

Each emphasis in MCB requires a certain number of elective courses. These courses may be any upper division lecture course offered by MCB or courses selected from the Approved Electives List on the [Major Requirements](#) page. Approval for other courses may be obtained via petition in the UAO.

### **Biophysical Chemistry: Physical Principles and the Molecules of Life**

MCB C100A [4 units]

*Prerequisites: Chem 3A or Chem112A, Math 1A, Bio 1A with Chem 3B or Chem 112B recommended.*

Thermodynamic and kinetic concepts applied to understanding the chemistry and structure of biomolecules (proteins, DNA, and RNA). Molecular distributions, reaction kinetics, enzyme kinetics. Bioenergetics, energy transduction, and motor proteins. Electrochemical potential, membranes, and ion channels. (F,Sp) [Check out information about our C100A tutoring program here.](#)

### **Biochemistry: Pathways, Mechanisms, and Regulation**

MCB 100B [3 units]

*Prerequisite: MCB C100A*

Bioenergetics, metabolic pathways, and regulation of metabolism; the chemistry, structure, function, synthesis, and degradation of the constituent molecules (amino acids, fatty acids, sugars, nucleotides) and cofactors of the major biological macromolecules. Diseases that are linked to metabolic disorders. Designed for majors in the biochemistry and molecular biology, genetics and development, or immunology emphases. (Sp)

### **Survey of the Principles of Biochemistry and Molecular Biology**

MCB 102 [4 units]

*Prerequisites: Biology 1A, Chemistry 3B or an equivalent course. Recommended: a course in physical chemistry.*

Credit option: Students will receive 2 units of credit for 102 after taking 100 or C100A/Chemistry C130. Students will receive no credit for 102 after taking 110 and either of 100/100B or C100A/Chemistry C130. No credit for 102 after taking Chemistry 135.

A comprehensive survey of the fundamentals of biological chemistry, including the properties of intermediary metabolites, the structure and function of biological macromolecules, the logic of metabolic pathways (both degradative and biosynthetic) and the molecular basis of genetics and gene expression. (F,Sp,Su)

### **Bacterial Pathogenesis**

MCB C103 [3 units]

*Prerequisites: C100A, 102 or consent of instructor.*

This course for upper division and graduate students will explore the molecular and cellular basis of microbial pathogenesis. The course will focus on model microbial systems which illustrate mechanisms of pathogenesis. Most of the emphasis will be on bacterial pathogens of mammals, but there will be some discussion of viral and protozoan pathogens. There will be an emphasis on experimental approaches. The course will also include some aspects of bacterial

genetics and physiology, immune response to infection, and the cell biology of host-parasite interactions. Also listed as Public Health C102 and Plant Biology C103. (Sp)

### **Genetics, Genomics & Cell Biology**

MCB 104 [4 units]

*Prerequisites: MCB 102*

*Restricted credit: Students will receive 1 unit of credit after taking MCB C142, or 140, 3 units of credit after taking MCB 110 or 130, and no credit after taking both C142 and 110 or 130.*

This course will introduce students to key concepts in genetic analysis, eukaryotic cell biology, and state-of-the-art approaches in genomic medicine. Lectures will highlight basic knowledge of cellular processes with the basis for human diseases, particularly cancer. Prerequisite courses will have introduced students to the concepts of cells, the central dogma of molecular biology, and gene regulation. Emphasis in this course will be on eukaryotic cell processes, including cellular organization, dynamics, and signaling. (F, Sp)

### **Molecular Biology: Macromolecular Synthesis and Cellular Function**

MCB 110 [4 units]

*Prerequisites: C100A (may not be taken concurrently); Plan 1 Emphasis 1 (BMB) majors should take 100B prior to 110.*

RESTRICTED CREDIT: MCB 130 prevents elective credit for MCB 110.

Molecular biology of prokaryotic and eukaryotic cells and their viruses. Mechanisms of DNA replication, transcription, translation. Structure of genes and chromosomes. Regulation of gene expression. Biochemical processes and principles in membrane structure and function, intracellular trafficking and subcellular compartmentation, cytoskeletal architecture, nucleocytoplasmic transport, signal transduction mechanisms, and cell cycle control. (F,Sp)

### **General Biochemistry and Molecular Biology Laboratory**

MCB 110L [5 units]

*Prerequisites: 110 (may be taken concurrently).* Experimental techniques of biochemistry and molecular biology, designed to accompany the lectures in 100B and 110. (F,Sp)

### **General Microbiology**

MCB C112 [4 units]

*Prerequisites: C100A/Chemistry C130 or 102.*

This course will explore the molecular bases for physiological and biochemical diversity among members of the two major domains, Bacteria and Archaea. The ecological significance and evolutionary origins of this diversity will be discussed. Molecular, genetic, and structure-function analyses of microbial cell cycles, adaptive responses, metabolic capability, and macromolecular syntheses will be emphasized. Also listed as Plant & Microbial Biology C112. (F)

### **General Microbiology Laboratory**

### MCB C112L [2 units]

*Prerequisites: C112 (may be taken concurrently).*

Experimental techniques of microbiology designed to accompany the lecture in C112 and C148. The primary emphasis in the laboratory will be on the cultivation and physiological and genetic characterization of bacteria. Laboratory exercises will include the observation, enrichment, and isolation of bacteria from selected environments. Also listed as Plant & Microbial Biology C112L. (F,Sp)

### Introduction to Comparative Virology

#### MCB C114 [4 units]

*Prerequisites: Introductory chemistry (1A or 3A/3AL-3B or equivalent) and introductory biology (1A/1AL-1B or equivalent) and general biochemistry (100B or equivalent--preferably completed but may be taken concurrently).*

Viruses will be considered as infectious agents of bacteria, plants, and animals (vertebrates and invertebrates). Several families of viruses will be compared with respect to biochemical, structural and morphological properties, and strategies of infection and replication. Also listed as Plant Biology C114 and Environ Sci, Policy, and Management C138. (Sp) □

### Molecular Biology of Animal Viruses

#### MCB 115 [2 units]

*Prerequisites: Upper division or graduate status. C100A/Chem C130 or C112 or equivalent.*

Structure, reproduction, mutations, and host cell interactions (including pathogenesis) of animal viruses. This upper division and graduate course will broadly survey the strategies that viruses use to propagate in eukaryote cells, with an emphasis on vertebrate systems and disease-causing viruses. We will also discuss host mechanisms of defense against viruses. Graduate students should additionally enroll in 215. 115/215 are taught concurrently. (currently not offered)

### Microbial Diversity

#### MCB C116 [3 units]

*Prerequisites: Upper-division standing. C112 or consent of instructor and organic chemistry (may be taken concurrently).*

This course for upper-division and graduate students will broadly survey myriad types of microbial organisms, both procaryote and eucaryote, using a phylogenetic framework to organize the concept of "biodiversity." Emphasis will be on the evolutionary development of the many biochemical themes, how they mold our biosphere, and the organisms that affect the global biochemistry. Molecular mechanisms that occur in different lineages will be compared and contrasted to illustrate fundamental biological strategies. Graduate students additionally should enroll in C216, Microbial Diversity Workshop. Also listed as Plant & Microbial Biology C116. (Sp)

### The Cancer Karyotype: What it is and What it Isn't □

#### MCB 118 [1 unit] (Note that this course does not fulfill any major requirements)

*Prerequisites: 102, 104 recommended.*

Mutational cancer theories do not explain why cancers: 1) have clonal individual karyotypes; 2) have polygenic transcriptomes and phenotypes; 3) have flexible karyotypes, which evolve progressive malignancy and drug resistance, but maintain autonomy and even immortality; and 4) Why carcinogens induce cancer only after conspicuously long latent periods of years to decades. To answer these questions, this course tests a new karyotypic theory, which postulates that cancers evolve much like new species. (F) Duesberg.

### **Cell & Systems Biology**

MCB 130A [4 units]

*Prerequisites: 104.*

RESTRICTED CREDIT: MCB 110 prevents elective credit for MCB 130. This course will provide a detailed discussion of a wide range of topics in cell biology emphasizing experimental approaches and key experiments that have provided important insights. The course is aimed at conveying an understanding of how cellular structure and function arise as a result of the properties of cellular macromolecules. An emphasis will be placed on the dynamic nature of cellular organization and will include a description of physical properties of cells (dimensions, concepts of free energy, diffusion, biophysical properties). Students will be introduced to quantitative aspects of cell biology and a view of cellular function that is based on integrating multiple pathways and modes of regulation (systems biology). (Sp) ( [more detailed description, including syllabus](#) )

### **Biology of Human Cancer**

MCB 132 [4 units]

*Prerequisites: 102 or 110 (may be taken concurrently); Biology 1A and 1B.*

The course is designed for students interested in learning about the molecular and cell biology of cancer and how this knowledge is being applied to the prevention, diagnosis and therapy of cancer. Topics covered include tumor pathology and epidemiology; tumor viruses and oncogenes; intracellular signaling; tumor suppressors; multi-step carcinogenesis and tumor progression; genetic instability in cancer; tumor-host interactions; invasion and metastasis; tumor immunology; cancer therapy. (F)

### **Cell Biology & Physiology Laboratory**

MCB 133L [4 units]

*Prerequisites: MCB 104*

Experimental analyses of central problems in cell biology and physiology using modern techniques, including DNA cloning and protein biochemistry, fluorescence microscopy of the cytoskeleton and organelles, DNA transfection and cell cycle analysis of cultured mammalian cells, RNA interference and drug treatments to analyze ion channel function in cell contractility and intracellular signaling, and somatosensation. (F,Sp)

### **Chromosome Biology/Cytogenetics**

MCB C134 [3 units]

*Prerequisites: Upper division genetics or cell biology course; concurrent enrollment with consent of instructor.*

Survey of behavior, structure, and function of chromosomes with emphasis on behavior in model organisms. Topics include mitosis, meiosis, chromosome aberrations, genome function, dosage compensation, transposons, repetitive DNA, and modern cytological imaging. Also listed as Plant & Microbial Biology C134. (Sp) ( [more detailed description](#) )

**Molecular Endocrinology**

MCB 135A [3 units]

*Prerequisites: 102, Biology 1A/1AL-1B, Chemistry 3A/3AL-3B or equivalent, or consent of instructor.*

Molecular mechanisms by which hormones elicit specific responses and regulate gene expression; hormone-receptor interaction; synthesis, transport and targeting of hormones, growth factors and receptors. (Offered alternate years in the Fall.) (F) *Firestone*

**Physiology**

MCB 136 [4 units]

*Prerequisites: Biology 1A/1AL-1B, Physics 8A-8B.*

Credit option: Students will receive no credit for 136 after IB 132.

Principles of mammalian (primarily human) physiology emphasizing physical, chemical, molecular and cellular bases of functional biology. The following topics will be covered: cellular and membrane ion and nonelectrolyte transport; cell and endocrine regulation; autonomic nervous system regulation; skeletal, smooth and cardiac muscle; cardiovascular physiology; respiration; renal physiology; gastrointestinal physiology. Discussion section led by Graduate Student Instructor will review material covered in lecture. (F)

**Computer Simulation in Biology**

MCB 137 [3 units]

Modeling and computer simulation of dynamic biological processes using special graphical interfaces requiring very little mathematical or computer experience. Models are drawn from the current literature to teach concepts and technique. The latter part of the course is a workshop for student-selected individual projects. Computer work may be done at home or in the university laboratory. (Sp) *Macey, Oster*

**General Genetics**

MCB 140 [4 units] (taught fall only)

*Prerequisites: C100A/Chemistry C130 and either 110 (which may be taken concurrently) or consent of instructor.*

*Credit option: Students will receive 1 unit of credit after taking 104, C142 or IB C163.*

In-depth introduction to genetics, including mechanisms of inheritance; gene transmission and recombination; transposable DNA elements; gene structure, function, and regulation; and developmental genetics. Some exams may be given in the evening. (F)

**Genetics Laboratory**

MCB 140L [4 units]

*Prerequisites: 104, 140. May be taken concurrently.*

Experimental techniques in classical and molecular genetics. (Sp)

### **Developmental Biology**

MCB 141 [4 units]

*Prerequisites: 102 or C100A/Chemistry C130, Biology 1A/1AL-1B; 110 or 104 recommended.*

An introduction to principles and processes of embryonic and post-embryonic development, stressing mechanisms of cell and tissue interactions, morphogenesis and regulation of gene expression. (Sp)

### **Evolution of Genomes, Cells and Development**

MCB 143 [3 units]

*Prerequisites: Biology 1A-1B and MCB C100A or 102; 104 or 140 recommended.*

*Student will receive no credit for 143 after taking IB 163.*

This course is intended for upper-division undergraduates seeking an interactive course based on modern concepts in evolution and comparative genomics. The course will emphasize the contribution of molecular evolution to a series of seminar events in life's history: origin of life; origin of cells; origin of eukaryotes; origin of multicellularity; evolution of animal development; human origins. (F)

### **Genomics**

MCB C145 [4 units]

*Prerequisites: 102 or 110*

In-depth introduction to genomics, including genome sequencing; bioinformatics; sequence annotation and analysis; complex trait mapping; DNA microarrays and their uses; proteomics; structural genomics. Also listed as Plant & Microbial Biology C145. (Currently not offered)

### **Topics in Computational Biology and Genomics**

MCB C146 [4 units]

*Prerequisites: Bioengineering 142, Computer Science 61A, or equivalent ability to write programs in Java, Perl, C, or C++; 100, 102, or equivalent; or consent of instructor.*

Instruction and discussion of topics in genomics and computational biology. Working from evolutionary concepts, the course will cover principles and application of molecular sequence comparison, genome sequencing and functional annotation, and phylogenetic analysis. Also listed as Bioengineering C146 and Plant & Microbial Biology C146. (Currently not offered)

### **Microbial Genomics and Genetics**

MCB C148 [3 units]

*Prerequisites: C100A/Chemistry C130 or 102.*

Course emphasizes bacterial and archaeal genetics and comparative genomics. Genetics and genomic methods used to dissect metabolic and development processes in bacteria, archaea, and selected microbial eukaryotes. Genetic mechanisms integrated with genomic information to address integration and diversity of microbial processes. Introduction to the use of computational tools for a comparative analysis of microbial genomes and determining relationships among bacteria, archaea, and microbial eukaryotes. Also listed as Plant & Microbial Biology C148. (Sp)□

### **Molecular Immunology**

MCB 150 [4 units]

*Prerequisites: C100A/Chemistry C130 or 102.*

Fundamentals of immunology with emphasis on biochemical and molecular approaches to study of the immune system and its application in medicine and biotechnology. Topics covered include description of the immune system, antibody and T-cell receptor structure and function, genes of the immunoglobulin superfamily, cells and molecular mediators that regulate the immune response, allergy, autoimmunity, immunodeficiency, tissue and organ transplants, and tumor immunology. (F,Sp)□

### **Immunology Laboratory**

MCB 150L [4 units]

*Prerequisites: 150 (may be taken concurrently); consent of instructor.*

Experimental techniques in mammalian molecular biology and cellular immunology. Molecular techniques covered include PCR and recombinant DNA procedures such as gene cloning, gene transfer, DNA sequencing, Southern blot, and restriction mapping. Immunological techniques covered include cell culture and monoclonal antibody production, flow cytometry, ELISA, immunoprecipitation, and western blot. (F,Sp) *Beatty, Sha*

### **Introduction to Neurobiology**

MCB C160 [4 units]

*Prerequisites: 102 or 100B, Biology 1A/1AL, Physics 8A-8B.*

An introductory course designed to provide a general understanding of the nervous system including how it functions, how it develops, and how it changes with learning and memory. Analysis from the level of molecules to cells to simple circuits to complex networks to higher brain functions. (F,Sp)

### **Neurobiology Laboratory**

MCB 160L [4 units]

*Prerequisites: Biology 1A/1AL, Physics 8A-8B, 100B or 102; C160 (or equivalent).*

Experimental analyses of properties and interactions of nerve cells and systems, illustrating principal features and current methods. Techniques employed include computer simulation of neuron properties, electrophysiological recording and stimulation of nerves and cells, digitally enhanced video imaging of outgrowth, fluorescence immunocytochemistry, analysis of sensory: CNS mapping, human-evoked potential recording, sensory psychophysics. (Sp) *Zucker*

### **Mammalian Neuroanatomy**

MCB 163 [4 units]

*Prerequisites: Biology 1A/1AL.*

Development, structure (gross and microscopic), and functional relationships of the mammalian nervous system. (F)

### **Molecular Neurobiology**

MCB 165 [3 units]

*Prerequisites: 102 or 110, C160.*

The molecular and biochemical aspects of the structure and function of the nervous system, including ion channels, neurotransmitters and their receptors, second messenger systems, and molecular mechanisms of development and plasticity. (Sp) *Presti*

### **Biophysical Neurobiology**

MCB 166 [3 units]

*Prerequisites: Biology 1A/1AL, Physics 8A-8B, Chemistry 1A, 3A/3AL-3B, and consent of instructor.*

Biophysical properties of ion channels and excitability, ion selectivity, membrane transport phenomena. Sensory transduction, optical measurements and microscopy. Cellular networks as computational devices, information processing and transfer. (F) *Lecar*

### **Physiological and Genetic Basis of Behavior**

MCB 167 [3 units]

Genetic, cellular, and circuit-level analysis of how the nervous system generates behavior. Includes sensory processing, movement, and learning. Focus is on model systems for animal behavior. Principles, cellular and circuit specializations, and neural computations for behavior will be presented. (Sp) *Feldman, Scott*