CELL AND MOLECULAR BIOLOGY (CAMB)

CAMB 431 Genome Science and Genomic Medicine
This course will be a focused study of genomes, genomic techniques, and how these approaches are and will be used in diagnosing and treating human disease. Topics will include genome sequencing, analysis of sequences and microarrays, and new techniques including high-throughput sequencing and reverse genetic analysis with a focus on genome-wide mutant collections. Prerequisite: BIOL 421 strongly recommended.
Taught by: B. Gregory
Course usually offered in spring term
Also Offered As: BIOL 431
Prerequisite: BIOL 221
Activity: Lecture
1.0 Course Unit

CAMB 480 Advanced Cell Biology
This course is designed for beginning graduate students and advanced undergraduates with a particular enthusiasm for cell biology. Biology 480 does not attempt to cover all aspects of cell biology, and is therefore not appropriate for students seeking a lecture course which provides a comprehensive survey of the field. Rather, the primary objective of this course is to teach those students considering a career in the biomedical sciences how to read, discuss, and question original research papers effectively. Intensive classroom discussions focus on the experimental methods used, results obtained, interpretation of these results in the context of cell structure and function, and implications for further studies. There is no assigned text; students learn to critically evaluate current literature by reading original papers on selected topics in modern cell biology. Accordingly, class participation/discussion is essential and the grade will be determined significantly by that. In addition, there will be two exams including answering short questions and an essay critiquing an original paper that is selected on a topic in Cell Biology.
Taught by: Guo
Course usually offered in fall term
Also Offered As: BIOL 480
Prerequisite: BIOL 201 AND BIOL 205
Activity: Lecture
1.0 Course Unit

CAMB 483 Epigenetics
This course investigates epigenetic phenomena: heritable alternate states of gene activity that do not result from alteration in nucleotide composition (mutations). Epigenetic mechanisms regulate genome accessibility and cell differentiation. They play a key role in normal development and in oncogenesis. For example both mammalian X-chromosome inactivation and nuclear transfer (cloning) are subject to epigenetic regulation. Amongst the epigenetic mechanisms we will discuss in this course are chromatin organization, histone modification, DNA methylation and non-coding RNAs. The course is geared toward advanced undergraduate and beginning graduate students and is a combination of lectures, student presentations and research presentations by guest speakers. Students will work with the current scientific literature.
Taught by: Wagner
Course usually offered in fall term
Also Offered As: BIOL 483
Prerequisite: BIOL 221
Activity: Lecture
1.0 Course Unit

CAMB 485 The RNA World: A Functional and Computational Analysis
A focused study of genomic, biochemical, cellular, and molecular aspects of RNA. Topics of study will include RNA structure, RNA processing and turnover, splicing, ribozymes and riboswitches, RNA editing and modification, RNA interference, endogenous eukaryotic RNA silencing pathways, small RNA biology, computational methodologies for studying RNA biology, and RNA viruses. Lectures, student presentations, and discussions will be based on readings from the primary literature.
Prerequisite: BIOL 421 strongly recommended
Taught by: B. Gregory
Course offered spring; even-numbered years
Also Offered As: BIOL 485
Prerequisite: BIOL 221
Activity: Seminar
1.0 Course Unit

CAMB 486 Chromosomes and the Cell Cycle
Life depends on the propagation of genetic material from one generation to next through cycles of genome replication and cell division. The genome is copied by the parent, and one exact copy is inherited by each daughter cell. We will treat chromosomes as discrete entities, rather than collections of genes, that are replicated and divided with high fidelity to ensure that the genome remains stable over many generations. By reading selected primary literature covering several decades, we will build an understanding of the cell cycle by focusing on chromosomes and the associated molecular machinery. We will explore mechanisms that underlie replication and division, particularly control mechanism that maintain genome integrity and are critical to prevent disease. The goal of the course is to develop a picture of the cell cycle by examining some of the key experiments and insights that have led to our current understanding. There is no textbook for the course. Readings from the primary literature will be assigned for each meeting and provided as pdf files. Presentations of these papers and class participation, including questions and critical evaluation, are an essential part of the course. Grading will be based on a final paper in the form of a research proposal (50%) and on class participation (50%).
Taught by: Lampson, M.
Course offered spring; even-numbered years
Also Offered As: BIOL 486
Prerequisite: BIOL 205
Activity: Seminar
1.0 Course Unit

CAMB 493 Epigenetics of Human Health and Disease
Epigenetic alterations encompass heritable, non-genetic changes to chromatin (the polymer of DNA plus histone proteins) that influence cellular and organismal processes. This course will examine epigenetic mechanisms in directing development from the earliest stages of growth, and in maintaining normal cellular homeostasis during life. We will also explore how diverse epigenetic processes are at the heart of numerous human disease states. We will review topics ranging from an historical perspective of the discovery of epigenetic mechanisms to the use of modern technology and drug development to target epigenetic mechanisms to increase healthy lifespan and combat human disease. The course will involve a combination of didactic lectures, primary scientific literature and research lectures, and student-led presentations.
Prerequisite: BIOL 483 recommended
Taught by: Berger
Course offered spring; odd-numbered years
Also Offered As: BIOL 493, GCB 493
Prerequisite: BIOL 221
Activity: Seminar
1.0 Course Unit

CAMB 501 Topics in Cancer Biology
Topics in Cancer Biology - more to come. Placeholder course for now
Taught by: TBD
Activity: Seminar
1.0 Course Unit

CAMB 502 Topics in Developmental, Stem Cell and Regenerative Biology
Topics in Developmental, Stem Cell and Regenerative Biology
Taught by: TBD
Activity: Seminar
1.0 Course Unit

CAMB 503 Topics in Genetics and Epidemiology
Topics in Genetics and Epidemiology - more to come. Placeholder course for now.
Taught by: TBD
Activity: Seminar
1.0 Course Unit

CAMB 504 Topics in Gene Therapy and Vaccines
TBD - placeholding the course for now
Taught by: TBD
Activity: Seminar
1.0 Course Unit

CAMB 505 Topics in Cell and Molecular Biology
Topics in Cell and Molecular Biology
Taught by: TBD
Activity: Seminar
1.0 Course Unit

CAMB 506 Topics in Microbiology, Virology and Parasitology
Topics in Microbiology, Virology and Parasitology. More info TBD, course is a placeholder for now.
Taught by: TBD
Activity: Seminar
1.0 Course Unit

CAMB 507 Topics in Physiology, Metabolism and Cell Biology
Topics in Physiology, Metabolism and Cell Biology. This course will be better defined later. Right now using this as placeholder since we need to get this info in the system by February 20
Taught by: TBD
Activity: Lecture
1.0 Course Unit

CAMB 508 Topics in Quantitative Training
Topics in Quantitative Training. This course will be better defined later. Right now using this as placeholder since we need to get this info in the system by February 20
Taught by: TBD
Activity: Lecture
1.0 Course Unit

CAMB 510 Immunology for CAMB
The purpose of this course is to provide a thorough grounding in immunology to Cell and Molecular Biology graduate students, with an emphasis on the role of the immune system in combating infectious diseases. This is a required course for CAMB students in the Microbiology, Virology and Parasitology program and the Vaccine and Gene Therapy program, replacing IMMU 506 (Immune Mechanisms). It may also be used as an elective by CAMB students in other programs such as those from the Cancer Biology program and Cell Biology, Physiology and Metabolism program. Prerequisite: If course requirements not met, permission of instructor required. The course is divided into two parts. The first deals with innate immune response with a focus on pattern recognition and subsequent signaling in infection by bacteria, viruses, and parasites. The second half will focus on adaptive immune mechanisms, the structure, function, and molecular biology of antigen receptors and major histocompatibility complex molecules, and the development, activation, and differentiation of lymphocytes and other hematopoietic cells involved in immunity. The course is comprised of two 1.5-hour lectures per week, with Friday journal club on selected weeks. EXAMS: There will be two exams. The first will be taken after part I, and the second after part II of the course. Both will be open book, in-class exams. The exam will consist of essay or brief answer questions based on experimental design and/or data. Each exam is weighed equally in determining the final letter grades of students. The grades are based solely on the exams.
Taught by: G. Scott Worthen
Course usually offered in spring term
Prerequisite: BIOM 600
Activity: Lecture
1.0 Course Unit

CAMB 511 Principles of Development
This graduate course, which will include lectures and readings from the literature, is designed to provide a foundation in the principles of developmental biology. Topics covered will include: the germ line and piRNA, signaling pathways in development, pattern formation and cell specification, gastrulation, tissue differentiation, morphogenesis, cell polarity, epigenetics in development, organogenesis, stem cell biology, regeneration, and developmental evolution. The use of molecular biology, biochemistry, genomics and genetics, cell biology, and embryological manipulations will be discussed in the context of the analysis of developmental mechanisms. Undergraduate background in cell biology and molecular biology required. Non-BGS students require permission from course director to enroll.
Taught by: M. Mullins & P. Seale
Course usually offered in spring term
Activity: Lecture
1.0 Course Unit

CAMB 512 Cancer Biology and Genetics
The course objective is to introduce the students to important and current concepts in Cancer Biology and Cancer Genetics. The lectures are organized into 4 broad thematic groups: A) Intro to Cancer Biology and Signal Transduction (e.g., tumor suppressor and oncogene function, DNA repair pathways, senescence, apoptosis); B) Intrinsic and Extrinsic Drivers (e.g., tumor microenvironment, hypoxia, angiogenesis); C) Genome regulation and in Primary and Metastatic Tumors and D) Evading Cell Death. The organizers, along with faculty from the School of Medicine, the Wistar Institute and CHOP, with expertise in the corresponding areas provide lectures for the course. The students are expected to present, and participate in discussions of one or more key recent papers. This is a year - long course. Non-CAMB students must contact the course director prior to registration. Students must have taken the fall CAMB 512 course to participate in the spring semester.
Taught by: Karin Eisinger, Todd Ridky, Kathrin Bernt & Kathryn Hamilton
Two terms. student may enter either term.
Activity: Lecture
0.5 Course Units

CAMB 518 Current Topics in Ion Channels
The course is a seminar format, specifically a journal club format, targeted to graduate students and MD/PhD students interested in ion channels. It meets for one hour, once a week for graduate students and once every other week for the entire group with formal presentation. On alternate weeks a faculty member meets with students to discuss and review the contents of each selected article for the subsequent week's presentation. This is an elective course meant to excite and intellectually enlighten students regarding the latest advances in ion channel research. It includes a wide range of ion channel topics from basic biophysics, structure, and physiology to cell biology and clinical applications. It is attended by faculty, students, and postdocs from the departments of Physiology, Pathology, Neuroscience, Pharmacology, Biochemistry & Biophysics, Psychiatry. We require a written critique of each paper presented by other participants during the semester, submitted prior to the formal presentation of the paper. This critique will be graded by a faculty member, as will the student's participation in both the preparatory sessions and formal presentation sessions. A final grade would be based on both of these components.
Taught by: Deutsch, C.
One-term course offered either term
Prerequisite: BIOM 600
Activity: Seminar
1.0 Course Unit

CAMB 522 Human Evolutionary Genomics
Advanced seminar on current topics in human genomics and human evolution. Topics include the methods used for mapping and sequencing genomes; phylogenetic and population genetic analysis; and detecting variation in the human genome. This course is designed for graduate students but advanced undergraduates with a strong background in genetics are also welcome. Permission of director required to enroll.
Taught by: S. Tishkoff
Course offered spring; even-numbered years
Also Offered As: BIOL 522
Activity: Seminar
1.0 Course Unit

CAMB 530 The Cell Cycle, Genome Integrity and Cancer
This seminar course focuses on molecular and biochemical events that regulate cell cycle progression and genome maintenance, and explores how these processes influence cancer etiology and treatment. Specific topics will familiarize students with the key principles and recent developments within these areas. These topics include CDK-Cyclins and their inhibitors, regulation of G1-S and G2-M phase cell cycle transitions, DNA damage checkpoints and repair, the impact of chromatin regulation on DNA repair, and how each of these processes affects cancer etiology and treatment. In depth reading and evaluation of research literature will be primarily used to accomplish these aims, as well as provide instruction on rigorous experimental design and data interpretation. If course requirements not met, permission of instructor required. Preferential registration of Cancer Biology and CAMB students up to the maximum of 12 students applies. Permission to register is required upon exceeding the 12 student limit.
Taught by: Asangani, Irfan and Greenberg, Roger
Course usually offered in fall term
Prerequisite: BIOM 555 AND BIOM 600
Activity: Seminar
1.0 Course Unit

CAMB 532 Human Physiology
This course will present a survey of the physiology of most of the major organ systems. It will integrate knowledge of cellular and molecular mechanisms into an understanding of function at the tissue, organ, and organism levels. It will begin with a brief review of membrane physiology, followed by electrophysiology and signaling in nerve. Then, after a brief outline of neural control systems and their role in homeostasis, it will present motility and muscle, the cardiovascular system, respiration, the renal and gastrointestinal systems, and selected topics from the endocrine system, the reproductive systems, environmental and exercise physiology. As well as providing a basis of integrative physiology for students in fields such as physiology, bioengineering and pharmacology, it should be of interest to students of cellular and molecular biology and genetic engineering who will need to appreciate the roles of specific systems and molecules at higher levels of organization. Prerequisite: Although not a formal prerequisite, a good foundation in cell bio level of BIOM/CAMB 600 (or an equivalent upper level undergraduat strongly recommended. A general understanding of the chemistry a biochemistry of macromolecules, and of basic molecular biology wi assumed. This course is primarily designed for 2nd year BGS stud year students in BGS or other programs will require the permissio instructor. This course is not open to undergraduates.
Taught by: Tejvir Khurana, Ben Prosser, and Paul Titchenell
Course usually offered in fall term
Also Offered As: PHRM 532
Activity: Lecture
1.0 Course Unit

CAMB 534 Seminar on current genetic research: Human Disease Modeling in Experimental Sys
An advanced seminar course emphasizing genetic research in model organisms and how it informs modern medicine. Each week a student will present background on a specific human disease. This is followed by an intense discussion by the entire class of 2 recent papers in which model organisms have been used to address the disease mechanism and/or treatment. As a final assignment, students will have the opportunity to write, edit, and publish a "News & Views" style article in the journal "Disease Models and Mechanisms". Offered spring semester. Prerequisite: If course requirements not met, permission of instructor required.
Taught by: T. Jongens
Course usually offered in spring term
Also Offered As: NGG 534
Prerequisite: CAMB 542 OR CAMB 605
Activity: Seminar
1.0 Course Unit

CAMB 542 Topics in Molecular Medicine
TiMM is planned as a once-weekly seminar course whose goal is to introduce students to the ways in which biomedical research can provide new insights into clinical medicine and, conversely, how knowledge of clinical disease impacts scientific discovery. There are two sections for the course -- 401 and 402. Section 401 is for first year MD/PhD students only and section 402 is for VMD/PhD and PhD students.
Taught by: Section 401: Johnson, Kohli Section 402: Atchison, Mason
Course usually offered in fall term
Also Offered As: PHRM 542
Activity: Seminar
1.0 Course Unit

CAMB 550 Genetic Principles
This is a required course of the Genetics and Epigenetics Program and is designed to provide students with a comprehensive overview of genetic concepts and methodology. The course is organized into three parts: I Fundamental genetic concepts and tools; II Genetics of model organisms (with focus on worms, flies, zebrafish and mice); III Human genetics and disease. Each week there will be two lectures and one associated discussion/problem-solving session. Discussions emphasize practical aspects of generating and interpreting genetic data. Offered spring semester.
Taught by: Grant,S. & Joyce, E.
Course usually offered in spring term
Activity: Lecture
1.0 Course Unit

CAMB 577 Advanced Epigenetics Technology
Second year students in GCB, CAMB (G&E), or IGG programs using genomics methods to measure transcriptomics and epigenomics changes in their experimental systems. The goal is to familiarize students with the latest cutting-edge genomics tools and cover solutions to major experimental and computational challenges in the investigation of genome-wide epigenetic data sets. Students will develop competence in (i) variations of experimental techniques improving resolution and throughout, (ii) issues related to the computational analyses closely related to the various genome-wide assays used to probe epigenetic processes and signals, (iii) computational approaches useful to overcome pitfalls associated to the analysis of a given epigenetic data modality, (iv) methods, techniques and studies on the integration of multi-layer epigenetic data sets.
Taught by: Golnaz Vahedi
Course usually offered in spring term
Also Offered As: GCB 577, IMUN 577
Prerequisite: (BIOL 483 OR BIOL 493) AND GCB 534 AND (GCB 535 OR GCB 536)
Activity: Lecture
1.0 Course Unit

CAMB 597 Neural Development, Regeneration and Repair
General Description: The goals of this course are to examine the principles underlying the nervous system development and to learn how understanding developmental mechanisms can inform strategies to promote regeneration and repair. This is not a survey course. Rather, the course will focus on selected topics, for which we will discuss the genetic, molecular and cellular strategies employed to study these problems in different model organisms. Emphasis is on how to interpret and critically evaluate experimental data. Students who are not in one of the BGS graduate programs need instructor permission to enroll.
Taught by: Wenqin Luo, Jonathan Raper
Course usually offered in fall term
Also Offered As: NGG 597
Prerequisite: BIOM 600
Activity: Lecture
1.0 Course Unit

CAMB 601 Advanced Virology Seminar
This seminar course covers current topics and important concepts in virology. Students will read selected papers on various topics in virology. Each subject will be illustrated by ground-breaking classic papers and innovative recent articles. Students will present a seminar under the guidance of a faculty member. Grades will be based on the guidance of a faculty member. Grades will be based on the quality of the seminar(s) and participation in discussion. Prerequisite: Non-CAMB students must obtain instructor approval.
Taught by: S. Weiss, P. Bates
Course usually offered in spring term
Prerequisite: CAMB 706
Activity: Seminar
1.0 Course Unit

CAMB 605 CAMB First Year Seminar
Topics are selected by course instructors and student participants. Course instructors vary yearly. The goal of this course is to provide students with an opportunity to analyze, present, and discuss significant research papers in the field of cell and molecular biology in small group settings. The sections are taught by faculty from the different programs within the Graduate Group. This is a required course for CAMB PhD students. Other BGS students are eligible, space permitting.
Taught by: John Seykora
Course usually offered in fall term
Activity: Seminar
1.0 Course Unit

CAMB 608 Regulation of Eukaryotic Gene Transcription
An advanced seminar course emphasizing current topics in gene regulatory mechanisms in eukaryotes. Based on the current literature, presentations and in depth discussions will familiarize the student with recent innovations and developing principles of genome regulation. Students are expected to bring their laptops to class. Non-CAMB students need approval from course directors. MD/PhD students do not need to take BIOM 555 as prerequisite.
Taught by: D. Epstein
Course usually offered in fall term
Prerequisite: BIOM 555
Activity: Seminar
1.0 Course Unit

CAMB 609 Vaccines and Immune Therapeutics
Vaccination is perhaps the most successful medical technological intervention. The goal of this course is to expand on students' general understanding of the immune system and to focus this understanding towards the application of modern vaccines and immune therapies in the 21st century. The course will provide the student with a sense of how these principles are applied to a vaccine and immune therapeutic development. The course covers basic vaccine science and describes how this science is translated through clinical, regulatory, ethical, and political issues to result in a final vaccine product. The courses' goal is to leave the student with an understanding of the implications of modern vaccines /immunotherapies and their impact on world health. Initial lectures review immune mechanisms believed to be responsible for vaccine-induced protection from disease. Subsequent lectures build on this background to explore the science of vaccines for diverse pathogens, including agents of bioterrorism, as well as vaccines and immunotherapies for cancer. An appreciation for the application of laboratory science to the clinical development and clinical trials of vaccines are provided. An important focus on the regulatory, safety, and ethical implications of vaccines in different world situations based on true world examples are presented. The financial implications of specific vaccines with these implications for global health is a focus of the course. The course is presented in a lecture-style consisting of multiple distinguished guest lecturers who are experts in their particular area of vaccine development. There are required readings to provide the student context and background for the diverse lectures. Students are graded on course participation and a final project/exam which the students will present. The project is to design a vaccine strategy for a current disease or pathogen of importance that does not as yet have an effective vaccine or immune therapy and present this to the class. Strategies used should build on the material presented in the class lectures. The course is intended for graduate students or medical students in various MS, Ph.D., or MD/Ph.D. programs on the campus, as well as local scientists and professionals in the community. As a prerequisite, students should have taken biology, biochemistry, or immunology courses at the advanced college level. This course is offered in the fall semester. Prerequisite: Biology, Biochemistry at the advanced college level, college-level immunology is recommended. Not limited to CAMB students, however first options are to CAMB students, the permission of the instructors via email.
Taught by: David Weiner, Paul Offit, Stanley Plotkin
Course usually offered in fall term
Also Offered As: IMUN 609
Activity: Lecture
1.0 Course Unit

CAMB 610 Molecular Basis of Gene Therapy and Genome Editing
This course focuses on the basic science relevant to achieving efficient and effective gene transfer and genome editing in animal models and humans for the treatment of disease. The course includes units devoted to a variety of vectors useful for gene transfer, the fundamentals of genome editing, and current therapeutic approaches using specific diseases as models. Prior background in biochemistry, cell biology, and molecular biology is essential. Aspects of organ system anatomy and physiology, virology, and immunology that are relevant to the course material are included in the course. Because of rapid movement in this field, specific topics vary somewhat from year to year. Offered every fall. Students not enrolled in a BGS graduate program who wish to take this course must notify Dr. Musunuru in advance in order to be added to a waiting list, given the limited enrollment. Students should send their undergraduate and graduate transcripts (including spring semester) along with their request to Dr. Musunuru via email: kiranmusunuru@gmail.com. This class is not accepting non-BGS masters students or auditors. Background in biochemistry, cell biology, and molecular biology is prerequisite for this course.
Taught by: Kiran Musunuru
Course usually offered in fall term
Activity: Lecture
1.0 Course Unit

CAMB 615 Protein Conformation Diseases
Protein misfolding and aggregation has been associated with over 40 human diseases, including Alzheimer's disease, Parkinsons disease, amytrophic lateral sclerosis, prion diseases, alpha (1)-antitrypsin deficiency, inclusion body myopathy, and systemic amyloidoses. This course will include lectures, directed readings and student presentations to cover seminal and current papers on the cell biology of protein conformational diseases including topics such as protein folding and misfolding, protein degradation pathways, effects of protein aggregation on cell function, model systems to study protein aggregation and novel approaches to prevent protein aggregation. Target audience is primarily 1st year CAMB, other BGS graduate students, or students interested in acquiring a cell biological perspective on the topic. MD/PhDs and Postdoc are welcome. MS and undergraduate students must obtain permission from course directors. Class size is limited to 14 students.
Taught by: Yair Argon
Course usually offered in fall term
Also Offered As: BMB 518, NGG 615
Prerequisite: BIOM 600
Activity: Lecture
1.0 Course Unit

CAMB 617 Emerging Infectious Diseases
A physician from just 25 years ago would not recognize two of today's most pressing public health problems, AIDS and Hepatitis C, nor be familiar with many other infectious diseases or agents including MERS, Ebola virus, Hantaanvirus, HTLV-1, HHV-8 and Borrelia burgdorferi. Such a physician might also be dismayed to learn that old enemies such as tuberculosis, malaria, diphtheria, West Nile virus, meningococcal meningitis, Yellow fever, and Dengue have become more (or rather less) prevalent due to antibiotic resistance and other factors. In addition, bioterrorism, long a theoretical possibility, is now part of today's reality and could result in the deliberate introduction of anthrax or other biological agents into the civilian population or the food supply. Thus, with the beginning of the new millennium, the medical profession, the veterinary profession, and the biomedical research establishment are faced with the triple-threat of emerging infectious diseases, reemerging infectious diseases, and bioterrorism. These topics are covered in this course, with an emphasis on student's participation in the discussion. Course open to graduate students only. Other students may petition the course director for permission to enroll. Emerging Infectious Diseases will cover emerging viral, bacterial and parasitic organisms, with lectures being given by faculty from the Schools of Medicine, Veterinary Medicine, Dental Medicine, and Arts and Sciences, and outside lecturers. Epidemiology, immune responses to infection, vaccine and antimicrobial agents, and pathogenesis all will be discussed. The course format will include short lectures by various faculty members to provide background information on each topic, followed by extensive discussion by students. Classes will run from 10am to 11:30AM on Mondays and Wednesdays in Johnson 207. Evaluation will be based on presentations of a research manuscript from the literature and participation in discussion sessions.
Taught by: S. Hensley, P. Bates
Prerequisite: BIOM 600 AND CAMB 706
Activity: Lecture
1.0 Course Unit

CAMB 632 Cell Control by Signal Transduction Pathways
This course, "Targeting the cancer cell: from mechanism to precision medicine", will examine how various signal transduction mechanisms influence cell functions including replication, growth, transcription, translation and intracellular trafficking. We will also consider how non-cell autonomous mechanisms, such as the tumor microenvironment and the immune system influence cancer cell signaling. We will consider how important signaling pathways, such as Ras, Raf, Notch, Wnt, TGF beta, and various kinases/phosphatases become dysregulated in cancer, as well as delve into how the DNA damage response, immune system, and tumor microenvironment exert important influences on oncogenic signaling. In the first half of the course, invited faculty members will pick 2 relatively recent papers from their field that highlight important areas. Each paper will be assigned to a student, who will meet with the faculty mentor prior to the class to discuss the paper and their presentation. During the class, students will present each paper for approximately 45 minutes with time for discussion. Students will present the important background, break down the paper, look for strengths and weakness and come up with a plan of what the next set of experiments could or should be. In the second half of the course, students will independently pick a relevant paper for in class presentation and will also write a short "News and Views" style article based on the paper they have chosen. The goal of the course is to provide students with a view of the cancer cell that integrates both cell autonomous and non-cell autonomous signals and to use this information to consider how to successfully treat cancer.
Taught by: X. Hua, J. Field, , A. Resnick, and W. Pear
Course usually offered in spring term
Also Offered As: PHRM 632
Prerequisite: BIOM 600
Activity: Seminar
1.0 Course Unit

CAMB 633 Advanced Seminar in Gene Therapy
Class: Each class will involve a review of a manuscript in the field of gene therapy selected by course faculty (Drs. Kurre, Pardi, Melenhorst or Rivella). Two weeks prior to their lecture, faculty will assign one primary research paper plus review articles that provides relevant background. Before the session, each paper will be assigned to a student presenter, who will prepare slides and meet with the faculty lecturers ahead of time. Two faculty will be present for each class. The student leader will introduce the paper and ask the group to each cover a portion of the result section in order to promote discussion, interaction and participation. Each session will last 1 hour, including presentation of the manuscript and Q&A. Each session will cover one paper on a weekly base, alternating these classes with lectures (see below). Each presentation will be utilized to grade the students (70%). Lectures: during each lecture, a faculty or external speakers will lecture for 40 minutes followed by a 15 minutes breakout discussion. The student will attend and ask questions during or at the end of the lecture. These lectures will happen independently from the paper discussion. Dr. Rivella, or a substitute, will also be present at each lecture. Prerequisites: Second year students, who already have notions of cell manipulation, immunotherapy and vector biology.
Taught by: Stefano Rivella, Professor of Pediatrics
Course offered spring; even-numbered years
Activity: Seminar
1.0 Course Unit

CAMB 637 Gene Therapy: Vectors, Immunology, and Disease
This seminar course is designed to provide students with a cohesive understanding of virology and immunology of gene therapy. Three major themes will be covered: vectors, vector immunology and gene therapy of genetic and acquired diseases. The topics to be covered are viewed as an extension of topics covered in CAMB 610 (Molecular Basis of Gene Therapy), although CAMB 610 is not an absolute prerequisite for this seminar. Each class will consist of a brief introduction by an instructor, reviewing background information related to the theme discussion. The topics are explored through discussions, led by assigned students, of seminal research articles. Students are expected to have thoroughly reviewed the assigned articles and be able to present and discuss various aspects of the papers. Regular attendance and active participation in the discussions, which focus on critical evaluation of experimental design, data presentation and interpretation, is essential. Student evaluation will be based on attendance, in-class presentation (for 50% of the letter grade), and a take-home exam (for another 50% of the grade).
Prerequisite: BGS Students only
Taught by: J. Riley
Course offered spring; even-numbered years
Activity: Seminar
1.0 Course Unit

CAMB 691 Advanced Topics in Cell Biology & Physiology
This course, together with its companion CAMB 692, offers an advanced, in depth analysis of selected topics in cell biology and physiology. CAMB 691 and 692 are complementary courses that focus on different aspects of cell biology; these courses are offered on an alternating basis in the spring semester. The courses can be taken in either order, but require BIOM 600 or an equivalent background in basic cell biology. CAMB 691 will focus on key issues at the forefront of research in the areas of (1) Channels and transporters, (2) Vesicular and viral trafficking, (3) Tissue mechanics, (4) Heart and muscle physiology, (5) Cytoskeletal dynamics and cell division. The course format pairs faculty presentations with student-led discussion sessions highlighting important papers from the primary literature. Students will be evaluated on their presentations, their participation in class discussions, and weekly problem sets. Offered alternately in the spring semester with CAMB 692. Permission needed for all non-CAMB students. Advanced undergrads must contact instructor to confirm qualifications.
Taught by: M. Marks, C. Deutsch
Course offered spring; even-numbered years
Prerequisite: BIOM 600
Activity: Seminar
1.0 Course Unit

CAMB 692 Advanced Topics in Cell Biology and Physiology II: Cell Signaling and Metabolis
Cells in complex organisms are required to adapt rapidly in a changing enviro nment. Maintaining homeostasis while performing specialized functions requires that cells respond to extracellular signals as well as fluctuations in a host of intracellular metabolites. This course will cover selected topics and general principles related to signal transduction and the control of metabolic flux in living cells. The course format will include student-led discussion sessions both providing an overview of a topic as well as focusing on important papers from the primary literature. Students will be evaluated on their presentations and participation, as well as problem sets. Offered alternately in the spring semester with CAMB 691.
Taught by: J. Bauer & R. Lee
Course offered spring; odd-numbered years
Prerequisite: BIOM 600
Activity: Seminar
1.0 Course Unit

CAMB 695 Scientific Writing
This 7-week course is designed to introduce students to basic scientific writing skills and is based upon the premise that clear writing, giving feedback, and receiving feedback are all essential tools for professional development. While this is not strictly a prelim preparatory course, applying the principles of this course will help improve your prelim writing and your scientific writing in general. Structure: An initial introductory lecture for the entire class is followed by 6 weekly small group sessions. These sessions are conducted as workshops designed to enhance student and faculty engagement to improve scientific writing. During the course, participants review the princinples of clear, persuasive writing, and apply these principles to writing for a scientific audience. Particular emphasis is placed on conveying the significance of your research, outlining your aims, and discussing your results. Classes are highly interactive, and the majority of class time will be spent discussing student scientific writing. In order to focus on the techniques of scientific writing, in-class discussion and critiques will not address scientific methodology or interpretations of results. Evaluations: One of the goals of the course is to encourage active and open interaction among students, and grading will be predominantly based on class attendance, participation, and timely submission of assignments, not on the quality of the writing itself. Offered spring semester.
Taught by: J. Katz, J. Lok
Course usually offered in spring term
Prerequisite: (BIOM 555 AND BIOM 600) AND CAMB 605
Activity: Lecture
0.5 Course Units

CAMB 697 Biology of Stem Cells
The goal of this course is to introduce graduate students to the field of stem cell biology through lectures and reviews of important contributions from the literature. Topics include embryonic stem cells, epigenetics and reprogramming, tissue specific stem cells such as hematopoetic, neuronal and epithelial stem cells, tissue regeneration, and tissue engineering. The future potential and challenges in stem cell and regeneration biology will be discussed. Important aspects of stem cell identification and characterization utilizing multiple model systems will also be a focus. Offered Fall Semester.
Taught by: P. Gadue, P. Rompolas
Course usually offered in fall term
Activity: Seminar
1.0 Course Unit

CAMB 698 Elective Tutorials in Cell and Molecular Biology
Interested students must contact the course directors well in advance to get permission to enroll in the course: Dr. Lee (rjl@pennmedicine.upenn.edu) for the fall semester or Dr. Stanger (bstanger@upenn.edu) for the spring semester. Total course enrollment is limited to 12 students (first come, first served). Students will meet weekly with a faculty mentor to focus in-depth on a biomedical topic of their choice. Prior to each semester in which the course is offered, students are encouraged to make arrangements with faculty on their own and contact mentors directly to set up an individualized plan. Student should submit proposed mentors/topics to the course director before enrolling. The course director must approve the plan prior to enrollment. This tutorial course is designed to provide students with an in-depth knowledge of a specific topic in Cell and Molecular biology. The tutorial can be used to enable students to become more deeply acquainted with the literature related to their field of interest or to expand on a topic that the student found interesting in one of their basic courses. It is also intended to improve presentation skills. Final student grades will be based on mentor evaluations as well as a written review-style paper and brief (10 min) presentation to all students enrolled in the course. One-term course offered either term.
Taught by: Robert Lee (Fall Semester) and Ben Stanger (Spring Semester)
One-term course offered either term
Prerequisite: BIOM 600
Activity: Seminar
1.0 Course Unit

CAMB 699 Lab Rotation
Two terms. student may enter either term.
Activity: Laboratory
0.5 Course Units

CAMB 700 Topics in Microbiology
This course is designed for second year students in the MVP program, and focuses on pathogen-host interactions. Students make a presentation designed for 30 minutes on a topic of their choice. The topic can be something that they are working on, or simply something that they are interested in. They are requested to provide sufficient background, discuss what is known and what is not known about the topic, and then frame two to three Specific Aims. The success of the course rests entirely upon the quality of the faculty and students involved. In past years, the class have been very interactive, with each class lasting about 1.5 hours. The discussions are deliberately wide-ranging, and review recent literature, techniques, and how to construct a grant. Generally, two faculty will be in attendance. Permission of instructor required to enroll. Students must have taken Immunology and two MVP pathogen classes.
Taught by: M. Weitzman, J. Zackul
Course usually offered in spring term
Activity: Seminar
1.0 Course Unit

CAMB 701 Tumor Microenvironment
This course is designed for second year (and up) graduate students interested in learning about the tumor microenvironment. The course will cover the main players of the tumor microenvironment field (stroma, vasculature and immune cells) and emphasize the connections between the basic biology of the tumor microenvironment to potential therapeutic intervention. The goals of this course are to enrich scientific culture, train for clear and concise oral presentations, improve grant-writing skills, and develop critical thinking, professional composure, and discussion skills. The course will be divided into 4 broad topic areas. The course will begin with didactic lectures presented with overviews of Immunology, Stromal cells and extracellular matrix, and Angiogenesis/Endiothelial cells. After that each session will be student run and consist of one hour of presentation of a didactic background lecture regarding the salient points of that week's topic, followed in the second hour by a discussoion of a primary research paper(s) to be read in advance of the session by all class participants. Discussions will include specific technical background needed for the paper, presentation of the KEY data in the paper, leading discussion on the data and conclusions drawn from the paper and putting them in the context of the state of the field. Specific requirements for students incude: - One to two presentations throughout the course. Students will be guided in choosing the approprioate depth of background nd topic area and ingiving formal presentations and constructive criticism of scientigic data. - Submission of a discussion point each week that a student is not presenting, due the night before class. -A Specific Aims Page for a grant using one of his or her two presentations as "preliminary data" or their own research project provided it is related to the tumor microenvironment and is approved by one of the course directors. Evaluation: Students will be evaluated on their participation in class (30%), their presentations (30%), their discussion points (15%) and their Specific Aims Page (25%). Students will be given feedback immediately after their presentations. Prerequisite: First year CAMB core courses must be completed. Course is for 2nd year graduate students and beyond. CB students get first priority followed by other CAMB students.
Taught by: Sandra Ryeom and Ellen Pure
Course usually offered in spring term
Activity: Seminar
1.0 Course Unit

CAMB 702 Current Biochemical Topics
Participation in the "Dr. George W. Raiziss Biochemical Rounds", a weekly seminar program sponsored by the Department of Biochemistry and Biophysics. Program deals with a wide range of modern biochemical and biophysical topics presented by established investigators selected from our faculty, and by leading scientists from other institutions. Prerequisite: Permission needed from Department
Taught by: Black and Shorter
Course offered summer, fall and spring terms
Also Offered As: BMB 650, PHRM 650
Activity: Seminar
1.0 Course Unit

CAMB 703 Mechanobiology of the Cell and its Microenvironment
This course is geared towards first and second year graduate students in BGS/CAMB and SEAS/BE with an interest in the interface of extracellular matrix (ECM) cell biology and biomechanics. Students will learn about the ECM and adhesion receptors and their impact on the cytoskeleton and signaling, as well as fundamental concepts in biomechanics and engineered materials. We will discuss how these topics can inform the study of cell biology, physiology and disease. An additional objective of the course is to give students experience in leading critical discussions and writing manuscript reviews. Invited outside speakers will complement the strengths of the Penn faculty.
Taught by: R. Mauck, R. Wells.
Course offered spring; even-numbered years
Also Offered As: BE 640
Prerequisite: BIOM 600
Activity: Lecture
1.0 Course Unit

CAMB 704 Stress Responses in Metabolism and Cancer
The course meets once a week for student presentations and lectures. The first 2-3 weeks encompasses lectures on state-of-the-art metabolic labeling, metabolomics, and other related methodologies. Subsequently, both "historical" and more recent papers in the field of cancer metabolism are reviewed with individual faculty experts in each chosen area. The overall goal of the course is to give students a better understanding of the abrogation of normal cellular metabolism and stress during cancer, and how these interplay with each other to create/retain a malignant state. Grades are dependent on 2 presentations per semester, class participation, and weekly answers to 2-3 questions on the assigned papers. Must have completed first-year CAMB courses to enroll.
Taught by: C. Simon, Z. Arany, and K. Wellen
Course usually offered in fall term
Activity: Lecture
1.0 Course Unit

CAMB 705 Advanced Topics in Bacterial-Host Interactions
This course will delve into specific topics in general area of bacterial pathogenesis and bacteria-host interactions. We will be exploring key historical and current papers on topics related to bacterial invasion of and replication within host cells, bacterial interference with host cell signaling pathways, bacterial interactions with host mucosal tissues, and the role of bacterial colonization in shaping and instructing host immune responses. Each week, a student will lead the class in the discussion of published papers on a specific topic. The format of each class will be a 10-15 minute introduction of the key background and underlying questions to be presented by the student, followed by an in-depth analysis by all members of the class of one to two articles. Students will be graded based on their introductory presentation and active participation in the paper discussions. Recommended strong background in cell biology, immunology and/or bacteriology fulfilled by 1st year CAMB (previous BGS) courses. Course is limited to 2nd - 3rd year graduate students or advanced undergraduates with course directors permission.
Taught by: Igor Brodsky and Sunny Shin
Course usually offered in spring term
Activity: Seminar
1.0 Course Unit

CAMB 706 MVP Core
This is a year-long course for the incoming CAMB-MVP students and others wishing to gain a broad overview of pathogens and their interactions with hosts. The course will provide students with key fundamental knowledge of Microbiology, Virology and Parasitology. The course starts with introductory lectures on Concepts of Host-Pathogen interactions. The rest of the course is divided into sections on Bacteriology, Virology and Parasitology. Each week there are three 1 hour class slots that are either lectures on a specific topic or discussions of a relevant paper presented by students. Classes are led by faculty from across the campus and are highly interactive. Evaluation is based on mid and final take home essay topics for each of the three sections. Regular attendance and active participation in the discussions is also part of the evaluation.
Taught by: M. Weitzman and S. Shin
Two terms. student may enter either term.
Activity: Seminar
1.0 Course Unit

CAMB 707 Cell and Gene Therapy
This course will provide students with a general overview of translational research in the area of gene and cell therapy. This includes technical considerations, translating preclinical investigation into therapeutics, the execution of gene and cell therapies clinical trials, and key regulatory issues. Entrepreneurial considerations will be discussed as well. By the end of this course, students will understand the basic technologies employed for gene and cell therapy along with approaches and pitfalls to translating these therapies into clinical applications including regulatory and commercial aspects of this emerging area. Prerequisite: For graduate students, at least one prior course in immunology. An undergraduate-level or medical school immunology course is sufficient to meet the prerequisite.
Taught by: Michael C. Milone, MD, PhD, Elizabeth Hexner, MD, MSTR
Course usually offered in spring term
Also Offered As: MTR 621, REG 621
Activity: Lecture
1.0 Course Unit

CAMB 708 HIV Virology/Pathogenesis/Cure Seminar/Journal Club
This will be a year-long class, held every other week, that is paper-based utilizing the current literature in HIV virology, pathogenesis and cure research. The class will have a journal club format with attendance and participation open to the full Penn student & postdoc community (teach-your-peers). Enrolled students will be responsible for approximately 4-5 presentations over the duration of the course, as well as for bi-weekly paper selection in conjunction with the instructors and coordinating the presentations by other participants. Prerequisites: Strong background in cell biology, immunology or virology fulfilled by 1st yr CAMB Courses. Course is limited to graduate students. Instructor permission required for non-CAMB graduate students.
Taught by: Ronald Collman and Katharine Bar
Two terms. student may enter either term.
Activity: Seminar
1.0 Course Unit

CAMB 709 Quantitative Imaging and Analysis for Biologists (QIAB)
This course will provide an introduction to the fundamentals of modern light microscopy and image analysis using the free software package, Fiji, as a guide. Topics include fundamentals of basic and advanced light microscopy, image data optimization, and commonly-used processing and analysis tools such as filters, segmentation, tracking, and simple macro programming. The goal is to provide students with the background and confidence required to pursue more advanced quantitative imaging methods as the need arises in their research. Students will be graded based on their active participation in class, completion of hands-on Fiji exercises, and a final presentation describing an application of at least one of the analysis methods covered in class to their own image data. CAMB 709 is limited to 2nd - 4th-year graduate students who have previous/current experience with light microscopy. Permission to enroll from course directors is required for all students.
Taught by: M. Lakadamyali and A. Stout
Activity: Lecture
0.5 Course Units

CAMB 710 Drug Discovery and Development
This course will expose graduate-level students to the process of drug discovery and development. The course will be structured to cover topics from the identification of a disease-relevant target through to Phase III Clinical Trials. The course will be lecture based and there will also be student-led journal club presentations as part of the course. There will also be a writing project consisting of a 3 page proposal of how to advance one of the areas of Drug Discovery & Development covered in the course.
Taught by: Dr.Ben E.Black, UPenn and Dr.Craig A.Leach, GlaxoSmithKline
Course usually offered in spring term
Also Offered As: BMB 605, PHRM 605
Activity: Lecture
1.0 Course Unit

CAMB 711 Integrative plant and animal mechanobiology
This course aims to provide students with an understanding of biomechanics that spans the plant and animal kingdoms, with the goal of emphasizing principles common to both. Major concepts include 1) Plant and Animal Cell Biology; 2) Solid, Fluid, and Transport Mechanics; and 3) Integrating Biology and Mechanics - Big Questions. In addition to lectures, there will be two journal article discussion sections. Most lectures will be given by Penn faculty, although selected topics (particularly in plant biology and mechanics) will be covered by faculty at other sites through lectures broadcast remotely. The Penn director will be present at all sessions of the class. Undergraduates require special permission from the director.
Taught by: Rebecca Wells
Course usually offered in fall term
Also Offered As: BE 711
Activity: Lecture
1.0 Course Unit

CAMB 712 Topics in Cancer Biology
This course is an elective course for 2nd year Cancer Biology Students on a range of cancer-related topics. The course is designed to expose students to a range of topics in cancer biology, improve writing skills, train students to give clear and concise oral presentations, develop active listening and critical thinking skills as well as discussion skills. The course will also teach students about rigor and reproducibility in experimental design. The course will interface with Cancer Biology WIP talks (which are only given by 3rd year and up students) and complement journal club and prelim preparation. Completion of first-year CAMB courses required to enroll. Course is designed for second-year CAMB students.
Taught by: Sandra Ryeom
Two terms. student may enter either term.
Activity: Seminar
1.0 Course Unit

CAMB 713 Neuroepigenetics
This is a course intended to bring students up to date concerning our understanding of Neural Epigenetics. It is based on assigned topics and readings covering a variety of experimental systems and concepts in the field of Neuroepigenetics, formal presentations by individual students, critical evaluation of primary data, and in-depth discussion of potential issues and future directions, with goals to: 1) Review basic concepts of epigenetics in the context of neuroscience, 2) Learn to critically evaluate a topic (not a single paper) and set the premise, 3) Improve experimental design and enhance rigor and reproducibility, 4) Catch up with the most recent development in neuroepigenetics, 5) Develop professional presentation skills - be a story teller. Each week will focus on a specific topic of Neuroepigenetics via a "seminar" style presentation by a class member. Prerequisite: If course requirement not met, permission of instructure is required.
Taught by: Zhaolan Zhou, Elizabeth Heller, and Hao Wu
Course usually offered in fall term
Also Offered As: NGG 713
Prerequisite: BIOM 555
Activity: Lecture
1.0 Course Unit

CAMB 714 DIYtranscriptomics
As access to high-throughput sequencing technology increases, the bottleneck in biomedical research has shifted from generating data, to analyzing and integrating diverse data types. Addressing these needs requires that students and postdocs equip themselves with a toolkit for data mining and interrogation. This course focuses specifically on studying global gene expression (transcriptomics) through the use of the R programming environment and the Bioconductor suite of software packages - a versatile and robust collection of tools for bioinformatics, statistics, and plotting. During this semester-long course students participate in a mix of lectures and guided code review, all while working with real datasets directly on their laptop. Students will learn to analyze RNAseq data using a lightweight and reusable set of modular scripts that leverage open-source software. In addition, students will learn best practices in data science for working in R/Bioconductor, including creating interactive data visualizations, making their analsyes transparent and reproducible, and identifying experimental bias in large datasets. Students are encouraged, but not required, to bring their own RNAseq data to the course. This course requires completion of pre-course materials provided by the instructor.
Taught by: Dan Beiting
One-term course offered either term
Activity: Lecture
1.0 Course Unit

CAMB 752 Genomics
Recent advances in molecular biology, computer science, and engineering have opened up new possibilities for studying the biology of organisms. Biologists now have access to the complete genomic sequence and set of cellular instructions encoded in the DNA of specific organisms, including homo sapiens, dozens of bacterial species, the yeast Saccharomyces cerevisiae, the nematode C. elegans, and the fruit fly Drosophila melanogaster. The goals of the course include the following: 1. introduce the basic principles involved in sequencing genomes, 2. familiarize the students with new instrumentation, informative tools, and laboratory automation technologies related to genomics, 3. teach the students how to access the information and biological materials that are being developed in genomics and 4. examine how these new tools and resources are being applied to basic and translational research. This will be accomplished through in depth discussion of classic and recent papers. Prerequisite: Permission of Instructor.
Taught by: S Diskin
Course usually offered in spring term
Also Offered As: GCB 752
Prerequisite: GCB 534
Activity: Seminar
1.0 Course Unit

CAMB 899 Pre-dissertation Research
Activity: Laboratory
1.0 Course Unit

CAMB 995 Dissertation
Activity: Dissertation
1.0 Course Unit