**GENOMICS & COMP. BIOLOGY (GCB)**

**GCB 493 Epigentics 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 a 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: S Berger Course offered spring; odd-numbered years Also Offered As: BIOL 493, CAMB 493 Prerequisite: BIOL 221 Activity: Seminar 1.0 Course Unit

**GCB 533 Statistics for Genomics and Biomedical Informatics**
GCB 533 is an introductory course in probability theory and statistical inference for graduate students in Genomics and Computational Biology. The goal of the course is to provide foundation of basic concepts and tools as well as hands-on practice in their application to problems in genomics. At the completion of the course, students should have an intuitive understanding of basic probability and statistical inference and be prepared to select and execute appropriate statistical approaches in their future research. Activity: Lecture 1.0 Course Unit

**GCB 534 Experimental Genome Science**
This course will survey methods and questions in experimental genomics, including next generation sequencing methods, genomic sequencing in humans and model organisms, functional genomics, proteomics, and applications of genomics methods. Students will be expected to review and discuss current literature and to propose new experiments based on material learned in the course. Prerequisite: Undergraduates and Masters students need BIOL 431. Taught by: C. Brown, J. Murray Also Offered As: PHRM 534 Prerequisite: BIOL 431 Activity: Lecture 1.0 Course Unit

**GCB 535 Introduction to Bioinformatics**
This course provides overview of bioinformatics and computational biology as applied to biomedical research. A primary objective of the course is to enable students to integrate modern bioinformatics tools into their research activities. Course material is aimed to address biological questions using computational approaches and the analysis of data. A basic primer in programming and operating in a UNIX environment will be presented, and students will also be introduced to Python R, and tools for reproducible research. This course emphasizes direct, hands-on experience with applications to current biological research problems. Areas include DNA sequence alignment, genetic variation and analysis, motif discovery, study design for high-throughput sequencing RNA, and gene expression, single gene and whole-genome analysis, machine learning, and topics in systems biology. The relevant principles underlying methods used for analysis in these areas will be introduced and discussed at a level appropriate for biologists without a background in computer science. The course is not intended for computer science students who want to learn about biologically motivated algorithmic problems; BIOL 437/GCB 536 and GCB/CIS/BIOL 537 are more appropriate. Prerequisites: An advanced undergraduate course such as BIOL 421 or a graduate course in biology such as Biol 526 (Experimental Principles in Cell and Molecular Biology), BIOL 527 (Advanced Molecular Genetics), BIOL 540 (Genetic Systems), or equivalent, is a prerequisite. Taught by: B Voight, C Greene Course usually offered in spring term Also Offered As: CIS 535, MTR 535, PHRM 535 Prerequisite: BIOL 421 OR BIOL 526 OR BIOL 527 OR BIOL 528 OR BIOL 540 Activity: Lecture 1.0 Course Unit

**GCB 536 Fundamentals of Computational Biology**
Introductory computational biology course designed for both biology students and computer science, engineering students. The course will cover fundamentals of algorithms, statistics, and mathematics as applied to biological problems. In particular, emphasis will be given to biological problem modeling and understanding the algorithms and mathematical procedures at the "pencil and paper" level. That is, practical implementation of the algorithms is not taught but principles of the algorithms are covered using small sized examples. Topics to be covered are: genome annotation and string algorithms, pattern search and statistical learning, molecular evolution and phylogenetics, functional genomics and systems level analysis. Prerequisite: College level introductory biology required; undergraduate or graduate level statistics taken previously or concurrently required; molecular biology and/or genetics encouraged; programming experience encouraged Taught by: Kim Course usually offered in fall term Also Offered As: BIOL 536, CIS 536 Prerequisite: (BIOL 101 AND BIOL 102) AND (STAT 111 AND STAT 112) Activity: Lecture 1.0 Course Unit
GCB 567 Mathematical Computation Methods for Modeling Biological Systems
This course will cover topics in systems biology at the molecular/cellular scale. The emphasis will be on quantitative aspects of molecular biology, with possible subjects including probabilistic aspects of DNA replication, transcription, translation, as well as gene regulatory networks and signaling. The class will involve analyzing and simulating models of biological behavior using MATLAB. Prerequisite: Graduate standing or permission of the instructor.
One-term course offered either term
Also Offered As: AMCS 567, BE 567
Activity: Lecture
1.0 Course Unit

GCB 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: CAMB 577, IMUN 577
Prerequisite: (BIOL 483 OR BIOL 493) AND GCB 534 AND (GCB 535 OR GCB 536)
Activity: Lecture
1.0 Course Unit

GCB 585 Wistar Institute Cancer Biology Course: Signaling Pathways in Cancer
This course is intended to provide foundational information about the molecular basis of cancer. When necessary the significance of this information for clinical aspects of cancer is also discussed. The main theme centers around cell cycle checkpoints with specific emphasis on the biochemistry and genetics of DNA damage signaling pathways, DNA damage checkpoints, mitotic checkpoints and their relevance to human cancer. The course is taught by the organizers and guest lecturers from universities and research institutions in the Northeast. Following every lecture, students present a research paper related to the topic of that lecture. The course is intended for first and second year graduate students but all graduate students are welcome to attend. Prerequisite: Undergraduates and Master’s degree candidates require permission from the course directors.
Taught by: Skordalakes and Murphy
Course usually offered in fall term
Also Offered As: BMB 585
Activity: Lecture
1.0 Course Unit

GCB 699 Lab Rotation
Activity: Laboratory
1.0 Course Unit

GCB 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: CAMB 752
Prerequisite: GCB 534
Activity: Seminar
1.0 Course Unit

GCB 899 Pre-Dissertation Research
Activity: Laboratory
1.0 Course Unit

GCB 995 Dissertation
One-term course offered either term
Activity: Dissertation
1.0 Course Unit