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

Manju Hingorani
BS, University of Bombay; PhD, Ohio State University
Professor of Molecular Biology and Biochemistry; Chair, Molecular Biology and Biochemistry; Professor, Integrative Sciences

Scott G. Holmes
BS, College of William and Mary; PhD, University of Virginia
Professor of Molecular Biology and Biochemistry; Professor, Integrative Sciences

Robert P. Lane
BA, Colgate University; PhD, California Institute Tech
Associate Professor of Molecular Biology and Biochemistry; Associate Professor, Integrative Sciences

Amy MacQueen
BA, Columbia University; PhD, Stanford University
Associate Professor of Molecular Biology and Biochemistry

Michael A. McAlear
BS, McGill University; PhD, McGill University
Associate Professor of Molecular Biology and Biochemistry; Associate Professor, Integrative Sciences

Ishita Mukerji
AB, Bryn Mawr College; PhD, University of California, Berkeley
Fisk Professor of Natural Science; Professor of Molecular Biology and Biochemistry; Professor, Integrative Sciences

Michelle Aaron Murolo
BS, Clarion University Pa; PhD, Yale University
Associate Professor of the Practice in Molecular Biology and Biochemistry

Donald B. Oliver
BS, Brandeis University; MAA, Wesleyan University; PhD, Tufts University
Daniel Ayres Professor of Biology; Professor of Molecular Biology and Biochemistry; Professor, Integrative Sciences

Rich Olson
BA, Cornell University; PhD, Columbia University
Associate Professor of Molecular Biology and Biochemistry; Associate Professor, Integrative Sciences

AFFILIATED FACULTY

Candice Marie Etson
BA, New York University; BFA, New York University; PhD, Harvard University
Assistant Professor of Physics; Assistant Professor, Chemistry; Assistant Professor, Molecular Biology and Biochemistry

Colin A. Smith
BA, New York University; PhD, University of California, San Francisco
Assistant Professor of Chemistry; Assistant Professor, Molecular Biology and Biochemistry; Assistant Professor, Integrative Sciences

Francis W. Starr
BS, Carnegie Mellon University; MS, Boston University; PhD, Boston University
Professor of Physics; Director, College of Integrative Sciences; Professor, Integrative Sciences; Professor, Molecular Biology and Biochemistry

VISITING FACULTY

Sarah M Kopac
BS, Fairfield University; PhD, Wesleyan University
Visiting Assistant Professor of Molecular Biology and Biochemistry

EMERITI

Anthony A. Infante
BA, Temple University; MAA, Wesleyan University; PhD, University of Pennsylvania
Professor of Molecular Biology and Biochemistry, Emeritus

Lewis N. Lukens
BA, Harvard University; MAA, Wesleyan University; PhD, University of Pennsylvania
Professor of Molecular Biology and Biochemistry, Emeritus

DEPARTMENTAL ADVISING EXPERTS

- Molecular Biophysics: [http://wesleyan.edu/academics/faculty/imukerji/profile.html](http://wesleyan.edu/academics/faculty/imukerji/profile.html)
- Integrative Genomic Sciences: Robert Lane [http://wesleyan.edu/academics/faculty/rlane/profile.html](http://wesleyan.edu/academics/faculty/rlane/profile.html)
- General Undergraduate Program: Don Oliver [http://wesleyan.edu/academics/faculty/doliver/profile.html](http://wesleyan.edu/academics/faculty/doliver/profile.html)
- Undergraduate Molecular Biology and Biochemistry Major [catalog.wesleyan.edu/departments/mbb/ugrd-mbb](catalog.wesleyan.edu/departments/mbb/ugrd-mbb)
- Graduate Molecular Biology and Biochemistry Program [catalog.wesleyan.edu/departments/mbb/grad-mbb](catalog.wesleyan.edu/departments/mbb/grad-mbb)

MB&B102 Science Information Literacy

Information literacy is the set of skills needed to find, retrieve, analyze, and use information. This course will focus on teaching these skills as especially applied to scientific information. Students will learn to determine the nature
and extent of information needed, to acquire needed information effectively and efficiently, to evaluate information and its sources critically, and to use information effectively to accomplish a specific purpose. Students will also examine the economic, ethical, legal, and social issues surrounding the use of information and how information literacy is important to lifelong learning and keeping current to new developments in his/her field. Topics will include the structure of scientific information and scientific publishing, the research process, types of information retrieval systems, search strategies and syntax, use of bibliographic management software (e.g., EndNote), criteria for critical evaluation, open-access publication, plagiarism, and copyright.

Offering: Host
Grading: OPT
Credits: 0.50
Gen Ed Area: None
Identical With: CHEM102, BIOL102, PHYS103, NS&B102, PSYC102, E&ES102, ASTR102, CHEM102, BIOL102, PHYS103, NS&B102, PSYC102, E&ES102, ASTR102
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
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Prereq: None

MB&B105 Genetics: From Mendel to the Human Genome Project
This course, intended for nonscience majors, will provide an introduction to the science of genetics. A review of classic experiments will serve as a foundation for a more focused study of selected current topics, such as gene therapy, genetically modified plants and animals, the genetics of viruses and cancer, and the implications of knowing the sequence of the human genome. For each topic we will strive to understand the basic science of the field, consider the potential applications of recent findings, and discuss ethical issues raised by genetic technology.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, 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, NSM-MBB
Prereq: None

MB&B108 Body Languages: Choreographing Biology
This course will present an introduction to human biology from the cellular to organism level. This subject will be examined through scientific and choreographic perspectives. Students will have the opportunity to practice movement awareness and learn basic principles of choreography and will apply these skills to exploration of human biology. Each class will involve lecture, discussion, and movement components.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB
Identical With: DANC108, DANC108
Prereq: None

MB&B109 Light, Energy, and Life
Light is the basis for many important processes on Earth, and this course is designed to introduce students to many of these fundamental processes. The first third of the course will focus on the nature of light and its interaction with matter. We will then turn to the process of vision and how light is detected by humans and animals. The second third will focus on light as an important energy source. We will discuss the natural process of photosynthesis and the role that it plays in the global carbon cycle. The role that sunlight plays in the phenomenon of global warming and the effects of global warming will also be explored. We will also discuss the artificial capture and harnessing of light energy, as in solar energy. The last part of the course will explore how light interacts with humans directly. Topics to be discussed include how light affects our moods and seasonal affective disorder, and the role of light in the onset of melanoma and other UV-light-related health problems.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, 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 does it take a step?

We will explore these major topics in molecular biophysics by discussing primary scientific literature. An 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, NSM-PHYS
Identical With: PHYS107, PHYS107, PHYS107, 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&B123 Introduction to Cancer
There is no doubt that cancer is currently one of the biggest global health
problems we face. Although we have made great strides in understanding the
underlying mechanisms of the disease and of treatments, millions of people
worldwide are still diagnosed with and will succumb to the disease every year. To
understand why cancer is still a huge threat, with all the progress that has been
made, the basic science of this multifaceted disease will be examined, including
the genetic basis of cancer; the role carcinogens, genetics, and infectious
diseases play in the development of cancer; the role of the immune system in
controlling cancer and how it can be harnessed in new, novel treatments;
the basic biochemistry behind chemotherapy; and the basic biology behind
preventative strategies.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB
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 (Mondays,
Wednesday) 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 (Fridays).
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB
Identical With: BIOL181, BIOL181, BIOL181, BIOL181, BIOL181, BIOL181,
BIOL181, BIOL181
Prereq: None

MB&B182 Principles of Biology II
This course concerns biological principles as they apply primarily at tissue,
organismic, and population levels of organization. Course topics include
developmental biology, animal physiology and homeostatic control systems,
endocrinology, neurophysiology and the neuronal basis of behavior. Evidence
for evolution is reviewed, as are the tenets of Darwin’s theory of evolution by
natural selection. The nature and importance of variation among organisms
and of stochastic processes in evolution are discussed, as are modern theories
of speciation and macroevolution. Finally, the course addresses interactions
between organisms and their environments as well as the interactions among
organisms in natural communities. 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.
In this course, we will discuss two other major paradigm shifts in human self-identity that threaten our self-perception as special beings—beginning with the Copernican revolution and discoveries about our unspecial place in the universe.

Both of these paradigm shifts were enabled by advances in technology. As we explore these paradigm shifts, the question arises: Are we beginning to understand the true nature of our place in the cosmos? We humans are no longer the center of the universe, and we have been shown to be an incredibly special species on our home planet. What does this mean to us as a species? How do we adapt to this new postgenome era.

We will also discuss bioethical issues that now face us in this new postgenome era. 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; however, this course will be conceptually challenging and cover a diverse set of complex topics.

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&B193 Principles of Cell and Molecular Biology: Advanced Topics
This 0.25-credit course is open to students currently enrolled in any section of MB&B/BIOL181 Principles of Biology I. The course is intended to supplement the introductory biology series at a more advanced level to provide a more challenging and enriching experience for students with strong backgrounds in biology (e.g., high school AP Biology with scores of 4 or 5). Students will read recently published journal articles at the frontiers of modern cell and molecular biology. This course introduces students to current technologies and methods being used in the field to advance our understanding of human biology and disease.

Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: NSM-MBB, NSM-MBB
Identical With: BIOL193, BIOL193
Prereq: None

MB&B194 Principles of Biology II: Advanced Topics
This 0.25-credit course is open to students currently enrolled in MB&B/BIOL182 Principles of Biology II. The course is intended to supplement the introductory biology course at a more advanced level to provide a more challenging and enriching experience for students with strong backgrounds in biology (e.g., students who performed well in MB&B/BIOL181). Students will read recently published journal articles at the frontiers of physiology, development, evolution, and ecology. This course introduces students to current technologies and methods being used in the field to advance our understanding of life.

Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: NSM-BIOL, NSM-BIOL
Identical With: BIOL194, BIOL194, BIOL194, BIOL194
Prereq: BIOL181 or MB&B181

MB&B203 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 two other major paradigm shifts in human self-understanding arising from modern biological science. The first is the theory of evolution and the implications on our perception of the line between human and animal. The second is the Human Genome Project and the implications on our perception of the line between human and machine. 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; however, this course will be conceptually challenging and cover a diverse set of complex topics.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB, NSM-MBB
Identical With: BIOL210, BIOL210, BIOL210, BIOL210, BIOL210, BIOL210
Prereq: [MB&B191 or BIOL191] AND [BIOL182 or MB&B182] OR ([MB&B191 or BIOL191] AND [BIOL182 or MB&B182]) OR ([MB&B195 or BIOL195] AND [BIOL182 or MB&B182])

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: 0.50
Gen Ed Area: NSM-MBB, NSM-MBB, NSM-MBB
Identical With: BIOL208, BIOL208, BIOL208, BIOL208, BIOL208, BIOL208, BIOL208
Prereq: [MB&B181 or BIOL181] AND [BIOL182 or MB&B182]] OR ([MB&B181 or BIOL181] AND [BIOL182 or MB&B182]) OR ([MB&B195 or BIOL195] 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, NSM-MBB, NSM-MBB
Identical With: [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. We will also discuss bioethical issues that now face us in this new postgenome era.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-BIOL, NSM-BIOL, NSM-BIOL
Identical With: BIOL210, BIOL210, BIOL210, BIOL210, BIOL210, BIOL210, BIOL210
Prereq: [MB&B181 or BIOL181] AND [BIOL182 or MB&B182]
MB&B212 Principles and Mechanisms of Cell Biology
This is the fundamental unit of life. Understanding cell behavior and function at the cellular level is critical for understanding biological function from the molecular to organismic levels. The goals of this course are to introduce many concepts of cellular function. Topics covered include cell and organelle structure and function, trafficking, cell adhesion and motility, proliferation, signal transduction and cell differentiation. Journal papers will introduce students to research in these topics of cell biology. To demonstrate how basic biological processes combine to form a coherent whole, we will discuss examples of integration of biological functions in tissues—and when these go awry in diseases.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB
Identical With: BIOL212, BIOL212, BIOL212, BIOL212, BIOL212, BIOL212, BIOL212
Prereq: [MB&B181 or BIOL181] OR [MB&B181 or BIOL181] OR [MB&B181 or BIOL181] OR [MB&B181 or BIOL181]

MB&B218 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, as well as digestion, absorption, and processing of nutrients for energy and growth.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB, NSM-MBB
Identical With: MB&B228, BIOL228, MB&B228, BIOL228, MB&B228, BIOL228, MB&B228, BIOL228
Prereq: [MB&B181 or BIOL181] AND CHEM251

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, as well as digestion, absorption, and processing of nutrients for energy and growth.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB, NSM-MBB
Identical With: MB&B228, BIOL228, MB&B228, BIOL228, MB&B228, BIOL228, MB&B228, 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 basic concepts in immunology, particular emphasis will be given to the molecular basis of specificity and diversity of the antibody and cellular immune responses. 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, NSM-MBB
Identical With: BIOL232, BIOL232, BIOL232, 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, NSM-MBB
Identical With: BIOL237, BIOL237, BIOL237, BIOL237
Prereq: [MB&B208 or BIOL208]

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 (sequence matching and manipulation, database access, output parsing, dynamic programming, etc.) frequently encountered in the field of bioinformatics.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB, NSM-MBB
Prereq: [MB&B181 or BIOL181] OR [MB&B181 or BIOL181] OR [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.
Membrane proteins constitute a third of all cellular proteins and 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 (x-ray crystallography, EM, NMR, etc.), 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, NS&B303, NS&B303, MB&B523, 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 research 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
MB&B505, MB&B505, MB&B505, MB&B505, CHEM305, CHEM505, MB&B505, MB&B505, MB&B505, MB&B505, MB&B505, MB&B505, CHEM305, CHEM505, MB&B505, MB&B505

MB&B306 Self-Perpetuating Structural States in Biology, Genetics, and Disease
Using a variety of examples from cell biology, genetics, and biochemistry, this course will examine the template-dependent processes governing the perpetuation of genotypes, phenotypes, and cellular organelles. Topics covered in detail will include the molecular biology of prions (infectious proteins), the mechanisms underlying epigenetic inheritance of gene expression states, and the reproduction of cellular structures required for chromosome segregation.
We will also examine the goals and progress of the emerging field of synthetic biology, contemplating the prospects of building complex biological systems from the ground up.
Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-BBB, NSM-NSMMB
Identical With: MB&B506, MB&B506, MB&B506
Prereq: MB&B208

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 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-NSM-CHEM, NSM-NSM-CHEM
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, how to build a genomics workflow, and an introduction to 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-NSM-BIOL, NSM-NSM-BIOL
Identical With: BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310, CIS310, BIOL310, BIOL310, BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310, BIOL310, CIS310
Prereq: [MB&B181 or BIOL181] OR [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 (mRNAs, tRNAs, rRNAs, proteins, amino acids, etc.) 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, NSM-MBB
Identical With: MB&B515, MB&B515, MB&B515, MB&B515
Prereq: [MB&B208 or BIOL208]

MB&B321 Biomedical Chemistry
This course is designed to explore the molecular basis of disease. Topics will reflect the importance of chemistry and biochemistry in the advancement of medicine today and will include treatment of metabolic disorders, problems and benefits of vitamin supplementation, and rational drug design and mode of action.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM, NSM-CHEM
Identical With: CHEM321, CHEM321, CHEM321, 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&B323 Cancer
Cancer is one of the biggest global health problems we face, even though we have made great strides in understanding the underlying mechanisms of the disease. To understand why cancer is still a huge threat, with all the progress that has been made, the basic science of this multifaceted disease will be examined with a focus on the genetic basis of cancer; the role carcinogens, genetics, and infectious diseases play in its development; the role of the immune system in controlling cancer and how it can be harnessed in new, novel treatments; the biochemistry of chemotherapies; and the basic biology behind suggested preventative strategies.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB
Identical With: MB&B181 or BIOL181] AND [BIOL182 or MB&B182]

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, MB&B528, MB&B528, 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, MB&B530, MB&B530, 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&B575, MB&B575, MB&B575, MB&B575

**Prereq:** [MB&B208] OR [CHEM383 or MB&B383] OR (CHEM144 AND MATH122) OR (PHYS111 AND PHYS112) OR CHEM338

**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 (like cancer), stems cells, cell differentiation, aging, adaptive evolution, etc. 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, NSM-MBB

**Identical With:** MB&B534, MB&B534, MB&B534, 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.

**Offering:** Crosslisting

**Grading:** A-F

**Credits:** 0.50

**Gen Ed Area:** NSM-MBB

**Identical With:** MB&B535

**Prereq:** None

**MB&B340 Practical Methods in Biochemistry**

The course will center on currently used techniques for protein separation and purification, such as ultracentrifugation, gel electrophoresis, and chromatography.

Particular attention will be given to the thermodynamic and kinetic principles underlying these separation techniques for isolating and characterizing an unknown protein. Both theory and examples of current applications will be presented.

**Offering:** Host

**Grading:** A-F

**Credits:** 1.00

**Gen Ed Area:** NSM-MBB, NSM-MBB, NSM-MBB, NSM-MBB, NSM-MBB

**Identical With:** CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390, CHEM390

**Prereq:** [MB&B208] OR [CHEM383 or MB&B383] OR (CHEM144 AND MATH122) OR (PHYS111 AND PHYS112) OR CHEM338

**MB&B357 Bio-Organic Chemistry**

This course is intended for juniors and seniors who have completed organic chemistry but who have not necessarily taken much biology. The goal of this course is to help students develop/enhance their biochemical intuition by thinking about organic chemistry concepts as applied to biological systems. This course will involve thinking about reaction mechanisms and will not be focused on metabolic pathways. Current topics in the literature will be covered including discussion and analysis of de novo enzyme design (first published in spring 2008).

**Offering:** Crosslisting

**Grading:** A-F

**Credits:** 1.00

**Gen Ed Area:** NSM-CHEM, NSM-CHEM

**Identical With:** CHEM357, CHEM357

**Prereq:** CHEM251 AND CHEM252

**MB&B365 Protein Design and Engineering**

You may think of science primarily as the discovery and investigation of what exists in nature. This course focuses on the creative application of biochemical knowledge in designing and creating novel macromolecules. While this has enormous economic importance in the development of new drugs and pharmaceuticals, it is also a fundamental way of gaining knowledge about the natural world. We will investigate both aspects, focusing primarily on protein design and engineering. This course will also investigate engineering of novel functions at the organism level. You will be asked to evaluate the scientific literature and to develop hypotheses and designs of your own.

**Offering:** Host

**Grading:** A-F

**Credits:** 1.00

**Gen Ed Area:** NSM-MBB, NSM-MBB

**Prereq:** 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-cycle 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, MB&B575, MB&B575, MB&B575, 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, NSM-MBB, NSM-MBB
Prereq: (MB&B181 or BIOL181)

MBB381 Physical Chemistry for the Life Sciences
This course is designed to provide students of biology, neurosciences, molecular biology, biochemistry, and biological chemistry with the foundations of physical chemistry relevant to the life sciences. The course is driven by consideration of a series of biological processes for which the concepts of physical chemistry provide a framework for explanation and understanding. The course will consist of three parts: thermodynamics, kinetics or rate processes, quantum mechanics and spectroscopy. Each part of the course is based on topics drawn from physiology, molecular biology, and biochemistry, the treatment of which motivates the introduction of physicochemical concepts and reasoning. Examples of topics include respiration, photosynthesis, ATP hydrolysis, active transport, vision, growth and decay processes, enzyme structure, and function and prebiotic evolution. The course is specifically designed to accommodate students with diverse scientific backgrounds and levels of mathematical preparation. An elementary review of all mathematical and computational methods required for the course will be provided. This course may also readily serve students of mathematics, physics, and chemistry as an introduction to applications of their subject area in the life sciences.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB, NSM-MBB, NSM-MBB, NSM-MBB
Identical With: CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81, CHEM381, MB&BS81
Prereq: (CHEM141 AND CHEM142 AND CHEM117 AND CHEM251) OR (CHEM143 AND CHEM144 AND MATH121 AND CHEM251)

MBB382 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 the general users of the Mercury spectrometer who wish to learn how to carry out and analyze advanced one-dimensional as well as two-dimensional NMR experiments.

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

MBB383 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, NSM-CHEM
Identical With: CHEM383, CHEM383, CHEM383, CHEM383
Prereq: (CHEM251 AND CHEM252)

MBB385 Advanced Biochemistry: Enzyme Kinetics
This course presents an introduction to the theory and practice of enzyme kinetics, both steady-state and presteady-state.

Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM, NSM-CHEM
Identical With: CHEM385, CHEM385, CHEM385, CHEM385
Prereq: [CHEM383 or MB&B383]

MBB386 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 Pauing 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)

MBB387 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

**Identical With:** MB&B294, MB&B294, MB&B294, MB&B294, MB&B294

**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. It 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


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

**MB&B401 Individual Tutorial, Undergraduate**

**Offering: Host**

**Grading: OPT**

**MB&B402 Individual Tutorial, Undergraduate**

Advanced work in certain fields of Molecular Biology and Biochemistry for qualified students with the consent of the department.

**Offering: Host**

**Grading: OPT**

**MB&B407 Senior Tutorial**

Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor.

**Offering: Host**

**Grading: A-F**

**MB&B408 Senior Tutorial**

Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor.

**Offering: Host**

**Grading: A-F**

**MB&B409 Senior Thesis Tutorial**

**Offering: Host**

**Grading: OPT**

**MB&B410 Senior Thesis Tutorial**

**Offering: Host**

**Grading: OPT**

**MB&B411 Group Tutorial, Undergraduate**

**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**

**Offering: Host**

**Grading: OPT**

**MB&B422 Undergraduate Research, Science**

Advanced experimental research in biochemistry, developmental biology, genetics microbiology, animal physiology, neurophysiology, behavioral genetics, cell biology and molecular biology.

**Offering: Host**

**Grading: OPT**

**MB&B423 Advanced Research Seminar, Undergraduate**

**Offering: Host**

**Grading: OPT**

**MB&B424 Advanced Research Seminar, Undergraduate**

**Offering: Host**

**Grading: OPT**

**MB&B465 Education in the Field, Undergraduate**

**Offering: Host**

**Grading: OPT**

**MB&B466 Education in the Field, Undergraduate**

**Offering: Host**

**Grading: OPT**

**MB&B491 Teaching Apprentice Tutorial**

**Offering: Host**

**Grading: OPT**

**MB&B492 Teaching Apprentice Tutorial**

Topic to be arranged in consultation with the tutor.

**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.

**Offering: Crosslisting**

**Grading: Cr/U**

**Credits: 0.50**

**Gen Ed Area: None**

**Identical With:** E&ES500, CHEM500, BIOL500, ASTR500, MUSC500, PHYS500, PSYC500, MATH500, CHEM500, E&ES500, ASTR500, MUSC500, PHYS500, PSYC500, MATH500, ASTR500, PSYC500, ASTR500, PSYC500, MATH500, BIOL500, CHEM500, E&ES500, ASTR500, MUSC500, PHYS500, PSYC500, MATH500, BIOL500, CHEM500, E&ES500, ASTR500, MUSC500, PHYS500, PSYC500, MATH500, ASTR500, PSYC500, ASTR500,
We will also examine the goals and progress of the emerging field of synthetic biology, contemplating the prospects of building complex biological systems from the ground up.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-MBB, NSM-MBB
Prereq: MB&B208

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 the BIOPHYSICAL JOURNAL, BIOPOLYMERS, CURRENT OPINION IN STRUCTURAL BIOLOGY, JOURNAL OF BIOMICROSTRUCTURAL STRUCTURE AND DYNAMICS, and the ANNUAL REVIEW OF MOLECULAR BIOPHYSICS AND BIOMICROSTRUCTURAL STRUCTURE.

Offering: Crosslisting
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM, NSM-CHEM
Prereq: None

MB&B508 Molecular Biophysics Journal Club II

Offering: Crosslisting
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM, NSM-CHEM
Identical With: CHEM308, MB&B308, CHEM508, PHYS318, PHYS518, CHEM308, MB&B308, CHEM508, PHYS318, PHYS518, CHEM308, MB&B308, CHEM508
Prereq: None

MB&B509 Molecular Biophysics
This course is an introduction to the branch of inquiry in the life sciences concerned with understanding the structures, functional energetics, and mechanisms of biological systems at the molecular level. Topics covered will include Brownian motion and its implications; theories of macromolecular binding, specificity, and catalysis; ion channels; molecular motors; self-assembly processes and single-molecule manipulations; protein and nucleic acid structure; physics of biopolymers; rate processes; mechanical and adhesive properties of biomolecules; molecular manipulation techniques; cell membrane structure; membrane channels and pumps; and molecular motors.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM, NSM-CHEM
Prereq: MB&B208

MB&B506 Self-Perpetuating Structural States in Biology, Genetics, and Disease
Using a variety of examples from cell biology, genetics, and biochemistry, this course will examine the template-dependent processes governing the perpetuation of genotypes, phenotypes, and cellular organelles. Topics covered in detail will include the molecular biology of prions (infectious proteins), the mechanisms underlying epigenetic inheritance of gene expression states, and the reproduction of cellular structures required for chromosome segregation.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM, NSM-CHEM
Prereq: MB&B208
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, NSM-MBB
Identical With: MB&B315, MB&B315, MB&B315, MB&B315
Prereq: [MB&B208 or BIOL208]

MB&B8519 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, CHEM519, CHEM519, CHEM519
Prereq: [CHEM251 AND CHEM252]

MB&B8520 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 like 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 also 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
Identical With: CHEM519, CHEM519, CHEM519, CHEM519
Prereq: [CHEM251 AND CHEM252]

MB&B8522 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&B8523 Receptors, Channels, and Pumps: Advanced Topics in Membrane Protein Structure and Function
Membrane proteins constitute a third of all cellular proteins and 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 (x-ray crystallography, EM, NMR, etc.), 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: Crossing
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Identical With: None
Prerequisites: [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, MB&B328, MB&B328, MB&B328
Prerequisites: 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, MB&B330, MB&B330, MB&B330
Prerequisites: [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, chromosome 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
Prerequisites: [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 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 (like cancer), stem cells, cell differentiation, aging, adaptive evolution, etc. 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: None
Identical With: MB&B334, MB&B334, MB&B334, MB&B334
Prerequisites: 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.

Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: None
Identical With: MB&B335
Prerequisites: None

MB&B543 You Can Learn a Lot by Just Looking": 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: None
Identical With: MB&B563, MB&B563
Prerequisites: MB&B208

MB&B549 Advanced Research Seminar, Graduate
Offering: Host
Grading: OPT

MB&B550 Advanced Research Seminar, Graduate
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&B563 You Can Learn a Lot by Just Looking*: 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, NSM-MBB
Identical With: MB&B543, MB&B543
Prereq: MB&B208

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, MB&B375, MB&B375, 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, NSM-MBB, NSM-MBB
Prereq: (MB&B181 or BIOL181)

MB&B581 Physical Chemistry for the Life Sciences
This course is designed to provide students of biology, neuroscience, molecular biology, biochemistry, and biological chemistry with the foundations of physical chemistry relevant to the life sciences. The course is driven by consideration of a series of biological processes for which the concepts of physical chemistry provide a framework for explanation and understanding. The course will consist of three parts: thermodynamics, kinetics or rate processes, quantum mechanics and spectroscopy. Each part of the course is based on topics drawn from physiology, molecular biology, and biochemistry, the treatment of which motivates the introduction of physicochemical concepts and reasoning. Examples of topics include respiration, photosynthesis, ATP hydrolysis, active transport, vision, growth and decay processes, enzyme structure, and function and prebiotic evolution. The course is specifically designed to accommodate students with diverse scientific backgrounds and levels of mathematical preparation. An elementary review of all mathematical and computational methods required for the course will be provided. This course may also readily serve students of mathematics, physics, and chemistry as an introduction to applications of their subject area in the life sciences.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB, NSM-MBB, NSM-MBB
Identical With: MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381, MB&B381, CHEM381
Prereq: (CHEM141 AND CHEM142 AND MATH117 AND CHEM251) OR (CHEM143 AND CHEM144 AND MATH121 AND CHEM251)

MB&B585 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
Prereq: None

MB&B586 Seminar in Molecular Biology
This course includes the presentation and discussion of recent findings in the field of molecular biology.

Offering: Host
Grading: OPT
Credits: 0.25
Gen Ed Area: None
Identical With: MB&B286, MB&B286, MB&B286, MB&B286
Prereq: None
MB&B587 Seminar in Biological Chemistry
Weekly presentations and discussions based on current research.
Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: CHEM587, CHEMS587, CHEM587, 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
Weekly presentations and discussions based on current research.
Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: CHEM588, CHEM588, CHEM588, CHEM588
Prereq: (CHEM383 or MB&B383 or CHEM325 or MB&B325 or MB&B208) OR [CHEM383 or MB&B383]

MB&B589 Advanced Research, BA/MA
Intensive investigation of special research problems leading to a BA/MA thesis.
Offering: Host
Grading: OPT

MB&B590 Advanced Research, BA/MA
Intensive investigation of special research problems leading to a BA/MA thesis.
Offering: Host
Grading: OPT

MB&B591 Advanced Research, Graduate
Investigation of special problems leading to a dissertation or thesis.
Offering: Host
Grading: OPT

MB&B592 Advanced Research, Graduate
Investigation of special problems leading to a dissertation or thesis.
Offering: Host
Grading: OPT