

MOLECULAR BIOLOGY AND BIOCHEMISTRY

Molecular Biology and Biochemistry (MB&B) focuses on the molecular basis of life — on mechanisms by which cells process, integrate, and act on information to create and propagate living organisms. In keeping with the culture of liberal education at Wesleyan University, the MB&B major is designed to accommodate a broad range of academic interests *and* allow students to concentrate in particular disciplines such as molecular biology, biochemistry, biophysics, structural biology, cell biology, genetics, epigenetics, genomics, and computational modeling. The interdisciplinary nature and flexibility of the MB&B major also enables students to couple their affinity for biological sciences with other majors, including chemistry, mathematics and computer science, science in society, psychology, government, economics, etc. MB&B provides foundational training for a range of professional careers in medicine, public health, pharmaceutical/biotechnology industry, public policy, science journalism, and teaching, among others. We welcome students of all interests and backgrounds to join us.

FACULTY

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AFFILIATED FACULTY

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EMERITI

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Professor of Molecular Biology and Biochemistry, Emeritus

DEPARTMENTAL ADVISING EXPERTS

- Molecular Biophysics: (<http://wesleyan.edu/academics/faculty/imukerji/profile.html>)Ishita Mukerji (<http://wesleyan.edu/academics/faculty/imukerji/profile.html>)
- Informatics and Modeling: Robert Lane (<http://wesleyan.edu/academics/faculty/rlane/profile.html>)
- Pre-Majors and General Undergraduate Program: Michelle Murolo (<https://www.wesleyan.edu/academics/faculty/mmurolo/profile.html>)
- General Graduate Program: Don Oliver (<http://wesleyan.edu/academics/faculty/doliver/profile.html>)
- Undergraduate Molecular Biology and Biochemistry Major (catalog.wesleyan.edu/departments/mbb/ugrd-mbb)
- Graduate Molecular Biology and Biochemistry Program (catalog.wesleyan.edu/departments/mbb/grad-mbb)

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**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Prereq: **None**

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&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 does it 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&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.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Identical With: **BIOL181**

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, nutrients, levels of oxygen and carbon dioxide, and the presence of infectious agents. We will examine the molecular, cellular, and tissue mechanisms that underlie the hormonal, neuronal, and behavioral processes that underlie these responses. We will learn how these systems develop in the embryo. At the population level, we will review evidence for evolution, including the tenets of Darwin's theory of evolution by natural selection. We will also discuss the nature and importance of variation among organisms, stochastic processes in evolution, and modern theories of speciation and macroevolution. Finally, the course addresses ecological aspects of population biology, including patterns and processes that inform the distribution and abundance of biodiversity, population

growth, organisms' responses to environmental variation, and interactions among species. Each of the topics of the course is explored from a comparative viewpoint to recognize common principles as well as variations among organisms that indicate evolutionary adaptation to different environments and niches.

Offering: **Crosslisting**

Grading: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL182**

Prereq: **[MB&B181 or BIOL181]**

MB&B191 Principles of Biology I--Laboratory

This laboratory course, to be taken concurrently with MB&B181 or BIOL181, provides direct experience with techniques used in cell biology and molecular biology. These include polymerase chain reaction (PCR), electrophoresis, enzyme assays, microscopy, and spectrophotometry. The lab course is a chance to learn these key techniques firsthand.

Offering: **Host**

Grading: **Cr/U**

Credits: **0.50**

Gen Ed Area: **NSM-MBB**

Identical With: **BIOL191**

Prereq: **None**

MB&B192 Principles of Biology II--Laboratory

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: **0.50**

Gen Ed Area: **NSM-BIOL**

Identical With: **BIOL192**

Prereq: **[MB&B191 or BIOL191]**

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: **NSM-BIOL**

Identical With: **BIOL194**

Prereq: **BIOL181 or MB&B181**

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 discuss how these processes become perturbed in disease states.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Identical With: **BIOL208**

Prereq: **([MB&B181 or BIOL181] AND [BIOL182 or MB&B182])**

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**

Identical With: **BIOL210**

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: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Identical With: **BIOL212**

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: **A-F**

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**

Identical With: **BIOL228**

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: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Identical With: **BIOL231**

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**

Identical With: **BIOL232**

Prereq: **([MB&B181 or BIOL181] AND [BIOL182 or MB&B182]) OR [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: **BIOL237**

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. The course is similar to BIOL265 but only meets in the second half of the semester (with BIOL265) and is designed for students with programming background, ideally in Python. The course introduces problem areas and conceptual frameworks in bioinformatics and discusses programming approaches used in bioinformatics such as sequence matching and manipulation algorithms using dynamic programming, clustering analysis of gene expression data, analysis of genetic nets using Object Oriented Programming, and sequence analysis using Hidden Markov Models, Regular Expressions, and information theory.

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: **0.25**

Gen Ed Area: **None**

Identical With: **MB&B585**

Prereq: **None**

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: **0.25**

Gen Ed Area: **None**

Identical With: **MB&B586**

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: **NSM-MBB**

Identical With: **NS&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: **NSM-MBB**

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: **None**

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

Presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from 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&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: **(CHEM251 AND CHEM252)**

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.

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

Ribosomes are the large and highly conserved organelles charged with the task of converting the nucleotide-based messages of mRNAs into the polypeptide sequence of proteins. This act of 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 mechanism of translation as well as the biosynthetic pathways that are involved in the synthesis of ribosomes themselves. Both prokaryotic and eukaryotic systems will be considered, including the question of how ribosome biosynthesis, which constitutes a major fraction of the total cellular economy, is regulated in response to changing cellular conditions.

Offering: **Host**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Identical With: **MB&B515**

Prereq: [**MB&B208** or **BIOL208**]

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: **OPT**

Credits: **1.00**

Gen Ed Area: **NSM-CHEM**

Identical With: **CHEM325**

Prereq: [**MB&B181** or **BIOL181**] OR [**MB&B191** or **BIOL191**]

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, BIOL533, 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, enzymatics, disease states (such as cancer), stem 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&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, BIOL538, 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, BIOL539, 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 therapies, 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 MBB208**

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: **A-F**

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

This course will cover how a spectrometer works as well as the theory and application of NMR experiments. The topics will include one-dimensional proton and heteronuclear experiments as well as decoupling. The course will begin with how the spectrometer works and how data processing is carried out, as well as how to calibrate the spectrometer and shim the magnet. The one-dimensional TOCSY and NOESY experiments will then be covered. The

course will also cover heteronuclear and homonuclear two-dimensional NMR experiments. The experiments will include two-dimensional DQFCOSY, TOCSY, NOESY, and ROESY proton experiments as well as heteronuclear experiments to correlate the chemical shifts of protons and heteronuclei, as well as how to select heteronuclear resonances on the basis of the number of directly attached protons.

The course will consist of lectures as well as a laboratory component in which the Mercury 300 will be used to obtain data that will be analyzed using the methods developed in the lecture part of the course. This course is specifically aimed at general users of the Mercury spectrometer who wish to learn how to carry out and analyze advanced one-dimensional and two-dimensional NMR experiments.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-CHEM**

Identical With: **CHEM382**

Prereq: **None**

MB&B383 Biochemistry

This introductory course to the principles and concepts of contemporary biochemistry presents both the biological and chemical perspectives. The major themes will be the structure of proteins and the basis of enzymatic activity, cellular metabolism and the generation and storage of metabolic energy, and general principles of the biosynthesis of cellular components.

Offering: **Crosslisting**

Grading: **A-F**

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 biophysics. 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: **([MB&B208 or BIOL208] AND CHEM141 AND CHEM142) OR ([MB&B208 or BIOL208] AND CHEM143 AND CHEM144)**

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**

Grading: **OPT**

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&ES500, 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: **None****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**

Presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from 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&B308, CHEM508, PHYS318, 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: **(CHEM251 AND CHEM252)****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

Ribosomes are the large and highly conserved organelles charged with the task of converting the nucleotide-based messages of mRNAs into the polypeptide sequence of proteins. This act of 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 mechanism of translation as well as the biosynthetic pathways that are involved in the synthesis of ribosomes themselves. Both prokaryotic and eukaryotic systems will be considered, including the question of how ribosome biosynthesis, which constitutes a major fraction of the total cellular economy, is regulated in response to changing cellular conditions.

Offering: **Crosslisting**

Grading: **A-F**

Credits: **1.00**

Gen Ed Area: **NSM-MBB**

Identical With: **MB&B315**

Prereq: **[MB&B208 or BIOL208]**

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-tracts 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), stem 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&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: **BIOL338, BIOL538, MB&B338**

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**
 Prereq: **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: **A-F**
 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: **0.25**
 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: **0.25**
 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) OR [CHEM383 or MB&B383]**

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) OR [CHEM383 or MB&B383]**