoral program.

Credit 0 units.

Typical periods offered: Summer