MOLECULAR BIOLOGY AND BIOCHEMISTRY (MB&B)

MB&B101F The Personal Genomics Revolution (FYS)
The first draft of the human genome sequence was published approximately 15 years ago, having taken more than a decade to complete at a cost of approximately three billion dollars. With incredible advances in sequencing technology, accompanying analysis tools, and maturation of sequence databases, we have arrived at the beginning of an era of “personal genomics.” Today, individuals can have their genomes sequenced in a few hours for a few hundred dollars! This course explores the kinds of information contained within one’s genome and the various ways in which genome sequences can be used for improving quality of life. Students will conduct original research to explore societal attitudes about the use of personal genomics for the purpose of making lifestyle choices (dating, diet, vocations, etc.); establishing notions of personal identity (race, gender, nationality, etc.); creating new social networks (based on genetic kinship); or prolonging life span (and revolutionizing medicine). As part of this research, students will also consider ethical issues (e.g., privacy, discrimination) surrounding the use of personal genomics, as well as how education might impact societal attitudes on particular applications of this technology. As this is an FYS course, student work will focus on developing skills in scholarly writing, which will include peer evaluations of other student writing and production of a final scholarly paper based on the results of their research project.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: None

MB&B102F Writing about Science (FYS)
This first-year seminar course will cover topical areas of science including the chemistry of foods and food additives, drugs, diseases and their treatments, the environment, and reproductive technologies. This class would be an excellent choice for prospective non-science majors who have an interest in understanding how modern science works. The course will emphasize writing and how to convey complex scientific concepts to a lay audience. Students will take part in special projects and work to understand and present their findings in presentations and written form.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: None

MB&B103 Copernicus, Darwin, and the Human Genome Project
Much of art and philosophy is inspired by the question: What does it mean to be human? The project of science has provided rational explanations of human identity that threaten our self-perception as special beings—beginning with the Copernican revolution and discoveries about our unspecial place in the universe. In this course, we will discuss three paradigms arising from modern molecular biology that provide perspective on the lines between living and non-living, human and non-human life, and human and machine by exploring the science of DNA, evolution, and the Human Genome Project, respectively. As part of both discussions, we will consider how society negotiates with science, as depicted in politics and popular art, ethical issues pertaining to the advancement of scientific (e.g., reproductive, genetic) technologies, and plausible resolutions to the tension between science and society that arise from a detailed understanding of the scientific method. Little or no background knowledge in science/biology will be assumed.
Offering: Host

MB&B107 The Science of Human Health: Microbiology and Immunology
Studying the molecular and cellular biology of disease-causing viruses and bacteria, we will survey the basic mechanisms that they deploy to colonize and harm our bodies. We will also learn about the cells and macromolecules that comprise our immune system, how they act in concert to detect and combat disease or, in certain instances, cause autoimmune disease. A case-study approach will be pursued to join these two subjects and to illustrate the complex interplay between pathogens and the immune system that allows us to successfully combat certain diseases, become persistently infected by others, or succumb to debilitating or fatal illnesses.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: None

MB&B108 Discutamos la ciencia en Español (Lets discuss science in Spanish)
This introductory course is designed for students with intermediate to advanced knowledge of the Spanish language. The class focus is to help students understand basic scientific concepts in Spanish and discuss scientific literature of general interest in Spanish. The goal is to develop language skills (reading, listening, writing, and speaking) with focus on scientific topics.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: None

MB&B108Z Discutamos la ciencia en Español (Lets discuss science in Spanish)
This introductory course is designed for students with intermediate to advanced knowledge of the Spanish language. The class focus is to help students understand basic scientific concepts in Spanish and discuss scientific literature of general interest in Spanish. The goal is to develop language skills (reading, listening, writing, and speaking) with focus on scientific topics.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: None

MB&B111 Introduction to Environmental Toxicology
This course will look at the human health consequences of anthropogenic and natural toxins in the environment. We will examine how chemicals are absorbed, distributed, and detoxified within our bodies, and the mechanism of acute and chronic damage to our health. We will explore how toxins travel through the environment and how permissible levels of exposure are decided upon. This naturally leads to a discussion about the perception and management of risk. We will look at case studies relating to industrial pollution, accidents, and contamination of our air, water, and food through the lens of human disease and social cost. Students are asked to think critically about available scientific evidence and form opinions about how much risk is acceptable in our daily lives.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: None

MB&B117 Life in the Cell from a Molecule’s Perspective
What does DNA look like when it is not condensed into chromosomes? How do partners in molecular processes find each other? If a molecular motor
"walks," how do they take a step? We will explore these major topics in molecular biophysics by discussing primary scientific literature. Emphasis will be placed on revealing the ways in which our understanding of biological processes can be improved by understanding the underlying physics. Students should have a broad high school science background, familiarity with quantitative and algebraic concepts, and a desire to incorporate quantitative thinking into verbal discourse. Writing is a core element of the course.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-PHYS
Identical With: PHYS107
Prereq: None

MB&B119 Biology and Chemistry in the Modern World: A Survey of Drugs and Disease
This course will cover a wide range of topics of current interest that are at the intersection of biology and chemistry. In particular, the molecular basis of issues related to drugs and disease will form a focus of the course. Topics to be discussed will include psychoactive and performance-enhancing drugs, mad cow, cancer, viral and bacterial diseases, and the chemistry of foods.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM119
Prereq: None

MB&B130Z Discovering a Small World Nanobots, Nanomedicine, and Nanomaterials
How can nano-sized salt and sugar help make food healthier? How can your iPod or Laptop get any smaller? Why does sunscreen contain titanium oxide nanoparticles? How small is "nano"? Through discussions on science fiction novels and learning of scientific principles, this course will explore how nanosized objects are studied and used to advance the fields of medicine, electronics and biomaterials. This general education course is designed for non-science undergraduate majors where students will explore what we may not know about our world, our community, our friends and ourselves. This course is meant to teach students how to critically interpret science in popular media and news sources.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM130Z
Prereq: None

MB&B155 Tiny Organisms with a Big Effect: The Microbiome
With the advent of advanced sequencing technology, we are able to characterize the microflora that lives on and inside of multicellular organisms, including humans. It follows that there are still many unknowns with respect to the function and dynamics of relationships between bacterial communities and their hosts. These bacterial communities, colonizing humans and other organisms with millions of microbes, have captured the interest of the public. Popular news outlets have made the disparate claims that the right human microbiome can act as a panacea and the wrong microbiome is such a calamity that it can destroy an individual’s health. This course will look at the true nature of the microbiome, to the extent that current research has revealed. We will discuss both normal and abnormal bacterial community compositions and any related disease states. Similarly, we will cover changes in microbiome composition over time and with respect to host development. In class, we will also consider the microbiomes of other organisms and how the presence and composition of the microbiome relates to disease states and/or life history.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL155
Prereq: None

MB&B160 Biochemical and Molecular Basis of Human Diseases
This general education course will cover the biochemical, molecular, genetic, and cellular aspects of selected human diseases. The basic anatomy of each relevant system will also be covered, along with ethical questions that can arise when addressing each condition. Topics will include sickle cell anemia, diabetes, atherosclerosis, and prion diseases.

Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: None

MB&B181 Principles of Biology I: Cell Biology and Molecular Basis of Heredity
This course presents an exploration of the contemporary view of the cell and an introduction to the molecules and mechanisms of genetics and gene function. The course will have two major themes. First, we will focus on the central dogma of molecular biology, describing the process of information transfer from genetic code in DNA through protein synthesis and function. Topics include DNA replication and repair, chromosome dynamics, RNA transcription, protein translation, gene regulation, and genomics. Second, we will focus on cell theory and the underlying molecular mechanisms of cellular activity, including cell signaling, energetics, cell motility, and cell cycling. Lectures will stress the experimental basis of conclusions presented and highlight important details and major themes. The course will also emphasize problem solving approaches in cell and molecular biology. The course will use software to ensure academic integrity. This course will require about 10 hours per week of engagement. Students should enroll separately in MB&B/BIOL191 Principles of Biology 1 - Laboratory.

Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: BIOL181
Prereq: None

MB&B181Z Principles of Biology I: Cell Biology and Molecular Basis of Heredity
This course presents an exploration of the contemporary view of the cell and an introduction to the molecules and mechanisms of genetics and gene function. The course will have two major themes. First, we will focus on the central dogma of molecular biology, describing the process of information transfer from genetic code in DNA through protein synthesis and function. Topics include DNA replication and repair, chromosome dynamics, RNA transcription, protein translation, gene regulation, and genomics. Second, we will focus on cell theory and the underlying molecular mechanisms of cellular activity, including cell signaling, energetics, cell motility, and cell cycling. Lectures will stress the experimental basis of conclusions presented and highlight important details and major themes. The course will also emphasize problem solving approaches in cell and molecular biology.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL181Z
Prereq: None

MB&B182 Principles of Biology II
This course covers biological principles at tissue, organ, organismic, and population levels of organization. We will review how animals regulate their internal environment to control or adapt to changes in temperature, salt levels,
of electrophysiology, microscopy, computer simulations, and analyses of DNA methods, data analysis, and empirical approaches to developmental biology, or MB&B182, will introduce students to experimental design, laboratory. This laboratory course, designed to be taken concurrently with BIOL182

**MB&B192 Principles of Biology II Laboratory (Online)**
This laboratory course, to be taken concurrently with MB&B181 or BIOL181, provides experience with techniques used in cell biology and molecular biology. These include polymerase chain reaction (PCR), electrophoresis, enzyme assays, and spectrophotometry.

- **Offering:** Host
- **Grading:** Cr/U
- **Credits:** 0.25
- **Gen Ed Area:** None
- **Identical With:** BIOL193, NS&B193
- **Prereq:** None

**MB&B194 Principles of Biology II: Advanced Topics**
This course provides an optional supplement to the introductory course in physiology, development, evolution, and ecology (BIOL182, which should be taken concurrently). It is designed for highly motivated biology students who seek to enrich their understanding by engaging with current research in an intensive seminar setting. Students in BIOL194 will read and discuss recent journal articles that probe in greater depth some of the subjects covered in BIOL182. Weekly meetings will consist of a short lecture by the professor followed by group discussion of the readings.

- **Offering:** Crosslisting
- **Grading:** Cr/U
- **Credits:** 0.25
- **Gen Ed Area:** None
- **Identical With:** BIOL194
- **Prereq:** BIOL181 or MB&B181

**MB&B198 Principles of Biology II Laboratory _ Online**
This laboratory course, designed to be taken concurrently with BIOL182 or MB&B182, will introduce students to experimental design, laboratory methods, data analysis, and empirical approaches to developmental biology, physiology, ecology, and evolution. Laboratory exercises use the techniques of electrophysiology, microscopy, computer simulations, and analyses of DNA sequence data. Some exercises will include exploration of physiological processes in living animals.

- **Offering:** Crosslisting
- **Grading:** Cr/U
- **Credits:** 0.25
- **Gen Ed Area:** None
- **Identical With:** BIOL198, NS&B198
- **Prereq:** BIOL192

**MB&B208 Molecular Biology**
This course is a comprehensive survey of the molecules and molecular mechanisms underlying biological processes. It will focus on the cornerstone biological processes of genome replication, gene expression, and protein function. The major biomacromolecules--DNA, RNA, and proteins--will be analyzed to emphasize the principles that define their structure and function. We will also consider how these components interact in larger networks within cells to permit processing of external and internal information during development and how these processes become perturbed in disease states.

- **Offering:** Host
- **Grading:** A-F
- **Credits:** 1.00
MB&B209 Research Frontiers in Molecular Biology and Biochemistry
This course of weekly discussions of current research is for students who have completed the MB&B or BIOL introductory series. Discussions will be informal in nature and cover topics of current interest in molecular biology and biochemistry, emphasizing possibilities for future research areas for the students.
Offering: Host
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-MBB
Prereq: [(MB&B181 or BIOL181) AND (BIOL182 or MB&B182)]

MB&B210 Genomics: Modern Genetics, Bioinformatics, and the Human Genome Project
Genetics has provided a foundation for modern biology. We will explore the classical genetics and go on to consider how genomics has transformed this field. This course is intended to introduce students to the fields of genetics and genomics, which encompass modern molecular genetics, bioinformatics, and the structure, function, and evolution of genomes. We will discuss important new areas of research that have emerged from the genome projects, such as epigenetics, polymorphisms, transgenics, systems biology, stem cell research, and disease mapping. Students will also discuss bioethical issues we face in this new postgenome era.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Prereq: [MB&B181 or BIOL181]

MB&B212 Principles and Mechanisms of Cell Biology
The cell is the smallest structural and functional unit of an organism. Understanding the molecular basis for its behavior and function is critical to understand biological function at all levels, from molecular to organismic. The primary goal of this course is to understand how cells function within the context of the multicellular organism or tissue—an environment that cells regulate as well as respond to. We also focus on the process of scientific discovery in the field of cell biology—how do we know what we know? Hence whilst the textbook will provide background reading, we will also discuss original research in class. We will cover cell and organelle structure and function, trafficking, cell adhesion and motility, proliferation, signal transduction, and cell differentiation, and consider how these processes are integrated to generate coherent cell behaviors, or go awry in disease.
Offering: Crosslisting
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: [MB&B181 or BIOL181]

MB&B223 The Molecular Basis of Cancer
Cancer is a group of diseases characterized by unregulated cell growth and tissue invasion. This course will focus on the molecular events that lead to cancer. We will cover topics in both molecular and cellular biology and genetics that are relevant to understanding the differences between normal and cancer cells. Particular focus will be placed on oncogenes and tumor suppressor genes, DNA damage responses, the p53 signaling pathway, cell cycle regulation, and the molecular basis of cancer therapies. This course will utilize both the textbook and primary scientific literature in the study of cancer.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: None
Prereq: [MB&B181]

MB&B228 Introductory Medical Biochemistry
This introductory course will focus on the essential concepts of biochemistry important to students interested in the health professions, including the chemical and biological foundations of cellular metabolism and related disease states. Major topics will include the structure and function of biological molecules in the human body (proteins, carbohydrates, fats, nucleic acids, vitamins), enzyme catalysis, cellular signaling, and digestion, absorption, and processing of nutrients for energy and growth.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: [MB&B181 or BIOL181] AND CHEM251

MB&B231 Microbiology
This course will study microorganisms in action, as agents of disease, in ecological situations, and as tools for research in molecular biology, genetics, and biochemistry. Particular emphasis will be placed on new ideas in the field.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: [MB&B181 or BIOL181] OR [MB&B208 or BIOL208]

MB&B232 Immunology
In this introduction to immunology, particular emphasis will be given to understanding both the innate immune response and its agents as well as the acquired immune response mediated by B and T cells. Cellular and antibody responses in health and disease will be addressed, along with mechanisms of immune evasion by pathogens, autoimmune disease, and cancer.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: [MB&B181 or BIOL181] AND BIOL223

MB&B233 Cellular Mechanisms of Gene Regulation and Gene Editing Tools
This course will explain the mechanisms of gene expression in eukaryotes. Then we will define the main and current techniques used for gene editing (CRISPR/Cas9, TALEN, site director mutagenesis, CRE/lox recombination). Discussions will include how these technologies can be used to optimize organisms for health, food, and energy applications. Ethical use and current regulations of gene editing tools will also be considered.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: [MB&B208 or BIOL208]

MB&B237 Signal Transduction
Cells contain elaborate systems for sensing their environment and for communicating with neighbors across the membrane barrier. This class will explore molecular aspects of signal transduction in prokaryotic and eukaryotic cells. Topics will include membrane receptors, GPCRs, kinases, phosphorylation, ubiquitination, calcium signaling, nuclear receptors, quorum sensing, and human
sensory systems. We will integrate biochemical functional approaches with structural and biophysical techniques.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: CHEM242
Prereq: [MB&B208 or BIOL208]

MB&B242 Informal Science Education for Elementary School Students II
This service-learning course will focus on designing and implementing original, effective, and engaging science-based lesson plans for elementary age children in an afterschool program setting at five local elementary schools. The classroom component includes writing, testing, and critiquing lesson plans and organizing a once-a-semester event, Science Saturday. Members of the class are required to volunteer weekly, co-lead Science Saturday, complete individual work, and organize meetings for projects outside of class. This course is a continuation of CHEM241.
Offering: Crosslisting
Grading: Cr/U
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM242
Prereq: None

MB&B265 Bioinformatics Programming
This course is an introduction to bioinformatics and programming for students with interest in the life sciences. It introduces problem areas and conceptual frameworks in bioinformatics. The course assumes little or no prior programming experience and will introduce the fundamental concepts and mechanisms of computer programs and examples (e.g., sequence matching and manipulation, database access, output parsing, dynamic programming) frequently encountered in the field of bioinformatics.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL265, COMP113, CIS265
Prereq: [MB&B181 or BIOL181]

MB&B266 Bioinformatics
This course is an introduction to bioinformatics for students with interest in the life sciences. It introduces problem areas and conceptual frameworks in bioinformatics. The course assumes little or no prior programming experience and will introduce the fundamental concepts and mechanisms of computer programs and examples (e.g., sequence matching and manipulation, database access, output parsing, dynamic programming) frequently encountered in the field of bioinformatics.
Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-BIOL
Identical With: BIOL266, COMP266, CIS266
Prereq: [MB&B181 OR BIOL181]

MB&B285 Seminar in Molecular Biology
This course involves presentation and discussion of recent literature in the field of molecular and cellular biology.
Offering: Crosslisting
Grading: OPT
Credits: 0.50

MB&B286 Seminar in Molecular Biology
This course includes the presentation and discussion of recent findings in the field of molecular and cellular biology.
Offering: Crosslisting
Grading: OPT
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B585
Prereq: None

MB&B303 Receptors, Channels, and Pumps: Advanced Topics in Membrane Protein Structure and Function
Membrane proteins constitute one-third of all cellular proteins and one-half of current drug targets, but our understanding of their structure and function has been limited in the past by technological obstacles. In spite of this, the past 10 years have yielded a wealth of new membrane protein structures that have helped to uncover the mechanistic underpinnings of many important cellular processes. This class will examine some of the new insights gained through the various techniques of modern structural biology. We will start with a general review of membrane properties, structural techniques (e.g., x-ray crystallography, EM, NMR), and protein structure analysis. We will then look at common structural motifs and functional concepts illustrated by different classes of membrane proteins. Students will read primary literature sources and learn how to gauge the quality and limitations of published membrane protein structures. These tools will be generally applicable to evaluating soluble protein structures as well.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B303, MB&B523
Prereq: [CHEM251 AND CHEM252 AND [MB&B208 or BIOL208]]

MB&B305 Enzymology of DNA Damage and Repair
Students in this course will learn about the sources and consequences of DNA damage and the biochemical mechanisms responsible for DNA repair. Course content will include lectures, student presentations, and discussion of current literature on DNA damage, repair and mutagenesis, with strong emphasis on protein structure-function and enzyme kinetics, as well as diseases associated with defective DNA repair.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B505
Prereq: MB&B208

MB&B306 Epigenetics
Basic genetics states that individuals with different DNA sequences express different traits. However, a large number of permanent and heritable changes to cells and organisms occur in the absence of changes to DNA sequence. Such epigenetic mechanisms explain a variety of disparate observations, including the ability of a zygote to develop into dozens of distinct cell types in multicellular organisms using one common DNA blueprint, the observation that grandchildren of individuals subject to famine have higher rates of metabolic defects, and the ability of neurons to mediate formation of long-term memories. In this course we will use a variety of examples from cell biology and genetics to examine the template-dependent processes governing the perpetuation of discrete phenotypes. Topics will include the molecular biology of prions (infectious
proteins) and environment-induced alterations in gene expression that may be transmitted to offspring.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B506
Prereq: MB&B181

MB&B307 Molecular Biophysics Journal Club I
This course includes presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from journals including but not limited to the Biophysical Journal, Biopolymers, Current Opinion in Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.

Offering: Crosslisting
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B507, CHEM507, CHEM307, PHYS317, PHYS517
Prereq: None

MB&B308 Molecular Biophysics Journal Club II

Offering: Crosslisting
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B508, CHEM508, PHYS318, PHYS518, CHEM308
Prereq: None

MB&B309 Molecular and Cellular Biophysics
This course is an integrated consideration of the biophysics and biophysical chemistry of biological systems from molecules to cells. The objective is to develop a critical sense of the quantitative data currently being obtained from microscopy to spectroscopy, considering both ensemble and single-molecule experiments, and to gain familiarity and facility with interpretation using mathematical and computational models. Biological systems are inherently complex, and some form of modeling is always involved in developing an explanation of how they work. However, these models typically involve only a few basic constructs (simple harmonic motion, ideal fluids, two-state Ising models, random walks, electrostatic interactions, classical dynamics, rate equations, QM energy levels, distribution functions, and network analysis) and only elementary aspects of linear algebra, calculus, differential equations, and statistics. This course deals with how these constructs are integrated in the framework of Boltzmann statistical mechanics to formulate mathematical models of biological phenomena, how these models are validated and refined, and how they are used to form explanations and make testable predictions. Model systems to be considered include the nucleosome, the ribosome, membrane dynamics and ion channels, molecular devices and motors, prototype signal transduction systems, and regulatory processes. This course is suitable for physics and chemistry students who wish to learn about biological applications and for molecular and cellular biology students to develop skills with quantitative physicochemical modes of inquiry applied to the life sciences.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM309, CHEM509, MB&B509, PHYS339, PHYS539

Prereq: None

MB&B310 Mechanisms of Protein Trafficking Within Eukaryotes
This course surveys the mechanisms of protein trafficking and sorting within eukaryotic cells with an emphasis on the major protein exocytosis pathway.

Offering: Crosslisting
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B510
Prereq: [MB&B208 or BIOL208] OR [BIOL212 or MB&B212]

MB&B311 Genomics Analysis
This course is an introduction to genomics and analysis for students with interest in life sciences. It introduces current applications of genomics techniques, covers how to build a genomics workflow, and introduces statistical analyses in R programming language. This course assumes little or no prior programming experience and will provide hands-on experience in taking raw next-generation sequencing data through a custom workflow and ending with analyses in R statistical software. This course emphasizes hands-on computational methodology, bioinformatics data analysis, and interpretation of quantitative information. The primary method of evaluation is through written work and the course will increase students skill in scientific writing and scholarship. Due to the ongoing pandemic, in the Fall of 2020 the course will be all online with both synchronous and asynchronous instruction, discussion groups and cloud based computational projects designed to train transferable skills in big data analysis.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL
Identical With: BIOL310, CIS310
Prereq: [MB&B181 or BIOL181]

MB&B313 Molecular, Proteomic, and Cell Biological Analysis of Telomere Composition and Function
This course will focus on a critical feature of the eukaryotic cell known as the telomere, or linear chromosome end. We will discuss the diverse set of critical molecular mechanisms affected by and involving telomeres including chromosome segregation, cellular aging, meiotic gamete production, and cancer progression. We will also focus on the physical architecture of the telomere, how this architecture dynamically alters in different biological contexts, and the types of molecules known to associate with telomeres in multiple model organisms including yeast and human cells. An emphasis will be placed on experimental strategies used for identifying new components of the telomere complex and for understanding telomere function during normal and diseased cellular states.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Identical With: MB&B513
Prereq: None

MB&B315 The Regulation of Ribosome Biosynthesis
This course will focus on understanding one of life’s original, and still greatest, feats: namely, how cells make proteins. Since early life forms evolved ribosomes several billion years ago, their synthesis, regulation, function, and evolution have been at the core of all aspects of biology.

This act of protein translation is remarkable, not only for its efficiency and fidelity, but also for the sheer complexity of the reaction, including the wide variety of molecules (e.g., mRNAs, tRNAs, rRNAs, proteins, amino acids) that need to be harnessed for its execution. In this course, we will investigate the biosynthetic pathways that are involved in effecting protein synthesis from various approaches. Both prokaryotic and eukaryotic systems will be considered,
including the questions of how ribosome biosynthesis and activity is relevant to genetic diseases, cancer, cell growth, and antibiotic activity.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B515
Prereq: [MB&B208 or BIOL208]

MB&B316 Advanced Topics in Structural Biology
This course will examine how researchers use the tools of structure determination to explore current fundamental questions in the biological sciences. Beginning with a short history of the field of structure biology, we will examine the benefits and limitations of various techniques used to study protein and DNA structure. We will read primary literary sources on a number of contemporary topics for which structural biology has made important contributions. This may include (but is not limited to) microbial pathogenesis, immunology, gene regulation, membrane protein biology, neurological signaling, signal transduction, and metabolism. This course will explore how the study of structural biology contributes to our understanding and treatment of human diseases, including the development of drugs and other therapeutic interventions.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Identical With: MB&B516
Prereq: None

MB&B317 Advanced Topics in Recombinant DNA
The breaking and rejoining of DNA molecules is at the heart of so many cell biological processes, including adaptive immunity, the common emergence of new viral variants (such as the flu), the fundamental life cycle of other viruses (such as retroviruses), the prevention of aneuploidy in reproductive cells, the production of chromosomal rearrangements in cancer cells, and the repair of damaged DNA. Used as a tool by molecular biologists, recombinant DNA has led to tremendous insight into cell function, development, and disease. Recombinant DNA methodology is growing in its capacity to precisely change the genes carried by organisms, which has important implications for both the food industry and medicine. In this half-semester course, we will examine primary literature that touches on how recombination between DNA sequences is utilized within cells and as a research tool by humans to promote new genetic outcomes.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Identical With: MB&B517
Prereq: None

MB&B321 Biomedical Chemistry
This course is designed to explore the molecular basis of disease and treatment options. Topics will reflect the importance of chemistry and biochemistry in the advancement of medicine today and will include treatment of metabolic disorders, rational drug design, and mode of drug action. A large portion of the course will be dedicated to learning computer programs used in computational drug design as part of a final drug design project.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM321
Prereq: (CHEM251 AND [CHEM383 or MB&B383])

MB&B322 Mechanisms of Protein Trafficking Within Prokaryotes
This course surveys the mechanisms of membrane protein topogenesis and protein secretion within E. coli, the quintessential prokaryote, where sophisticated genetic and biochemical analysis has been possible. The course surveys the primary literature with student presentations and a written final examination.

Offering: Crosslisting
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B522
Prereq: [MB&B208 or BIOL208] OR [BIOL212 or MB&B212]

MB&B325 Introduction to Biomolecular Structure
This course aims to provide a framework for understanding three-dimensional structures of proteins, nucleic acids, and their complexes. The first half of the course emphasizes structural modules and topological patterns in major classes of proteins and nucleic acids. The second part of the course covers novel structural motifs, such as helix-turn-helix, zinc-finger, and leucine zipper, that are responsible for recognition of specific nucleotide sequences in nucleic acids by proteins. Analysis of structures using tools available on the Web and independent exploration of protein and nucleic acid databases are strongly encouraged.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM325
Prereq: MB&B181 OR BIOL181

MB&B328 Topics in Eukaryotic Genetics: Transcription
This half-semester course will follow two principal themes: We will examine the use of genetic methods in current biological research and apply these methods to address questions about the regulation of gene expression in eukaryotes. Our examination of transcriptional regulation will lead us into the related topics of gene organization, chromosome structure, and signal transduction.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B528
Prereq: None

MB&B330 Molecular and Cellular Basis of Human Diseases
This course will cover the molecular, genetic, cellular, and biochemical aspects of selected human ailments. Topics will include aging, atherosclerosis, osteoporosis, diabetes, obesity, and Alzheimer's disease.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B530
Prereq: [MB&B208 or BIOL208] OR [CHEM383 or MB&B383]

MB&B333 Gene Regulation
This course aims to develop a genome perspective on transcriptional gene regulation. The genome sequence, now completed in a number of organisms, is described as a blueprint for development. More than simply a parts list (i.e., genes), this blueprint is an instruction manual as well (i.e., regulatory code). A next critical phase of the genome project is understanding the genetic and epigenetic regulatory codes that operate during development. Through a combination of lectures and discussion of primary literature, this course will explore current topics on promoters and transcription factors, chromatin structure, regulatory RNA, chromosomal regulatory domains, and genetic
regulatory networks. An overarching theme is how genomes encode and execute regulatory programs as revealed by a global systems biology approach in modern genomics research.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B533, BIOL333, BIOL333
Prereq: [BIOL182 or MB&B182]

MB&B334 Stochastic Biology: Randomness and Order in Gene Regulation
While much of biology is discussed with assumptions of “determinism” (e.g., the cell is instructed to express a transcription factor that activates a downstream gene in a deterministic and entirely predictable way) and “homogeneity” (e.g., a population of cells all behaving synchronously in the same way), there is a growing appreciation that many biological outcomes are, in fact, statistical phenomena and stochastic in nature. In this half-credit module, we will discuss stochastic behavior in biology from the perspective of gene expression. A focus will be on emerging molecular and cellular techniques that enable observation of stochastic behavior at a single-cell resolution, thus permitting researchers to characterize molecular behavior as it actually occurs, as opposed to averaging a behavior across a population of otherwise diverse individuals. Insights on stochastic behaviors have far-reaching implications in biology, challenging long-held perspectives on transcription, replication, signal transduction, enzymes, disease states (such as cancer), stems cells, cell differentiation, aging, and adaptive evolution. This course will focus primarily on one of these: stochastic behavior in transcription and chromosome dynamics and its implications to understanding cell and tissue behavior.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Identical With: MB&B534
Prereq: None

MB&B335 Protein Folding: From Misfolding to Disease
Amyloidogenesis, the process by which proteins and peptides misfold to form amyloid fibers, is at the root of several different diseases, including Parkinson’s disease, Alzheimer’s disease, mad cow disease, and type II diabetes to name a few. This course will focus on current research in the field that seeks to understand why a functional, well-folded protein adopts the misfolded amyloid form. In the course of discussing the misfolded nature of these proteins, we will review central elements of protein structure and stability to better understand the protein-folding landscape and the process of misfolding. We will also discuss how the process of misfolding leads to the different diseases and disease pathologies. We will read current literature that studies the molecular nature of these diseases and discuss the strategies used to detect, identify and study these misfolded proteins in the body and in the test-tube.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B535, CHEM335, CHEM535
Prereq: MB&B208 OR MB&B325

MB&B336 Metals, Metalloenzymes, and Disease
This class will examine primary scientific evidence showing the role of transition metals in the development of various diseases that are established early in development. The course objective is to teach the biochemistry of transition metals in cells and how metal imbalance (absence or overload) leads to various diseases like Wilson, Menkes, mitochondrial myopathies, and even cancer.

Offering: Crosslisting
Grading: A-F
Credits: 1.00

Gen Ed Area: NSM-MBB
Identical With: MB&B536
Prereq: MB&B191 AND MB&B208 AND CHEM251

MB&B338 Biology and MB&B Symposium I
Weekly seminars by distinguished national and international scientists. The seminar series provides an exciting opportunity to hear about advances in research in the life sciences.

Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: BIOL338, BIOL353, MB&B538
Prereq: None

MB&B339 Biology and MB&B Symposium II
Weekly seminars by distinguished national and international scientists. The seminar series provides an exciting opportunity to hear about advances in research in the life sciences.

Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: BIOL339, BIOL359, MB&B539
Prereq: None

MB&B340 Practical Methods in Biochemistry
This course centers on currently used techniques for protein separation, characterization, and purification, such as ultracentrifugation, gel electrophoresis, and chromatography. These topics will be introduced within the general context of the behavior of macromolecules in solution. The relative stability of proteins in different media, the forces stabilizing protein structure, and the interaction of proteins will be discussed. We will explicitly consider different techniques used to study proteins. Relatively novel techniques to be discussed include surface plasmon resonance, microarray methods and mass spectrometry, and single molecule microscopy. In the course, we will go through three or four different protein purification protocols and discuss the methods used in each one. We will also touch upon the commonly used spectroscopic techniques used to characterize proteins, including absorption, fluorescence, and circular dichroism. The course will focus on biochemical techniques and understanding the physical principles underlying these techniques and will also discuss tactics for optimizing established isolation and purification procedures and for isolating and characterizing an unknown protein.

The course content is appropriate for advanced undergraduates (juniors/seniors) and beginning graduate students from chemistry, biology, molecular biophysics or MB&B.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: CHEM390
Prereq: [MB&B208] OR [CHEM383 or MB&B383]

MB&B342 Molecules to Medicine
This course will explore the process of drug development, including target selection, lead discovery using computer-based methods and combinatorial chemistry/high-throughput screening, organic synthesis, bioavailability, clinical trials, and other factors (some economics and politics) involved in bringing a drug to the marketplace. Critical consideration of the variables to contend with at each step will be described and discussed, including aspects of research ethics and patent law. The basic science of molecular recognition, computer-aided drug design, and the role of factors from synthetic chemistry to toxicology will be presented. Case studies of the development of drugs recently successful in making the journey from molecule to medicine will be discussed, as well as
the story of some that did not, and why. Emerging new design strategies such as fusion-protein therapeutics, crisper technology, and enhanced use of rational design and combinatorial methods will be emphasized, and how pharmaceutical research is evolving in the postgenomic era, particularly with biologics. Job opportunities in the pharmaceutical industry will be discussed.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM342, BIOL342, CIS342
Prereq: CHEM252 OR MB&B208

MB&B375 The Cell-Division Cycle and Cancer
This course will cover a broad range of topics that are related to the process of cell division. We will discuss how the cell cycle is executed and regulated in a variety of eukaryotic systems. Major consideration will be applied to discussions of cancer and the defects in cell-division regulation that underlie this disease. Some of the topics include growth factors, signaling pathways, apoptosis, cyclin-dependent kinases as cell-cycle regulators, transcriptional and posttranscriptional control of cell-cycle genes, DNA replication, DNA damage checkpoints, and tumor suppressors.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B575
Prereq: None

MB&B377 Advanced Genetics
This course will focus on classical genetics, a discipline that grew from a desire to explain how adaptive traits are passed from generation to generation. Special emphasis will be placed on model organism genetics and on understanding how classical genetic analysis, in conjunction with the analysis of cellular and chromosome behavior, led to key discoveries about the nature of the gene, DNA, RNA, protein, and cellular function.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B577
Prereq: None

MB&B381 Physical Chemistry for the Life Sciences
The course is concerned with the basic physicochemical principles and model systems essential to understanding, explaining, and predicting the behavior of biological systems in terms of molecular forces. The course integrates fundamental concepts in thermodynamics, kinetics, and molecular spectroscopy with the structures, functions, and molecular mechanisms of biological processes. The objectives of the course are to (1) familiarize life science students at the advanced undergraduate and beginning graduate level with basic physicochemical laws, theories, and concepts important to the life sciences; (2) provide a working knowledge of mathematical methods useful in life science research; (3) develop a critical perspective on explanation of biological processes and understanding biological systems; and (4) survey the main applications of physical chemistry in the life sciences. Theory, methodology, and biophysical concepts are distributed throughout the course.

Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: CHEM381, MB&B581
Prereq: (CHEM251 AND MATH117) OR (CHEM251 AND MATH120) OR (CHEM251 AND MATH121)

MB&B382 Practical NMR
Nuclear magnetic resonance (NMR) is an extremely powerful and flexible technique that can be used to analyze molecules sized from just a few atoms up to tens of thousands of atoms. This course will provide an introduction to how NMR spectroscopy works and background on the important theoretical aspects relevant for the most common NMR experiments. Time will be spent gaining practical experience in conducting NMR experiments both during and outside class. The ultimate goal of both the theoretical and hands-on sections of this course is to enable you to correctly select and perform NMR experiments necessary to characterize molecules.

In addition to learning how NMR hardware is used to produce spectra, we also cover important tasks like sample preparation and the finer points of data processing that will help you get better data. Beyond simple one-dimensional experiments, we will discuss a number of different multidimensional NMR experiments for determining the structures of small organic molecules, including COSY, HSQC, HMBC, and NOE. Furthermore, you will learn how protein structures are solved using 2D, 3D, and 4D experiments, and how the motion of those proteins can be measured at the atomic level.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM382
Prereq: None

MB&B383 Biochemistry
This rigorous introductory course to the principles and concepts of contemporary biochemistry presents both the biological and chemical perspectives. The major themes will be the structure and function of the major macromolecules (proteins, lipids, and carbohydrates), the basis and measurement of enzymatic activity, and general mammalian and plant cellular metabolism.

Offering: Crosslisting
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM383
Prereq: (CHEM251 AND CHEM252)

MB&B386 Biological Thermodynamics
This course is addressed to undergraduate and graduate students interested in biological chemistry and structural biology. The course presents thermodynamic methods currently used to relate structure to function in biological molecules. Topics include binding curves, chemical ligand linkages, binding polynomial, cooperativity, site-specific binding processes, and allosteric effects. Several models for allosteric systems, such as the Monod-Wyman-Changeux model, the induced-fit model, and the Pauling model, are analyzed in detail. Applications of these models are illustrated for functional regulation of respiratory proteins and for protein-nucleic-acid complexes involved in control of gene expression.

Offering: Crosslisting
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM386
Prereq: (MATH121 AND MATH122)

MB&B387 Enzyme Mechanisms
The chemical mechanisms involved in the action of a series of typical enzymes will be considered.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: CHEM387
Prereq: [CHEM383 or MB&B383]

**MB&B394 Advanced Laboratory in Molecular Biology and Genetics**
This course is designed to familiarize students with current research techniques in molecular biology, biochemistry, and genetics. A variety of methods and approaches will be applied in a series of short projects, primarily using E. coli and Saccharomyces cerevisiae (budding yeast) as model systems. Students will gain hands-on experience employing recombinant DNA, microbiology, protein biochemistry, and other methods to answer basic research questions. This course provides excellent preparation for students planning to conduct independent research at the undergraduate level (MB&B401/402) and beyond.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB

Prereq: [MB&B208 or BIOL208]

**MB&B395 Structural Biology Laboratory**
One of the major catalysts of the revolution in biology that is now under way is our current ability to determine the physical properties and three-dimensional structures of biological molecules by x-ray diffraction, nuclear magnetic resonance (NMR) spectroscopy, and other spectroscopic methods. This course is designed to familiarize students with current research techniques in biochemistry and molecular biology. Students will perform spectroscopic investigations on a protein that they have isolated and characterized using typical biochemical techniques, such as electrophoresis, enzyme extraction, and column chromatography. The course will provide hands-on experience with spectroscopic methods such as NMR, fluorescence, UV-Vis absorption, and Raman as well as bioinformatic computational methods. All of these methods will be applied to the study of biomolecular structure and energetics. This course provides a broad knowledge of laboratory techniques valuable for independent research at the undergraduate level and beyond.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: CHEM395, PHYS395
Prereq: [(CHEM142 AND CHEM325) OR (CHEM142 AND MB&B208) OR (CHEM142 AND PHYS207)] OR [(CHEM144 AND CHEM325) OR (CHEM144 AND MB&B208) OR (CHEM144 AND PHYS207)]

**MB&B401 Individual Tutorial, Undergraduate**
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

**MB&B402 Individual Tutorial, Undergraduate**
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

**MB&B407 Senior Tutorial (downgraded thesis)**
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.
Offering: Host
Grading: A-F

**MB&B408 Senior Tutorial (downgraded thesis)**
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.
Offering: Host
Grading: A-F

**MB&B409 Senior Thesis Tutorial**
Topic to be arranged in consultation with the tutor.
Offering: Host

**MB&B410 Senior Thesis Tutorial**
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

**MB&B411 Group Tutorial, Undergraduate**
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

**MB&B412 Group Tutorial, Undergraduate**
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

**MB&B421 Undergraduate Research, Science**
Individual research projects for undergraduate students supervised by faculty members.
Offering: Host
Grading: OPT

**MB&B422 Undergraduate Research, Science**
Individual research projects for undergraduate students supervised by faculty members.
Offering: Host
Grading: OPT

**MB&B423 Advanced Research Seminar, Undergraduate**
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

**MB&B424 Advanced Research Seminar, Undergraduate**
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

**MB&B465 Education in the Field, Undergraduate**
Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.
Offering: Host
Grading: OPT

**MB&B466 Education in the Field, Undergraduate**
Students must consult with the department and class dean in advance of undertaking education in the field for approval of the nature of the responsibilities and method of evaluation.
Offering: Host
Grading: OPT

**MB&B491 Teaching Apprentice Tutorial**
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: Host
Grading: OPT

**MB&B492 Teaching Apprentice Tutorial**
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: Host
Grading: OPT

**MB&B500 Graduate Pedagogy**
The elements of good teaching will be discussed and demonstrated through lectures, practice teaching sessions, and discussions of problems encountered in the actual teaching environment. The staff consists of faculty and experienced
graduate students. An integral part of the course is a required one-day workshop BEFORE the first day of formal classes.

Training in pedagogy in the first semester of attendance is required for all incoming Wesleyan MA and PhD students who have not already fulfilled this requirement at Wesleyan. BA/MA students are not required to get training in pedagogy but may choose to do so.

Offering: Crosslisting
Grading: Cr/U
Credits: 0.50
Gen Ed Area: None
Identical With: E&ESS500, CHEM500, BIOL500, ASTR500, MUSC500, PHYS500, PSYC500, MATH500
Prereq: None

MB&B501 Individual Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

MB&B502 Individual Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

MB&B503 Selected Topics, Graduate Sciences
Topic to be arranged in consultation with the tutor. A seminar primarily concerned with papers taken from current research publications designed for, and required of, graduate students.
Offering: Host
Grading: OPT

MB&B504 Selected Topics, Graduate Sciences
Topic to be arranged in consultation with the tutor. A seminar primarily concerned with papers taken from current research publications designed for, and required of, graduate students.
Offering: Host
Grading: OPT

MB&B505 Enzymology of DNA Damage and Repair
Students in this course will learn about the sources and consequences of DNA damage and the biochemical mechanisms responsible for DNA repair. Course content will include lectures, student presentations, and discussion of current literature on DNA damage, repair and mutagenesis, with strong emphasis on protein structure-function and enzyme kinetics, as well as diseases associated with defective DNA repair.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B305
Prereq: MB&B208

MB&B506 Epigenetics
Basic genetics states that individuals with different DNA sequences express different traits. However, a large number of permanent and heritable changes to cells and organisms occur in the absence of changes to DNA sequence. Such epigenetic mechanisms explain a variety of disparate observations, including the ability of a zygote to develop into dozens of distinct cell types in multicellular organisms using one common DNA blueprint, the observation that grandchildren of individuals subject to famine have higher rates of metabolic defects, and the ability of neurons to mediate formation of long-term memories. In this course we will use a variety of examples from cell biology and genetics to examine the template-dependent processes governing the perpetuation of discrete phenotypes. Topics will include the molecular biology of prions (infectious proteins) and environment-induced alterations in gene expression that may be transmitted to offspring.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B306
Prereq: MB&B181

MB&B507 Molecular Biophysics Journal Club I
This course includes presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from journals including but not limited to the Biophysical Journal, Biopolymers, Current Opinion in Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: Host
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B307, CHEM507, CHEM307, PHYS317, PHYS517
Prereq: None

MB&B508 Molecular Biophysics Journal Club II
Offering: Host
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B308, CHEM508, PHYS518, CHEM308
Prereq: None

MB&B509 Molecular and Cellular Biophysics
This course is an integrated consideration of the biophysics and biophysical chemistry of biological systems from molecules to cells. The objective is to develop a critical sense of the quantitative data currently being obtained from microscopy to spectroscopy, considering both ensemble and single-molecule experiments, and to gain familiarity and facility with interpretation using mathematical and computational models. Biological systems are inherently complex, and some form of modeling is always involved in developing an explanation of how they work. However, these models typically involve only a few basic constructs (simple harmonic motion, ideal fluids, two-state Ising models, random walks, electrostatic interactions, classical dynamics, rate equations, QM energy levels, distribution functions, and network analysis) and only elementary aspects of linear algebra, calculus, differential equations, and statistics. This course deals with how these constructs are integrated in the framework of Boltzmann statistical mechanics to formulate mathematical models of biological phenomena, how these models are validated and refined, and how they are used to form explanations and make testable predictions. Model systems to be considered include the nucleosome, the ribosome, membrane dynamics and ion channels, molecular devices and motors, prototype signal transduction systems, and regulatory processes. This course is suitable for physics and chemistry students who wish to learn about biological applications and for molecular and cellular biology students to develop skills with quantitative physicochemical modes of inquiry applied to the life sciences.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM309, MB&B309, CHEM509, PHYS339, PHYS539
Prereq: None

**MB&B510 Mechanisms of Protein Trafficking Within Eukaryotes**
This course surveys the mechanisms of protein trafficking and sorting within eukaryotic cells with an emphasis on the major protein exocytosis pathway.

Offering: Host
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B310
Prereq: [MB&B208 or BIOL208] OR [BIOL212 or MB&B212]

**MB&B511 Group Tutorial, Graduate**
Topic to be arranged in consultation with the tutor.

Offering: Host
Grading: OPT

**MB&B513 Molecular, Proteomic, and Cell Biological Analysis of Telomere Composition and Function**
This course will focus on a critical feature of the eukaryotic cell known as the telomere, or linear chromosome end. We will discuss the diverse set of critical molecular mechanisms affected by and involving telomeres including chromosome segregation, cellular aging, meiotic gamete production, and cancer progression. We will also focus on the physical architecture of the telomere, how this architecture dynamically alters in different biological contexts, and the types of molecules known to associate with telomeres in multiple model organisms including yeast and human cells. An emphasis will be placed on experimental strategies used for identifying new components of the telomere complex and for understanding telomere function during normal and diseased cellular states.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Identical With: MB&B313
Prereq: None

**MB&B515 The Regulation of Ribosome Biosynthesis**
This course will focus on understanding one of life’s original, and still greatest, feats: namely, how cells make proteins. Since early life forms evolved ribosomes several billion years ago, their synthesis, regulation, function, and evolution have been at the core of all aspects of biology.

This act of protein translation is remarkable, not only for its efficiency and fidelity, but also for the sheer complexity of the reaction, including the wide variety of molecules (e.g., mRNAs, tRNAs, rRNAs, proteins, amino acids) that need to be harnessed for its execution. In this course, we will investigate the biosynthetic pathways that are involved in effecting protein synthesis from various approaches. Both prokaryotic and eukaryotic systems will be considered, including the questions of how ribosome biosynthesis and activity is relevant to genetic diseases, cancer, cell growth, and antibiotic activity.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B315
Prereq: [MB&B208 or BIOL208]

**MB&B516 Advanced Topics in Structural Biology**
This course will examine how researchers use the tools of structure determination to explore current fundamental questions in the biological sciences. Beginning with a short history of the field of structure biology, we will examine the benefits and limitations of various techniques used to study protein and DNA structure. We will read primary literary sources on a number of contemporary topics for which structural biology has made important contributions. This may include (but is not limited to) microbial pathogenesis, immunology, gene regulation, membrane protein biology, neurological signaling, signal transduction, and metabolism. This course will explore how the study of structural biology contributes to our understanding and treatment of human diseases, including the development of drugs and other therapeutic interventions.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Identical With: MB&B316
Prereq: None

**MB&B517 Advanced Topics in Recombinant DNA**
The breaking and rejoining of DNA molecules is at the heart of so many cell biological processes, including adaptive immunity, the common emergence of new viral variants (such as the flu), the fundamental life cycle of other viruses (such as retroviruses), the prevention of aneuploidy in reproductive cells, the production of chromosomal rearrangements in cancer cells, and the repair of damaged DNA. Used as a tool by molecular biologists, recombinant DNA has led to tremendous insight into cell function, development, and disease. Recombinant DNA methodology is growing in its capacity to precisely change the genes carried by organisms, which has important implications for both the food industry and medicine. In this half-semester course, we will examine primary literature that touches on how recombination between DNA sequences is utilized within cells and as a research tool by humans to promote new genetic outcomes.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Identical With: MB&B317
Prereq: None

**MB&B519 Structural Mechanisms of Protein-Nucleic Acid Interactions**
This course focuses on recent advances in the understanding of the structural basis of the recognition of nucleic acids by proteins. Macromolecular systems to be discussed include site-specific DNA endonucleases, topoisomerases, the histone fold, helicases, site-specific recombinases, nuclear RNA-protein complexes, tRNA-binding proteins, and the ribosome.

Offering: Crosslisting
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: CHEM519
Prereq: [CHEM251 AND CHEM252]

**MB&B520 Topics in Nucleic Acid Structure**
This course focuses on the principles of nucleic acid structure. The scope of this course is to go beyond the common DNA structures such as B-DNA and A-DNA helical structures. The course will concentrate on other DNA structural motifs such as branched DNA, supercoiled DNA, triplex DNA, and quadruplex DNA. Physical characterization of these structures as well as the functional implication of these structures (in terms of DNA replication, transcription, telomeres, etc.) will be discussed extensively. Discussion will also center on the forces that stabilize these structures, such as H-bonding and stacking interactions. The course will also cover other important DNA structural motifs such as curved or bent DNA as found in A-tracks and the relevance of these structures in promoter recognition and gene expression. Important RNA structures, such as ribozymes and pseudoknots, will be discussed. We will also discuss the significance of DNA structural motifs in eukaryotic genomes and the application of bioinformatic tools to search for these motifs.

Offering: Host
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Prereq: None

**MB&B522 Mechanisms of Protein Trafficking Within Prokaryotes**

This course surveys the mechanisms of membrane protein topogenesis and protein secretion within E. coli, the quintessential prokaryote, where sophisticated genetic and biochemical analysis has been possible. The course surveys the primary literature with student presentations and a written final examination.

Offering: Host
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B322
Prereq: [MB&B208 or BIOL208] OR [BIOL212 or MB&B212]

**MB&B523 Receptors, Channels, and Pumps: Advanced Topics in Membrane Protein Structure and Function**

Membrane proteins constitute one-third of all cellular proteins and one-half of current drug targets, but our understanding of their structure and function has been limited in the past by technological obstacles. In spite of this, the past 10 years have yielded a wealth of new membrane protein structures that have helped to uncover the mechanistic underpinnings of many important cellular processes. This class will examine some of the new insights gained through the various techniques of modern structural biology. We will start with a general review of membrane properties, structural techniques (e.g., x-ray crystallography, EM, NMR), and protein structure analysis. We will then look at common structural motifs and functional concepts illustrated by different classes of membrane proteins. Students will read primary literature sources and learn how to gauge the quality and limitations of published membrane protein structures. These tools will be generally applicable to evaluating soluble protein structures as well.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B303, NS&B303
Prereq: [CHEM251 AND CHEM252 AND [MB&B208 or BIOL208]]

**MB&B528 Topics in Eukaryotic Genetics: Transcription**

This half-semester course will follow two principal themes: We will examine the use of genetic methods in current biological research and apply these methods to address questions about the regulation of gene expression in eukaryotes. Our examination of transcriptional regulation will lead us into the related topics of gene organization, chromosome structure, and signal transduction.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B328
Prereq: None

**MB&B530 Molecular and Cellular Basis of Human Diseases**

This course will cover the molecular, genetic, cellular, and biochemical aspects of selected human ailments. Topics will include aging, atherosclerosis, osteoporosis, diabetes, obesity, and Alzheimer’s disease.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B330
Prereq: [MB&B208 or BIOL208] OR [CHEM383 or MB&B383]

**MB&B533 Gene Regulation**

This course aims to develop a genome perspective on transcriptional gene regulation. The genome sequence, now completed in a number of organisms, is described as a blueprint for development. More than simply a parts list (i.e., genes), this blueprint is an instruction manual as well (i.e., regulatory code). A next critical phase of the genome project is understanding the genetic and epigenetic regulatory codes that operate during development. Through a combination of lectures and discussion of primary literature, this course will explore current topics on promoters and transcription factors, chromatin structure, regulatory RNA, chromosomal regulatory domains, and genetic regulatory networks. An overarching theme is how genomes encode and execute regulatory programs as revealed by a global systems biology approach in modern genomics research.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B333, BIOL533, BIOL333
Prereq: [BIOL182 or MB&B182]

**MB&B534 Stochastic Biology: Randomness and Order in Gene Regulation**

While much of biology is discussed with assumptions of "determinism" (e.g., the cell is instructed to express a transcription factor that activates a downstream gene in a deterministic and entirely predictable way) and "homogeneity" (e.g., a population of cells all behaving synchronously in the same way), there is a growing appreciation that many biological outcomes are, in fact, statistical phenomena and stochastic in nature. In this half-credit module, we will discuss stochastic behavior in biology from the perspective of gene expression. A focus will be on emerging molecular and cellular techniques that enable observation of stochastic behavior at a single-cell resolution, thus permitting researchers to characterize molecular behavior as it actually occurs, as opposed to averaging a behavior across a population of otherwise diverse individuals. Insights on stochastic behaviors have far-reaching implications in biology, challenging long-held perspectives on transcription, replication, signal transduction, enzymatics, disease states (such as cancer), stems cells, cell differentiation, aging, and adaptive evolution. This course will focus primarily on one of these: stochastic behavior in transcription and chromosome dynamics and its implications to understanding cell and tissue behavior.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Identical With: MB&B334
Prereq: None

**MB&B535 Protein Folding: From Misfolding to Disease**

Amyloidogenesis, the process by which proteins and peptides misfold to form amyloid fibers, is at the root of several different diseases, including Parkinson’s disease, Alzheimer’s disease, mad cow disease, and type II diabetes to name a few. This course will focus on current research in the field that seeks to understand why a functional, well-folded protein adopts the misfolded amyloid form. In the course of discussing the misfolded nature of these proteins, we will review central elements of protein structure and stability to better understand the protein-folding landscape and the process of misfolding. We will also discuss how the process of misfolding leads to the different diseases and disease pathologies. We will read current literature that studies the molecular nature of these diseases and discuss the strategies used to detect, identify and study these misfolded proteins in the body and in the test-tube.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B335, CHEM335, CHEM535
Prereq: MB&B208 OR MB&B325
MB&B536 Metals, Metalloenzymes, and Disease
This class will examine primary scientific evidence showing the role of transition metals in the development of various diseases that are established early in development. The course objective is to teach the biochemistry of transition metals in cells and how metal imbalance (absence or overload) leads to various diseases like Wilson, Menkes, mitochondrial myopathies, and even cancer.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B336
Prereq: MB&B191 AND MB&B208 AND CHEM251

MB&B538 Biology and MB&B Symposium I
Weekly seminars by distinguished national and international scientists. The seminar series provides an exciting opportunity to hear about advances in research in the life sciences.
Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: MB&B338, BIOL338, BIOL538
Prereq: None

MB&B539 Biology and MB&B Symposium II
Weekly seminars by distinguished national and international scientists. The seminar series provides an exciting opportunity to hear about advances in research in the life sciences.
Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: BIOL339, BIOL539, MB&B339
Prereq: None

MB&B543 The Hidden World: Microscopy and Its Central Role in Cell and Molecular Biology
This class will examine fundamental and cutting-edge imaging tools that are used to visualize cellular structures and processes. The course objective is to teach both the physical mechanics underlying how a microscope achieves magnification and resolution and how progressively more sophisticated imaging tools have consistently facilitated major advancements in our understanding of cell and molecular biological events.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB
Prereq: MB&B208

MB&B549 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

MB&B550 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

MB&B557 Research Seminars in Molecular Biology
This seminar course comprises weekly one-hour formal presentations by MB&B Department graduate students about their research projects. The presentations include background information and rationale of the project, description of research approaches and methodology, experimental details, results and analysis, including problem-solving activities/plans and future directions. Active discussion among the participants promotes sharing of new ideas and techniques and enhances students' communication skills.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None

MB&B558 Research Seminars in Molecular Biology
This seminar course comprises weekly one-hour formal presentations by MB&B Department graduate students about their research projects. The presentations include background information and rationale of the project, description of research approaches and methodology, experimental details, results and analysis, including problem-solving activities/plans and future directions. Active discussion among the participants promotes sharing of new ideas and techniques and enhances students' communication skills.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Prereq: None

MB&B571 Teaching: Techniques and Theory
This course will help teaching assistants working with the Principles of Biology labs prepare to teach weekly lab sessions. Students will obtain hands-on experience with various techniques in the areas of molecular and cell biology. In addition, best teaching practices will be discussed and students will share their teaching experiences with each other.
This course may be repeated up to two times for credit.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: BIOL571
Prereq: None

MB&B575 The Cell-Division Cycle and Cancer
This course will cover a broad range of topics that are related to the process of cell division. We will discuss how the cell cycle is executed and regulated in a variety of eukaryotic systems. Major consideration will be applied to discussions of cancer and the defects in cell-division regulation that underlie this disease. Some of the topics include growth factors, signaling pathways, apoptosis, cyclin-dependent kinases as cell-cycle regulators, transcriptional and posttranscriptional control of cell-cycle genes, DNA replication, DNA damage checkpoints, and tumor suppressors.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: MB&B375
Prereq: None

MB&B577 Advanced Genetics
This course will focus on classical genetics, a discipline that grew from a desire to explain how adaptive traits are passed from generation to generation. Special emphasis will be placed on model organism genetics and on understanding how classical genetic analysis, in conjunction with the analysis of cellular and chromosome behavior, led to key discoveries about the nature of the gene, DNA, RNA, protein, and cellular function.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B377
Prereq: None

MB&B581 Physical Chemistry for the Life Sciences
The course is concerned with the basic physicochemical principles and model systems essential to understanding, explaining, and predicting the behavior of biological systems in terms of molecular forces. The course integrates fundamental concepts in thermodynamics, kinetics, and molecular spectroscopy with the structures, functions, and molecular mechanisms of biological processes. The objectives of the course are to (1) familiarize life science students at the advanced undergraduate and beginning graduate level with basic physicochemical laws, theories, and concepts important to the life sciences; (2) provide a working knowledge of mathematical methods useful in life science research; (3) develop a critical perspective on explanation of biological processes and understanding biological systems; and (4) survey the main applications of physical chemistry in the life sciences. Theory, methodology, and biophysical concepts are distributed throughout the course.
Offering: Crosslisting
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B381, CHEM381
Prereq: (CHEM251 AND MATH117) OR (CHEM251 AND MATH120) OR (CHEM251 AND MATH121)

MB&B585 Seminar in Molecular Biology
This course involves presentation and discussion of recent literature in the field of molecular and cellular biology.
Offering: Host
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B285
Prereq: None

MB&B586 Seminar in Molecular Biology
This course includes the presentation and discussion of recent findings in the field of molecular and cellular biology.
Offering: Host
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B286
Prereq: None

MB&B587 Seminar in Biological Chemistry
This course involves weekly presentations and discussions based on current research.
Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: CHEM587
Prereq: (CHEM383 or MB&B383 or CHEM325 or MB&B325 or MB&B208)

MB&B588 Seminar in Biological Chemistry
This course involves weekly presentations and discussions based on current research.
Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: CHEM588
Prereq: (CHEM383 or MB&B383 or CHEM325 or MB&B325 or MB&B208)