

## Core Course Descriptions

### **Genetic Engineering: BLCHM 6400**

This course covers essential techniques used in genetic engineering. Assuming little 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 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.

### **Genetics and Genomes: MBIOL 6420**

The Genetics and Genomes course covers the basic principles of genetics in both prokaryotes and eukaryotes, and the basic mechanisms of genome structure and replication. Mechanisms governing the transmission of genetic information are covered in bacteria, fungi, flies, worms, and vertebrates, including mutagenesis, transposons, suppression, epistasis, recombination, mosaics, gene knockouts, and two hybrid analysis. The genomes section of the course covers the organization of genes on chromosomes, chromatin structure, DNA replication and repair, gene silencing, chromosome inactivation, imprinting, and genome evolution.

### **Gene Expression: MBIOL 6440**

This course covers both transcriptional and post-transcriptional mechanisms of gene regulation. Lectures cover recent advances in these fields with material based on the primary literature. In the past exams have been take-home. The transcriptional regulation section of the course covers, basic mechanisms of gene activation and repression, chromatin remodeling machines, regulation of transcription activation by signal transduction cascades. The post-transcriptional section covers mechanisms regulating RNA processing (splicing, editing, and transport), translation and mRNA stability.

### **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 proteolytic 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.

### **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.