Core Course Descriptions

Genetic Engineering: BLCHM 6400

This course covers essential techniques used in genetic engineering. Assuming modest background in biology, the course introduces fundamental aspects of molecular biology including mechanisms for storage of information in DNA and transfer of this information to RNA and protein molecules. Manipulations of DNA molecules to rearrange or remodel genetic information (cloning) are described from both theoretical and practical viewpoints. Topics covered include the use of restriction endonucleases, amplification of DNA sequences using the polymerase chain reaction (PCR), detection of DNA and RNA using hybridization (Southern and Northern blotting), properties of cloning vectors and their use in constructing genomic and cDNA libraries, DNA sequencing and sequence analysis, creating and detecting mutations in DNA and introducing these mutations into a genome, and expression and characterization of proteins.

Proteins and Nucleic Acid Biochemistry: MBIOL 6410 & BLCHM 6410

This required course begins with a review of the basics of protein and nucleic acid structure. This review is followed by an in-depth discussion of the kinetic and thermodynamic principles involved in the formation and stabilization of protein and nucleic acid structures. Special topics include ribozymes, protein design, nucleic acid-protein interactions, and discussions of various enzymes that act on nucleic acids.

G3: Genetics, Genomes, and Gene Expression: MBIOL 6420

This course covers transmission genetics, methods of genetic and genome analysis in model systems and humans, as well as transcriptional and post-transcriptional mechanisms of gene regulation. Lectures cover both classical achievements and recent advances in these fields, with readings based chiefly in the primary literature.

Cell Biology: MBIOL 6480

This course is split into three sections covering the following topics: 1. cell structure/function and intracellular trafficking. 2. Signal transduction, cell cycle and apoptosis. 3. Cell-cell communication, differentiation and tissue maintenance. Each section will consist of a series of lectures intended to explore the basic concepts associated with the various topics. Each section will have an in class exam and a writing assignment in the form of a mini grant proposal that is intended to encourage the following skills: the identification of important scientific problems and the formation of a testable hypothesis; the creation of a research plan to test the hypothesis; the presentation of this material in an acceptable and persuasive format.

Biophysical Chemistry: BLCHM 6450

Topics covered include: Basics of thermodynamics and statistical mechanics, with applications in biochemistry; transport phenomena; enzyme kinetics and inhibition; kinetic isotope effects; principles and applications of absorbance, fluorescence, and CD spectroscopies.

Protein Chemistry: BLCHM 6460

This is a one half semester course which focuses on the mechanisms of chemical reactions involving peptides and proteins and methods for their study. Subject matter includes enzyme mechanisms, chemical modification of proteins and cofactor chemistry. Prerequisite: organic chemistry

Structural Methods: BLCHM 6430

This course provides an integrated approach to the applications of NMR, X-ray crystallography, and mass spectrometry in structural biology. Topics covered include: basic NMR theory, and the application of 2D and 3D NMR methods for the determining protein and RNA structures; methods of macromolecular crystallization and crystal structure determination; methods of accurate mass measurement, peptide and oligonucleotide sequencing, and identification of proteins from analysis of protelytic digests in conjunction with database searching. An introduction to molecular modeling will be presented, which will include force fields, energy minimization, and molecular dynamics simulations of biomolecules.

Literature Review and Problem Solving: MBIOL 6200 & BLCHM 6200

In order to teach the skills required to be a successful independent scientist this course will teach students how to digest and analyze papers and problem solve, both of which will review and apply material from core coursers. The instructors will develop specific course content. Topics may include: How to read a paper (read at home, discuss in class); Survey of the core services; Problem solving with open-ended problems posed on real-life or made-up situations. A focused effort will be made to help students identify topics that they can develop into grants in the Spring term. Grading will be based on participation and individual work.

Guided Grant Preparation: MBIOL 6300 & BLCHM 6300

To prepare students for their thesis research, prelims, and qualifying exams, we will offer a guided grant preparation course in the second half of the Spring semester that builds on their experience earlier in the semester (critical reading of primary literature and problem solving). The guided grant writing course will provide an opportunity for students to create an original research proposal by critical review of other grants, training in hypothesis generation, scientific writing, and experimental design. The written original grant proposal will be used as a basis for an oral qualifying examination by a faculty committee.