Biology

**BIOL 5375** Genes to Genomes (3 semester credit hours) is an expansive coverage of molecular genetics with emphasis on genomes rather than genes. Students will gain a new perspective on how genes function together and in concert in living cells, focusing at the genome level. Students also will learn how to study genomes, inspect genome anatomies, analyze how genomes function and determine how genomes replicate and evolve. The course is structured to involve students directly in individual topics by class discussions of research papers and reviews, the latest advances in genome science and new and innovative techniques. Instructor consent required. (3-0) Y

**BIOL 5376 (BMEN 6387)** Applied Bioinformatics (3 semester credit hours) Genomic information content; data searches and multiple sequence alignment; mutations and distance-based phylogenetic analysis; genomics and gene recognition; polymorphisms and forensic applications; nucleic-acid and protein array analysis; structure prediction of biological macromolecules. Prerequisites: At least one semester of undergraduate statistics and probability, and two semesters of undergraduate calculus or instructor consent required. (3-0) T

**BIOL 5381** Genomics (3 semester credit hours) Genome sequence acquisition and analysis; genomic identification; biomedical genome research; DNA microarrays and their use in applied and healthcare research. (3-0) T

**BIOL 5410 (MSEN 5410)** Biochemistry (4 semester credit hours) Emphasis is on metabolic biochemistry, especially as it relates to human disease states. Prerequisite: at least one semester of undergraduate biochemistry and instructor consent required. (4-0) Y

**BIOL 5420** Molecular Biology (4 semester credit hours) Genetic analysis of gene structure (mutations and their analysis, complementation, and recombination), gene expression (transcription, RNA processing, translation), and the regulation of gene expression in selected model systems (viral, prokaryotic, organellar, eukaryotic); principles of genetic engineering (cloning and recombinant DNA technology). (4-0) Y

**BIOL 5440 (MSEN 5440)** Cell Biology (4 semester credit hours) Molecular architecture and function of cells and subcellular organelles; structure and function of membranes; hormone and neurotransmitter action; growth regulation and oncogenes; immune response; eukaryotic gene expression. Prerequisite: **BIOL 5420** or equivalent or instructor consent required. (4-0) Y

**BIOL 5460** Quantitative Biology (4 semester credit hours) Fundamental mathematical and statistical concepts; hypothesis testing. Quantitative approaches to studying gene expression and protein-DNA interactions. Prerequisites: at least one semester of undergraduate calculus and one semester of general physics or instructor consent required. (4-0) Y

**BIOL 5V00** Topics in Biological Sciences (1-6 semester credit hours) May be repeated for credit as topics vary. Instructor consent required. ([1-6]-0) Y

**BIOL 5V01** Topics in Biological Sciences (1-6 semester credit hours) Includes a laboratory component. May be repeated for credit as topics vary (9 semester credit hours maximum). (1-[0-10]) Y
**BIOL 5V95** Advanced Topics in Molecular and Cell Biology: Individual Instruction (1-6 semester credit hours) May be repeated for credit as topics vary. Instructor consent required. ([1-6]-0) Y

**BIOL 6193** Colloquium in Molecular and Cell Biology (1 semester credit hour) Required for all degree students except non-thesis MS, to be taken before a Supervising Committee is appointed. Pass/Fail only. (1-0) Y

**BIOL 6252** Current Research in Molecular Biology (2 semester credit hours) Recent developments in biosynthesis, structure, function, and expression of nucleic acids in prokaryotes and eukaryotes. Students will participate in a critical analysis of current research publications. Pass/Fail only. May be repeated for credit as topics vary (8 semester credit hours maximum). (2-0) S

**BIOL 6315** Epigenetics (3 semester credit hours) Almost all cell types in our body share the same genetic information, but they perform very distinct functions. For example, our nerve cells are morphologically and functionally distinct from our muscle cells. How can the same genome give rise to hundreds of distinct cell types in our body? How can different diseases affect identical twins sharing the same genetic information? Why our parents and grandparents’ diet and health may have lasting influences on our own health? The field of epigenetics emerged over the past decades to tackle these fundamental questions that intersect our genome, development, environment, and disease. The course will provide a broad overview of epigenetic phenomena and epigenetic mechanisms with weekly lectures and small group discussions of primary literature. The course will introduce students to seminal works in epigenetics and recent developments with the goal of instilling critical knowledge of the field. (3-0) Y

**BIOL 6327** RNA World (3 semester credit hours) The nature of modern RNA suggests a prebiotic RNA world. This course will begin with a presentation of the arguments that a RNA world existed before the evolution of protein synthesis. Additional topics will include RNA evolution, the origin and evolution of introns, RNA replication, the evolution and involvement of tRNAs and rRNAs in protein synthesis, the structure and mechanism of large catalytic RNAs such as Group I and Group II introns and the RNase P RNA, the structure and mechanism of small nuclear RNAs such as hammerheads and hairpins, RNA editing, and the mechanism of telomerase. (3-0) T

**BIOL 6331** Molecular Genetics (3 semester credit hours) A graduate survey of the phenomena and mechanisms of heredity, its cytological and molecular basis, with a focus on bacterial and model eukaryotic systems. Topics will include fundamentals of Mendelian Genetics, genetic recombination and genetic linkage, as well as gene structure and replication, gene expression and the transfer of genetic information, mutation and mutagenesis, and applications of recombinant DNA techniques to genetic analysis. For students who have not had undergraduate genetics. Instructor consent required. (3-0) Y

**BIOL 6333** Macromolecules: Structure, Function, and Dynamics (3 semester credit hours) This course includes a discussion of DNA structures, protein structures, the folding and stability of domains, and the binding of proteins to DNA. Methods used to investigate the relation of structure to function are emphasized. Types of protein structures whose structure and function are considered include transcription factors, proteinases, membrane proteins, proteins in signal transduction, proteins on the immune system, and engineered proteins. Instructor consent required. (3-0) Y

**BIOL 6337** Regulation of Gene Expression (3 semester credit hours) An in depth look at how the cell makes use of its genetic information, with a primary focus on the mechanisms of transcription regulation. The
course emphasizes a critical discussion of techniques and results from the recent scientific literature. Topics are taken from eukaryotic and/or prokaryotic systems and typically cover areas such as promoter organization, RNA polymerase and transcription factor structure and function, the organization and packaging of chromosomes, whole-genome analyses, and the pathways that control gene expression during growth and development. (3-0) Y

**BIOL 6341** Oncogenes (3 semester credit hours) Properties of cancer cells, in vivo and in vitro. Telomeres and cellular immortality. The role of DNA and RNA viruses in human cancers. Molecular biology of chronic leukemia retroviruses and the acutely transforming retroviruses. Retroviral oncogenes; the role of mutation, amplification, and chromosomal translocation of cellular oncogenes in human cancer. Regulation of the eukaryotic cell cycle, and the role of tumor suppressor genes. The role of oncogenes in growth hormone signal transduction. The role of apoptosis, and developmental signaling pathways in cancer. (3-0) Y

**BIOL 6345** Molecular Basis of Acquired Immune Deficiency Syndrome (3 semester credit hours) Topics include an analysis of the molecular basis of the infection of target cells by HIV, the intracellular replication of retroviruses, with special attention given to the HIV tat and rev genes, and an analysis of the roles of the HIV accessory genes: vif, vpr, vpu and nef. The immunological response of the host to HIV is considered, as is the biological basis for the ultimate failure of the immune system to contain this virus, with attendant immune collapse. The molecular basis of a variety of existing and potential anti-retroviral therapies is considered. (3-0) Y

**BIOL 6351** Cellular and Molecular Biology of the Immune System (3 semester credit hours) Innate and adaptive immunity. Structure and function of immunoglobulins and MHC molecules, and their role in the adaptive immune response. Function of the primary and secondary lymphoid tissues, and the role of professional antigen presenting cells. The molecular basis for the generation of diversity during cellular development of B and T lymphocytes. The role of complement in innate immunity, and details of T cell and B cell mediated immunity. (3-0) Y

**BIOL 6352** Modern Biochemistry I (3 semester credit hours) Structure and function of proteins, including enzyme kinetics and catalytic mechanisms; structure and metabolism of carbohydrates, including oxidative phosphorylation and electron transport mechanisms. For students who have not had undergraduate biochemistry. (3-0) S

**BIOL 6353** Modern Biochemistry II (3 semester credit hours) Continuation of **BIOL 6352**. Structure and metabolism of lipids, including membrane structure and function. Nitrogen metabolism: amino acids and nucleotides. Polynucleotide replication, transcription, and translation. For students who have not had undergraduate biochemistry. (3-0) Y

**BIOL 6354** Microbial Physiology (3 semester credit hours) Microbial physiology considers the basic processes of microbes, especially those variations that are unique to microbes: energy generation, fermentations, and other pathways specific to bacteria, cellular structure and differentiation, and bacterial responses to the environment. (3-0) Y

**BIOL 6356** Eukaryotic Molecular and Cell Biology (3 semester credit hours) Regulation of cellular activities in eukaryotic cells; structural and molecular organization of eukaryotic cells; molecular basis of cell specialization; membranes and transport. For students who have not had undergraduate cell biology. (3-0)
BIOL 6358 (MSEN 6358) Bionanotechnology (3 semester credit hours) Protein, nucleic acid and lipid structures. Macromolecules as structural and functional units of the intact cell. Parallels between biology and nanotechnology. Applications of nanotechnology to biological systems. (3-0) T

BIOL 6359 Medical Cell Biology for MAT (3 semester credit hours) Organization of cells, structure and function of DNA and proteins, gene therapy, regenerative medicine, and the endocrine system. Designed for students who are pursuing a MAT degree. Instructor consent required. (3-0) S

BIOL 6360 Medical Cell Biology for Biotechnology (3 semester credit hours) This course will explore cell structure, the structure of DNA, mutations in DNA, gene therapy, stem cells, cell signaling, and the immune system etc. Emphasis will be placed on understanding the cellular and molecular basis of health and disease. For students who have not had undergraduate cell biology and/or molecular genetics. Instructor consent required. (3-0) S

BIOL 6373 (BMEN 6391) Proteomics (3 semester credit hours) Protein identification, sequencing, and analysis of post-translational modifications by liquid chromatography/tandem mass spectrometry; determination of protein three dimensional structure by x-ray crystallography; its use in drug design; understanding protein interactions and function using protein chip microarrays. Prerequisites: one semester of undergraduate biochemistry and one semester of graduate biochemistry or instructor consent required. (3-0) T

BIOL 6384 Biotechnology Laboratory (3 semester credit hours) Laboratory instruction in LC/MS/MS mass spectral analysis of protein sequence, ICAT (isotope coded affinity tag) reagents, and MS analysis of cellular proteomes, PCR and DNA Sequencing, and DNA microarray analysis; fluorescence and confocal microscopy and fluorescence activated cell sorting. Instructor may require students to demonstrate adequate laboratory skills in order to enroll. (1-2) Y

BIOL 6385 (BMEN 6389) Computational Biology (3 semester credit hours) Machine learning and probabilistic graphical models have become essential tools for analyzing and understanding complex systems biology data in biomedical research. This course introduces fundamental principles and methods behind the most important high throughput data analysis tools. Applications will cover molecular evolutionary models, DNA/protein motif discovery, gene prediction, high-throughput sequencing and microarray data analysis, computational modeling gene expression regulation, and biological pathway and network analysis. Prerequisite: Some background in elementary statistics/probability or introductory bioinformatics, or instructor consent required. (3-0) Y

BIOL 6390 (BMEN 6390) Metabolic Pathways for Translational Medicine (3 semester credit hours) This course will provide extensive discussion of major metabolic pathways in human and other experimental models of human diseases with emphasis on biochemical understanding, roles and effects of the pathways in the entire cellular network, and potential application to medicine. Prerequisite: BMEN 6389 or BIOL 6385 or instructor consent required. (3-0) T

BIOL 6V00 Topics in Biological Sciences (1-6 semester credit hours) May be repeated for credit (9 semester credit hours maximum). Department consent required. [(1-6)-0] Y

BIOL 6V01 Topics in Biological Sciences (1-6 semester credit hours) Includes a laboratory component. May
be repeated for credit as topics vary (9 semester credit hours maximum). (1-[0-10]) Y

**BIOL 6V02** The Art of Scientific Presentation (1-2 semester credit hours) Students learn how to give an effective seminar by reading scientific articles on a central theme in biology and then delivering a presentation, first to their classmates, followed by another presentation to the Molecular and Cell Biology faculty and students. While learning the focused theme, students acquire skill sets in critical reading of scientific literature and oral presentation. Required for all PhD students. Pass/Fail only. ([1-2]-0) Y

**BIOL 6V03** Research in Molecular and Cell Biology (1-9 semester credit hours) Pass/Fail only. May be repeated for credit as topics vary. Instructor consent required. ([1-9]-0) S

**BIOL 6V19** Topics in Biochemistry (2-5 semester credit hours) May be repeated for credit as topics vary (9 semester credit hours maximum). ([2-5]-0) Y

**BIOL 6V29** Topics in Molecular Biology (2-5 semester credit hours) May be repeated for credit as topics vary (9 semester credit hours maximum). ([2-5]-0) Y

**BIOL 6V39** Topics in Biophysics (2-5 semester credit hours) May be repeated for credit as topics vary (9 semester credit hours maximum). Department consent required. ([2-5]-0) T

**BIOL 6V49** Topics in Cell Biology (2-5 semester credit hours) May be repeated for credit as topics vary (9 semester credit hours maximum). Department consent required. ([2-5]-0) Y

**BIOL 6V50** Internship in Biotechnology/Biomedicine (1-6 semester credit hours) Provides faculty supervision for a student's internship. Internships must be in an area relevant to the student's coursework for the MS in Biotechnology. Pass/Fail only. May be repeated for credit as topics vary. Instructor consent required. ([1-6]-0) R

**BIOL 6V95** Advanced Topics in Molecular and Cell Biology: Individual Instruction (1-6 semester credit hours) May be repeated for credit as topics vary. Instructor consent required. ([1-6]-0) Y

**BIOL 6V98** Thesis (3-9 semester credit hours) Pass/Fail only. May be repeated for credit. Instructor consent required. ([3-9]-0) S

**BIOL 7V10** Research Seminar in Biochemistry (2-5 semester credit hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. Pass/Fail only. May be repeated for credit as topics vary. ([2-5]-0) Y

**BIOL 7V20** Research Seminar in Molecular Biology (2-5 semester credit hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. Pass/Fail only. May be repeated for credit as topics vary. ([2-5]-0) Y

**BIOL 7V30** Research Seminar in Biophysics (2-5 semester credit hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. Pass/Fail only. May be repeated credit as topics vary. ([2-5]-0) R

**BIOL 7V40** Research Seminar in Cell Biology (2-5 semester credit hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. Pass/Fail only. May be repeated for credit as topics vary. ([2-5]-0) Y
**BIOL 8V01** Research in Molecular and Cell Biology (1-9 semester credit hours) Pass/Fail only. May be repeated for credit as topics vary. ([1-9]-0) S

**BIOL 8V99** Dissertation (1-9 semester credit hours) Pass/Fail only. May be repeated for credit. Prerequisites: Open to PhD students only and instructor consent required. ([1-9]-0) S