Biology Course Descriptions

Core Courses

BIOL 5410 Biochemistry of Proteins and Nucleic Acids (4 semester hours) Chemistry and metabolism of amino acids and nucleotides; biosynthesis of nucleic acids; analysis of the structure and function of proteins and nucleic acids and of their interactions including chromatin structure. 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 5430 Macromolecular Physical Chemistry (4 semester hours) Structures and properties of macromolecules, interactions with electromagnetic radiation, thermodynamics of macromolecular solutions, and transport processes. Prerequisites: MATH 2417 (Calculus and PHYS 1301 (General Physics)). (4-0) Y

BIOL 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 5V50 Methods in Molecular and Cell Biology I (2-6 semester hours) Laboratory instruction in biological, biophysical, and biochemical techniques. Supplemental lectures and demonstrations. (P/F grading) (1-[4-10]) Y

BIOL 5V51 Methods in Molecular and Cell Biology II (2-6 semester hours) Laboratory instruction in advanced techniques in molecular and cell biology. Supplemental lectures and demonstrations. (P/F grading) (1-[4-10]) Y

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Advanced Study

Work is offered beyond the core curriculum in four major areas that parallel four of the lecture-type core courses. Each area provides elective courses, advanced colloquia, and dissertation opportunities. Electives will usually be offered only one semester per year and in some cases only once every other year.

Topics in Biochemistry

(Bulla, DeJong, González, Goodman, Gray, Hannig, Levene, Miller, Reitzer, Spiro)

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General Electives

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 6354 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

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

Deleted: **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 undergraduate biochemistry. (3-0) Y

Special Electives

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

Topics in Molecular Biology

(Breen, DeJong, González, Goodman, Hannig, Levene, , Miller, Pace, Reitzer, Spiro)

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General Electives

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 5376 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

Deleted: Introductory statistics and 2 semesters of calculus required.

BIOL 6121-6123 Biotechnology I-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 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 6335 Graduate Medical Microbiology (3 semester hours) This course expose 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 6373 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. (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 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

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Deleted: (3 semester hours) A survey of microorganisms that live in close association with other organisms. From bacteriophages to trypanosomes, this course will cover a wide range of plant and animal parasites and symbionts and their interactions at the molecular level.

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course makes use of recent scientific literature and the latest discoveries in the area of population density dependent gene expression. [(2-3)-0] R

Special Electives

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

Topics In Biophysics

(Gray, Levene, Xia)

General Electives

BIOL 6V30 Biopolymers (2-4 semester hours) Structure and properties of biologically important macromolecules. ([2-4]-0) R
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 Structures (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 of the immune system, and engineered proteins. ([2-3]-0) Y
BIOL 6V39 Topics in Biophysics (2-5 semester hours) May be repeated for credit to a maximum of 9 hours. ([2-5]-0) T

Deleted: This course includes a discussion of protein motifs such as alpha-domains, beta structures, and alpha/beta structures in enzymes, of protein folding and stability, and of DNA structures. Circular dichroism, NMR, and crystallographic methods of structural determination are presented. Types of proteins whose structure and function are considered include transcription factors, proteinases, membrane proteins, proteins in signal transduction, proteins of the immune system, and engineered proteins. Students also receive instruction in the viewing and manipulation of protein and DNA structures using an advanced molecular modeling system.

Special Electives

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

Topics In Cell Biology

(Breen, Burr, D'Mello, Draper, Goodman, Pace)

General Electives

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, 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 6357 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

BIOL 6V41 Oncogenes (2-4 semester 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. ([2-4]-0) Y

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

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Deleted: Examines some of the remarkable progress made in recent years towards understanding how the nervous system develops. Among topics covered are signals regulating formation of neural tissue, patterning of the brain, differentiation and migration of neurons, formation of neural connections, neuronal survival, and elimination of superfluous cells. Course is designed to be interactive and will include lectures, student presentations, and discussion of important discoveries in the area.

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Deleted: **Molecular Biology of HIV/AIDS**…Topics include a discussion of the history and epidemiology of AIDS, the likely origins of human immunodeficiency virus (HIV), and the molecular and cell biology of HIV replication. The cell biological basis of the immunodeficiency induced by HIV infection is examined, as well as that of common accompanying pathologies such as Kaposi's sarcoma. The molecular basis of a variety of existing and potential anti-viral therapies is considered. ... [3]

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Deleted: **Immunobiology**

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Deleted: Interactions of antigens and antibodies. Fine structure of antibodies. Tissues and cells of the immune system. Response of B and T lymphocytes to antigens. Cellular interactions in humoral and cell-mediated immunity. Genetic basis of antibody diversity. Immunity and infectious diseases…**BIOL 6356 Eukaryotic Molecular and Cell Biology** (3 semester hours) Structural organization of eukaryotic cells; regulation of cellular activities; membranes and transport; cellular replication; examples of cell specialization such as blood (immunoglobins) and muscle cells. For students who have not had undergraduate cell biology. (3-0) S

Subject matter includes a discussion of representative examples of the principal categories of dominantly acting oncogenes. The role in oncogenesis of tumor suppressor genes ("recessive oncogenes") is also considered, as are anti-apoptotic oncogenes such as Bcl. The roles that the proteins encoded by these genes play in growth hormone signal transduction, gene regulation, cell cycle regulation, and programmed cell death will be examined. Students will also read and discuss the primary literature in this field. ... [5]

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

Special Electives

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

General Topics in Molecular and Cell Biology

General Electives

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 5V52 Methods in Molecular and Cell Biology III (2-6 semester hours) Laboratory instruction in advanced techniques in molecular and cell biology. Supplemental lectures and demonstrations. (1-[4-10]) T
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 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 6V04 Biology Seminar (1-6 semester hours) May be repeated for credit to a maximum of 6 hours ([1-6]-0) Y
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

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Special Electives

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. Normally required of all degree students. To be taken before the preliminary examination. (P/F grading, may be repeated for credit to a maximum of 4 hours.) (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 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 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 undergraduate biochemistry. (3-0) Y

BIOL 6356 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

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 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 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 8V01 Research in Molecular and Cell Biology (1-9 semester hours) (May be repeated for credit.) ([1-9]-0) S

BIOL 8V98 Thesis (3-9 semester hours) (May be repeated for credit.) ([3-9]-0) S

BIOL 8V99 Dissertation (3-9 semester hours) (May be repeated for credit.) ([3-9]-0) S

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Molecular Biology of HIV/AIDS

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Topics include a discussion of the history and epidemiology of AIDS, the likely origins of human immunodeficiency virus (HIV), and the molecular and cell biology of HIV replication. The cell biological basis of the immunodeficiency induced by HIV infection is examined, as well as that of common accompanying pathologies such as Kaposi's sarcoma. The molecular basis of a variety of existing and potential anti-viral therapies is considered.

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Interactions of antigens and antibodies. Fine structure of antibodies. Tissues and cells of the immune system. Response of B and T lymphocytes to antigens. Cellular interactions in humoral and cell-mediated immunity. Genetic basis of antibody diversity. Immunity and infectious diseases

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BIOL 6356 Eukaryotic Molecular and Cell Biology (3 semester hours) Structural organization of eukaryotic cells; regulation of cellular activities; membranes and transport; cellular replication; examples of cell specialization such as blood (immunoglobins) and muscle cells. For students who have not had undergraduate cell biology. (3-0) S

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Subject matter includes a discussion of representative examples of the principal categories of dominantly acting oncogenes. The role in oncogenesis of tumor suppressor genes ("recessive oncogenes") is also considered, as are anti-apoptotic oncogenes such as Bcl. The roles that the proteins encoded by these genes play in growth hormone signal transduction, gene regulation, cell cycle regulation, and programmed cell death will be examined. Students will also read and discuss the primary literature in this field.