**Biology**

**BIOL 5375** Genes to Genomes (3 semester 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. (3-0) Y

**BIOL 5376 (BMEN 6387)** Applied Bioinformatics (3 semester 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: **STAT 1342** (introductory statistics) and **MATH 1325** and **MATH 1326** (2 semesters of calculus). (3-0) T

**BIOL 5381** Genomics (3 semester 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 hours) Analysis of the structure and function of proteins and nucleic acids and of their interactions. Metabolic biochemistry, especially as it relates to disease states. Prerequisite: **BIOL 3361** (biochemistry) or equivalent. (4-0) Y

**BIOL 5420** Molecular Biology (4 semester 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 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. Prerequisites: **BIOL 5410** and **BIOL 5420**, or the equivalent, or permission of the instructor. (4-0) Y

**BIOL 5460** Mathematical Biology (4 semester hours) Fundamental mathematical and statistical concepts; hypothesis testing. Quantitative approaches to studying gene expression and protein-DNA interactions. Prerequisites: **MATH 2417** (calculus) and **PHYS 1301** (general physics). (4-0) Y

**BIOL 5v00** Topics in Biological Sciences (1-6 semester hours) May be repeated for credit to a maximum of 9 hours. ([1-6]-0) Y

**BIOL 5v01** Topics in Biological Sciences (1-6 semester hours) Includes a laboratory component. May be repeated for credit to a maximum of 9 hours (1-[0-10]) Y

**BIOL 5v95** Advanced Topics in Molecular and Cell Biology (Individual instruction) (1-6 semester hours) May be repeated for credit with permission of the graduate advisor. ([1-6]-0) Y
**BIOL 6121** Biotechnology I (1 semester hour) Gene cloning, nucleotide sequencing and other aspects of genetic engineering. This course has between one and five components, which will be offered sequentially and which may therefore be taken independently (with consent of instructor). (0-2) Y

**BIOL 6122** Biotechnology II (1 semester hour) Gene cloning, nucleotide sequencing and other aspects of genetic engineering. This course has between one and five components, which will be offered sequentially and which may therefore be taken independently (with consent of instructor). (0-2) Y

**BIOL 6123** Biotechnology III (1 semester hour) Gene cloning, nucleotide sequencing and other aspects of genetic engineering. This course has between one and five components, which will be offered sequentially and which may therefore be taken independently (with consent of instructor). (0-2) Y

**BIOL 6150** Current Research in Molecular and Cell Biology (1 semester hour) Analysis of recent developments in molecular and cell biology. Students will attend presentations of current research literature. P/F grading only. May be repeated for credit (4 hours maximum). (1-0) Y

**BIOL 6193** Colloquium in Molecular and Cell Biology (1 semester hour) Required for all degree students except non-thesis M.S., to be taken before a Supervising Committee is appointed. (P/F grading) (1-0) Y

**BIOL 6211** Posttranscriptional Regulation of Gene Expression (2 semester hours) Emphasis on current research in regulation of gene expression involving posttranscriptional mechanisms. Topics include translational regulation of gene expression, protein and messenger RNA turnover, regulation of protein folding and localization, protein phosphorylation, and the formation of active and inactive protein complexes. (2-0) T

**BIOL 6227** RNA World (2 semester 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. (2-0) T

**BIOL 6228** Prokaryotic Gene Expression (2 semester hours) Principles of gene regulation in bacteria are discussed. The readings consist of recent developments described in the research literature. Topics will vary, but will include bacterial chromosome structure, function and structure of RNA polymerase and promoters, the mechanism of action of various repressors and activators, the coordination of gene expression in phage lambda, during nitrogen limitation, and during sporulation. (2-0) T

**BIOL 6252** Current Research in Molecular Biology (2 semester 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. (P/F grading, may be repeated for credit to a maximum of 8 hours.) (2-0) S

**BIOL 6335** Graduate Medical Microbiology (3 semester hours) This course exposes students to advanced concepts and principles of medical microbiology. In addition, the course will deal with mechanisms associated with disease processes, microbial virulence, the control of bacterial growth, and host responses to infection. (3-0) T
**BIOL 6336** Parasitology (3 semester hours) A look at the molecular level at microorganisms that live at the expense of higher eukaryotes. Emphasis will be given to the latest scientific literature describing these important pathogenic interactions. Therapeutic treatments and preventive methods will also be covered. (3-0) T

**BIOL 6337** Regulation of Gene Expression (3 semester 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 6338** Symbiotic Interactions (3 semester hours) An in depth look, at the molecular level, of well characterized symbiotic interactions between prokaryotes and eukaryotes. This course makes use of recent scientific literature and the latest discoveries in the area of symbiosis. (3-0) R

**BIOL 6340** Developmental Neurobiology (3 semester hours) The course will cover the molecular and cellular mechanisms underlying key processes in the development of the vertebrate nervous system such as neural induction, k morphogenesis of the neural tube, patterning of the brain, differentiation and migration of neurons, axon guidance, synaptogenesis and the regulation of neuronal survival. The course is designed to be interactive and will include lectures, student presentations, and discussion of important discoveries in the area. (3-0) Y

**BIOL 6345** Molecular Basis of Acquired Immune Deficiency Syndrome (3 semester 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 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 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 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
**Microbial Physiology (3 semester 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

**Eukaryotic Molecular and Cell Biology (3 semester 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) S

**Cell Signaling (3 semester hours)**

This course will provide information on signal transduction pathways controlling growth, development and diseases. Students will be required to present research papers and discuss experimental data. (3-0) R

**Bionanotechnology (3 semester 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

**Medical Cell Biology for MAT (3 semester 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. (3-0) S

**Medical Cell Biology for Biotechnology (3 semester 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. (3-0) S

**Proteomics (3 semester 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. Prerequisite: Undergraduate or graduate biochemistry (3-0) T

**Biotechnology Laboratory (3 semester 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

**Computational Biology (3 semester hours)**

Using computational and statistical methods to analyze biological data, and perform mathematical modeling and computational simulation techniques to understand the biological systems. The course introduces methods in 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: (BMEN 6374 and BMEN 6387) or BIOL 5376 or instructor permission. (3-0) Y
**BIOL 6390 (BMEN 6390)** Metabolic Pathways for Translational Medicine (3 semester 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. Prerequisites: BMEN 6389 or BIOL 6385 or instructor permission. (3-0) T

**BIOL 6v00** Topics in Biological Sciences (1-6 semester hours) May be repeated for credit to a maximum of 9 hours. ([1-6]-0) Y

**BIOL 6v01** Topics in Biological Sciences (1-6 semester hours) Includes a laboratory component. May be repeated for credit to a maximum of 9 hours. (1-[0-10]) Y

**BIOL 6v02** The Art of Scientific Presentation (1-2 semester 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 Ph.D. students. (P/F grading) ([1-2]-0) Y

**BIOL 6v03** Research in Molecular and Cell Biology (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S

**BIOL 6v04** Biology Seminar (1-6 semester hours) May be repeated for credit to a maximum of 6 hours. ([1-6]-0) Y

**BIOL 6v19** Topics in Biochemistry (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. ([2-5]-0) Y

**BIOL 6v28** DNA Replication, Recombination, and Repair (2-3 semester hours) Focuses on central aspects of DNA enzymology and metabolism. The mechanisms of DNA replication, recombination, and repair are fundamental to understanding many principles of molecular biology, genetics, molecular medicine, and evolution. This course is mechanistically oriented and will provide a strong working knowledge of these processes through an extensive overview, which includes discussions of some of the most recent publications on these topics. ([2-3]-0) T

**BIOL 6v29** Topics in Molecular Biology (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. ([2-5]-0) Y

**BIOL 6v30** Biopolymers (2-4 semester hours) Structure and properties of biologically important macromolecules. ([2-4]-0) R

**BIOL 6v31** Molecular Genetics (3-4 semester 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. ([3-4]-0) Y

**BIOL 6v32** Electron Microscopy (2-3 semester hours) Theory and practice of electron microscopy. The laboratory section includes specimen preparation, operation of the electron microscope, and darkroom
work. ([1-2]-2) R

**BIOL 6v33** Biomolecular Structure (2-3 semester 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. ([2-3]-0) Y

**BIOL 6v34** Quorum Sensing (2-3 semester hours) The focus of this course is the analysis of quorum sensing and its role in pathogenic and symbiotic interactions. This course makes use of recent scientific literature and the latest discoveries in the area of population density dependent gene expression. ([2-3]-0) R

**BIOL 6v39** Topics in Biophysics (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. ([2-5]-0) T


**BIOL 6v42** Membrane Biology I (2-4 semester hours) Membrane traffic in the secretory pathway. Topics covered include insertion of proteins into membranes, the mechanism of vesicular traffic from the rough endoplasmic reticulum through the Golgi apparatus to the plasma membrane, protein sorting during secretion and membrane biogenesis. ([2-4]-0) T

**BIOL 6v43** Membrane Biology II (2-4 semester hours) Membrane traffic in the endocytic pathway. Topics covered include the structure, function and sorting of membrane receptors, the formation and function of clathrin-coated pits, membrane recycling and the biogenesis of endosomes and lysosomes. ([2-4]-0) R

**BIOL 6v44** Animal Cell Culture (2-4 semester hours) Theory and practice of the growth of animal cells in culture. Topics include: the isolation and characterization of mammalian cell mutants, chromosome mapping, the use of somatic cell hybrids to investigate eukaryotic gene regulation, gene transfer into animal cells, gene targeting and production of gene knockouts. ([2-4]-0) R

**BIOL 6v49** Topics in Cell Biology (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. ([2-5]-0) Y

**BIOL 6v50** Internship in Biotechnology/Biomedicine (1-6 semester 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. May be repeated for credit. ([1-6]-0) R

**BIOL 6v92** Readings in Molecular and Cell Biology (3-9 semester hours) ([3-9]-0) Y

**BIOL 6v95** Advanced Topics in Molecular and Cell Biology (Individual Instruction) (1-6 semester hours) May
be repeated for credit with permission of the graduate advisor. ([1-6]-0) Y

BIOL 6v98 Thesis (3-9 semester hours) (May be repeated for credit.) ([3-9]-0) S

BIOL 7450 Research Seminar in Molecular and Cell Biology (4 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading. May be repeated for credit.) (4-0) S

BIOL 7v10 Research Seminar in Biochemistry (2-5 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading. May be repeated for credit.) ([2-5]-0) Y

BIOL 7v20 Research Seminar in Molecular Biology (2-5 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading. May be repeated for credit.) ([2-5]-0) Y

BIOL 7v30 Research Seminar in Biophysics (2-5 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading. May be repeated for credit.) ([2-5]-0) R

BIOL 7v40 Research Seminar in Cell Biology (2-5 semester hours) Presentation and analysis of ongoing independent research projects, accompanied by evaluation of recent related literature. (P/F grading, may be repeated for credit.) ([2-5]-0) Y

BIOL 8v01 Research in Molecular and Cell Biology (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S

BIOL 8v99 Dissertation (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S