

# BIOCHEMISTRY (BCHM)

## Courses

### **BCHM 1041 (3) Biotechnology and Society**

Covers recent advances in biotechnology and how those impact society. Content and discussion will focus on both the science behind technological advances, their impact on society, and the ethical issues raised by new technologies. Topics change each semester but can include: GMO crops, genome editing, drug discovery and development, stem cell therapies, development and use of new cancer treatments, human genome sequencing and its impact on diagnosis and treatments, human microbiome, neurodegenerative diseases. Formerly CHEM 1041.

**Requisites:** Restricted to students with 0-56 credits (Freshmen or Sophomore) only.

**Grading Basis:** Letter Grade

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

### **BCHM 2700 (4) Foundations of Biochemistry**

Covers chemistry of aqueous solutions; energetics in biology; structure of proteins, nucleic acids, carbohydrates, and membranes; protein evolution; macromolecular interactions; enzyme kinetics, mechanism and regulation. Will be taught from a strong chemical perspective and mastery of basic concepts of general and organic chemistry will be required. Familiarity with basic concepts of molecular and cellular biology encouraged. Formerly CHEM 4700.

**Requisites:** Requires prerequisite course of CHEM 3311 or CHEM 3451 (minimum grade C-).

**Grading Basis:** Letter Grade

### **BCHM 3491 (4) Organic Chemistry 2 for Biochemistry Majors**

Covers amines, alkylation reactions, additions to unsaturated C-C bonds, aromaticity and aromatic reactivity, organic materials, biomolecules, nomenclature of organic compounds, reaction mechanism. Department enforced corerequisite: CHEM 3341 or CHEM 3381. Formerly CHEM 3491.

**Equivalent - Duplicate Degree Credit Not Granted:** CHEM 3471 and CHEM 3331

**Requisites:** Requires prerequisite courses of CHEM 3451 and CHEM 3321 or CHEM 3361 (all minimum grade C-). Restricted to Chemistry (CHEM) or Biochemistry (BCHM) majors only.

**Grading Basis:** Letter Grade

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

### **BCHM 4312 (3-4) Quantitative Optical Imaging**

Explores the fundamentals of optical imaging in biology. Covered topics include an introduction to optics and microscopes, fluorescence microscopy and image analysis. MATLAB will be taught throughout the course and used for image processing.

**Equivalent - Duplicate Degree Credit Not Granted:** MCDB 4312, MCDB 5312 and BCHM 5312

**Grading Basis:** Letter Grade

### **BCHM 4400 (4) Core Concepts in Physical Chemistry for Biochemists**

Introduces thermodynamics, kinetics and spectroscopy, emphasizing macromolecule and biochemical applications. Includes thermodynamics, chemical and physical equilibria, solution chemistry, rates of chemical and biochemical reactions, chemical bonds and principles and selected examples of spectroscopies applied to biological systems. Department enforced prerequisite or corequisite: PHYS 1120 or PHYS 2020. Formerly CHEM 4411.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 5400 and CHEM 4511

**Requisites:** Requires prerequisite courses BCHM 2700 or CHEM 4700 and PHYS 1110 or PHYS 2010 and MATH 2300 or APPM 1360 (all minimum grade C-).

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

### **BCHM 4491 (3) Modern Biophysical Methods**

Covers the basic theory of biophysical methods widely employed in biochemistry and biology, including: electrophoresis, mass spec, calorimetry, evanescent waves, plasmon resonance, X-ray diffraction, absorbance and fluorescence spectroscopy, magnetic resonance, electron and optical microscopy and single molecule methods. Discusses ways to maximize rigor and reproducibility in biophysical studies. Department enforced prerequisites: undergraduate chemistry (general, organic physical); physics; calculus.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 5491

**Requisites:** Requires prerequisite courses of CHEM 3311 or CHEM 3451 and PHYS 1110 or PHYS 2010 and MATH 2300 or APPM 1360 and CHEM 4400 (formerly CHEM 4411) or CHEM 4511 or corequisite of CHEM 4400 or CHEM 4511 (all minimum grade C).

**Grading Basis:** Letter Grade

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

### **BCHM 4611 (3) Principles of Biochemistry**

Lec. One-semester survey of the main themes of modern biochemistry: biomolecular structure/function, metabolism, biosynthesis, DNA from genome to proteome and cellular signaling. For biology and engineering majors and others wanting a survey of biochemistry. Formerly CHEM 4611.

**Requisites:** Requires prerequisite course of CHEM 3311 or CHEM 3451 (minimum grade C-).

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

### **BCHM 4621 (3) Genome Databases: Mining and Management**

Lec. Develops essential skills for performing genomic analyses, with focus on developing practical research tools. Introduces human genome and microbiome projects, Python/Sql scripting, accessing and understanding genomic data, sequence alignment and search, evolutionary models, expression data, biological networks, and macromolecular structure.

**Equivalent - Duplicate Degree Credit Not Granted:** MCDB 4621, MCDB 5621 and BCHM 5621

**Requisites:** Requires prerequisite course of BCHM 4700 or CSCI 3104 or MCDB 3500 (minimum grade C-).

**Recommended:** Prerequisite MCDB 3135 or CSCI 3104 or CHEM 4700 and recommended corequisite of CSCI 2270.

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

**BCHM 4720 (4) Metabolic Pathways and Human Disease**

Covers energy metabolism and anabolic/catabolic pathways; metabolism of carbohydrates, lipids, amino acids, and nucleic acids; photosynthesis; special topics on human diseases with pathologies and metabolic pathways. Formerly CHEM 4720.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 5720

**Requisites:** Requires prerequisite courses of BCHM 2700 and CHEM 3331 or CHEM 3471 (all minimum grade C-).

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

**BCHM 4740 (4) Biochemistry of Gene Transmission, Expression and Regulation**

Covers biosynthesis and function of macromolecules including DNA, RNA and proteins; molecular basis of replication, transcription and translation; biochemistry of subcellular systems; signaling and regulation of gene expression in eukaryotes; and special topics. Formerly CHEM 4740.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 5740

**Requisites:** Requires a prerequisite course of BCHM 2700 or CHEM 4700 (minimum grade C-).

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

**BCHM 4751 (3) Current Topics in Biochemical Research**

Lec. Covers current topics in modern biochemical research through lectures, reading recent research articles, critical thinking and class discussion. Topics include protein and nucleic acid structure and function, biomolecular interactions, enzyme function and cellular signaling and regulation. Formerly CHEM 4751.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 5751

**Requisites:** Requires prerequisite courses of BCHM 4700 and BCHM 4740 or MCDB 3135 (all minimum grade C-).

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sciences

**BCHM 4761 (3) Biochemistry Laboratory**

Two 4-hour periods per week. Introduction to modern biochemical techniques. Topics include enzymology, spectrophotometry, electrophoresis, multi-step protein purification, recombinant DNA techniques and molecular cloning. Formerly CHEM 4761.

**Requisites:** Requires prerequisite courses of BCHM 2700 and CHEM 3341 or 3381 (all minimum grade C-). Restricted to Chemistry (CHEM) or Biochemistry (BCHM) majors only.

**Additional Information:** Arts Sci Gen Ed: Distribution-Natural Sci Lab  
Arts Sci Gen Ed: Distribution-Natural Sciences

**BCHM 4901 (1-6) Independent Study in Biochemistry**

For undergraduate study. Department consent required.

**Repeatable:** Repeatable for up to 8.00 total credit hours.

**BCHM 5312 (3-4) Quantitative Optical Imaging**

Explores the fundamentals of optical imaging in biology. Covered topics include an introduction to optics and microscopes, fluorescence microscopy and image analysis. MATLAB will be taught throughout the course and used for image processing.

**Equivalent - Duplicate Degree Credit Not Granted:** MCDB 5312, MCDB 4312 and BCHM 4312

**Grading Basis:** Letter Grade

**BCHM 5341 (3) Chemical Biology and Drug Design**

Develop knowledge base and skills in the interdisciplinary field of chemical biology, including aspects of chemistry and biology, and integrating both with respect to hierarchical levels of structure (atomic, molecular, cellular). Students will receive training that helps to develop their careers in biotech, pharmaceutical and other research-oriented industries as well as in academia. Department enforced prerequisites: introductory organic chemistry and general biochemistry. Formerly CHEM 5341.

**Requisites:** Restricted to graduate students only.

**BCHM 5400 (4) Core Concepts in Physical Chemistry for Biochemists**

Introduces thermodynamics, kinetics and spectroscopy, emphasizing macromolecule and biochemical applications. Includes thermodynamics, chemical and physical equilibria, solution chemistry, rates of chemical and biochemical reactions, chemical bonds and principles and selected examples of spectroscopies applied to biological systems. Formerly CHEM 5411.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 4400 and CHEM 4511

**Requisites:** Restricted to graduate students only.

**BCHM 5491 (3) Modern Biophysical Methods**

Covers the basic theory of biophysical methods widely employed in biochemistry and biology, including: electrophoresis, mass spec, calorimetry, evanescent waves, plasmon resonance, X-ray diffraction, absorbance and fluorescence spectroscopy, magnetic resonance, electron and optical microscopy and single molecule methods. Discusses ways to maximize rigor and reproducibility in biophysical studies. Department enforced prerequisites: undergraduate chemistry (general, organic physical); physics; calculus.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 4491

**Requisites:** Restricted to graduate students only.

**Grading Basis:** Letter Grade

**BCHM 5621 (3) Genome Databases: Mining and Management**

Lec. Develops essential skills for performing genomic analyses, with focus on developing practical research tools. Introduces human genome and microbiome projects, Python/Sql scripting, accessing and understanding genomic data, sequence alignment and search, evolutionary models, expression data, biological networks, and macromolecular structure.

**Equivalent - Duplicate Degree Credit Not Granted:** MCDB 5621, MCDB 4621 and BCHM 5621

**Requisites:** Restricted to graduate students only.

**BCHM 5661 (3) Advances in Molecular Biophysics**

Discuss recent literature concerning biophysical studies of macromolecular structure and mechanism, including DNA, RNA, proteins, and their interactions.

**Recommended:** Prerequisites one year of physical chemistry or quantum mechanics, one year of biology, graduate standing, or instructor consent.

**BCHM 5720 (4) Metabolic Pathways and Human Disease**

Covers energy metabolism and anabolic/catabolic pathways; metabolism of carbohydrates, lipids, amino acids, and nucleic acids; photosynthesis; special topics on human diseases with pathologies and metabolic pathways. Formerly CHEM 5720.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 4720

**Requisites:** Restricted to graduate students only.

**BCHM 5740 (4) Biochemistry of Gene Transmission, Expression and Regulation**

Covers biosynthesis and function of macromolecules including DNA, RNA and proteins; molecular basis of replication, transcription and translation; biochemistry of subcellular systems; signaling and regulation of gene expression in eukaryotes; and special topics. Formerly CHEM 5740.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 4740

**Requisites:** Restricted to graduate students only.

**BCHM 5751 (3) Current Topics in Biochemical Research**

Lec. Covers current topics in modern biochemical research through lectures, reading recent research articles, critical thinking and class discussion. Topics include protein and nucleic acid structure and function, biomolecular interactions, enzyme function and cellular signaling and regulation. Department consent required. Formerly CHEM 5751.

**Equivalent - Duplicate Degree Credit Not Granted:** BCHM 4751

**Requisites:** Restricted to graduate students only.

**BCHM 5770 (3) Fundamentals of Biochemistry I**

Analysis of topics in biochemistry including DNA structure and replication, RNA synthesis and processing, protein synthesis, enzyme function and mechanism, and protein structure and dynamics. Intended as a comprehensive treatment of areas central to modern biochemistry for entering graduate students. Lectures concurrent with BCHM 5771 covering the same topics except for the requirement of a written research proposal. Formerly CHEM 5770.

**BCHM 5771 (5) Advanced General Biochemistry 1**

Lect. In-depth analysis of DNA structure and replication, RNA synthesis and processing, protein synthesis, enzyme function and mechanism, protein structure, protein dynamics, and physical chemistry of macromolecules. Intended as a comprehensive treatment of areas central to modern biochemistry for entering graduate students. Formerly CHEM 5771.

**BCHM 5776 (1) Scientific Ethics and Responsible Conduct in Research**

Lect. Advanced discussion of topics in scientific ethics, including requirements for responsible conduct of research, case histories of fraud, research misconduct, ethical misconduct and development of professional values and ethical standards.

**Equivalent - Duplicate Degree Credit Not Granted:** MCDB 5776

**Requisites:** Requires prerequisite course of BCHM 5771 or CHEM 5271 (minimum grade B-). Restricted to graduate students only.

**BCHM 5780 (3) Fundamentals of Biochemistry II**

Analysis of topics in biochemistry including protein structure, methods of structure determination and prediction, protein folding, and protein dynamics. Intended as a comprehensive treatment of areas central to modern biochemistry for entering graduate students. Lectures concurrent with CHEM 5781, covering the same topics except for the requirement of a written research proposal. Formerly CHEM 5780.

**Requisites:** Requires prerequisite course of BCHM 5770 (minimum grade B-). Restricted to graduate students only.

**BCHM 5781 (5) Advanced General Biochemistry 2**

Lect. Detailed consideration of contemporary topics in biochemistry, including protein structure (primary, secondary, tertiary, and quaternary), methods of structure determination and prediction, protein folding (kinetics, thermodynamics, denaturation, and renaturation), and protein dynamics (internal motions and methods of analysis). Formerly CHEM 5781.

**Requisites:** Requires prerequisite course of BCHM 5771 (minimum grade B-). Restricted to graduate students only.

**BCHM 5801 (3) Advanced Signal Transduction and Cell Cycle Regulation**

Lect. Advanced discussion of current research and literature in signal transduction, including ligands, receptors, and intracellular signaling pathways, as well as control on transcription, chromatin structure, DNA replication, mitosis, and cell cycle progression. Formerly CHEM 5801.

**Requisites:** Restricted to graduate students only.

**Recommended:** Prerequisites CHEM 5771 and CHEM 5781 and MCDB 5210 or MCDB 5220.

**BCHM 5811 (3) Advanced Methods in Protein Sequencing and Analysis**

Lect. Advanced discussion of current methods in protein sequencing, sequence analysis, and posttranslational modifications, emphasizing techniques of mass spectrometry, use of protein databases, sequence alignment and motifs, structure prediction, and modeling of signaling pathways. Department consent required. Formerly CHEM 5811.

**Requisites:** Restricted to graduate students only.

**Recommended:** Prerequisites CHEM 5771 and CHEM 5781 and MCDB 5210.

**BCHM 5821 (1) Special Topics in Signaling and Cell Regulation**

Lect. Reviews and evaluates literature on subjects of current interest in signal transduction transcription, cell cycle progression, and cell regulation. Primarily for graduate level presentation of special topics by students, faculty, and research staff. Department consent required. Formerly CHEM 5821.

**Repeatable:** Repeatable for up to 5.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 6601 (1) Biochemistry Seminar**

Required of all biochemistry graduate students. Credit is deferred until presentation of satisfactory seminar. Formerly CHEM 6601.

**Requisites:** Restricted to graduate students only.

**BCHM 6711 (3-6) Advanced Topics in Biochemistry**

Detailed study of current literature relative to one main topic is undertaken each semester. Topics covered on a rotating basis include enzyme kinetics and mechanisms; lipids and lipoproteins; chemistry and enzymology of nucleic acids; biochemistry of nucleic acids in eukaryotic cells; protein chemistry. Presentations include faculty lectures and student reports. Department enforced prerequisite: one year of biochemistry courses. Department consent required. Formerly CHEM 6711.

**Repeatable:** Repeatable for up to 12.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 6731 (3-6) Advanced Topics in Biochemistry**

Detailed study of current literature relative to one main topic is undertaken each semester. Topics covered on a rotating basis include enzyme kinetics and mechanisms; lipids and lipoproteins; chemistry and enzymology of nucleic acids; biochemistry of nucleic acids in eukaryotic cells; protein chemistry. Presentations include faculty lectures and student reports. Department enforced prerequisite: one year of biochemistry courses. Department consent required. Formerly CHEM 6731.

**Repeatable:** Repeatable for up to 12.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 6901 (1-6) Research in Biochemistry**

**Repeatable:** Repeatable for up to 15.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 6941 (1) Master's Candidate for Degree**

Students are not admitted for the master's degree but may be transferred to the MS plan if they are unable to meet the demands of the PhD program.

**Requisites:** Restricted to graduate students only.

**Grading Basis:** Pass/Fail

**BCHM 6951 (1-6) Master's Thesis**

Students are not admitted for the master's degree but may be transferred to the MS plan if they are unable to meet the demands of the PhD program.

**Requisites:** Restricted to graduate students only.

**BCHM 7601 (2) Seminar: Nucleic Acid Chemistry**

Topics in various aspects of current research; emphasizes student readings and presentations. Department consent required.

**Repeatable:** Repeatable for up to 6.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 7611 (1) Seminar: Structures and Dynamics of Biopolymers in Solution**

Discussion of experimental and theoretical approaches for probing structures and dynamics of proteins, peptides, and nucleic acids; and computations in molecular dynamics simulation, modeling, and geometry. Department consent required. Formerly CHEM 7611.

**Repeatable:** Repeatable for up to 6.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 7621 (1) Seminar: Biochemistry and Molecular Biology of Signal Transduction**

Discusses and reviews the current literature and experimental results in signal transduction, cell cycle and tumor suppressor gene regulation. Emphasizes the understandings of molecular and biochemical mechanisms of the origin of human tumor cells. Formerly CHEM 7621.

**Requisites:** Restricted to graduate students only.

**BCHM 7651 (2) Seminar: Environmental Biochemistry**

Topics in various aspects of current biochemical and environmental research. Department consent required. Formerly CHEM 7651.

**Repeatable:** Repeatable for up to 6.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 7661 (1) Structure/Function of Human Mediator Transcription Complexes**

Study of the mechanisms of eukaryotic gene expression with an emphasis on the structure and function of human mediator transcription complexes. Formerly CHEM 7661.

**Requisites:** Restricted to graduate students only.

**BCHM 7671 (1) Seminar: Topics in Designing Probes for Signaling Reactions**

Discussion of advances and developments in biomolecular dynamics, with emphasis on experimental studies via ultrafast laser spectroscopy. The connection of protein dynamics with function will also be considered. Formerly CHEM 7671.

**Requisites:** Restricted to graduate students only.

**BCHM 7691 (1) Seminar: Protein Dynamics and the Mechanism of Sensory Proteins**

Discusses recent results and current literature in the areas of the mechanism of sensory proteins, internal motions of proteins, and protein folding. Department consent required. Formerly CHEM 7691.

**Repeatable:** Repeatable for up to 6.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 7701 (1) Seminar: Enzyme Mechanisms and Kinetics**

Studies experimental approaches to understand the mechanisms of enzymic catalysis. Techniques include steady-state and pre-steady-state kinetics, isotope trapping and partitioning, inhibition by substrate analogues, and covalent modification of proteins. Department consent required. Formerly CHEM 7701.

**Repeatable:** Repeatable for up to 6.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 7711 (1) RNA Mediated Inorganic and Organic Reactions**

Discussion of advances and developments in biomolecular dynamics, with emphasis on experimental studies via ultrafast laser spectroscopy. The connection of protein dynamics with function will also be considered. Formerly CHEM 7711.

**Requisites:** Restricted to graduate students only.

**BCHM 7741 (1) Seminar: Signal Transduction and Protein Phosphorylation**

Devoted to experimental methods for understanding mechanisms of signal transduction in mammalian cells through pathways involving regulation of protein phosphorylation. Department consent required. Formerly CHEM 7741.

**Repeatable:** Repeatable for up to 6.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 7751 (1) Seminar: Protein Structure and Folding**

Studies structure and folding of proteins and protein complexes using biophysical methods, including nuclear magnetic resonance (NMR), circular dichroism, and fluorescence spectroscopies. Department consent required. Formerly CHEM 7751.

**Repeatable:** Repeatable for up to 6.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 7761 (1) Seminar: Eukaryotic Transcriptional Regulation**

Studies the regulation of transcription by RNA Polymerase II from human promoters. Department consent required. Formerly CHEM 7761.

**Repeatable:** Repeatable for up to 6.00 total credit hours.

**Requisites:** Restricted to graduate students only.

**BCHM 7781 (1) Seminar: Topics in Structural Biology**

Discussion of advances and developments in structural biology with emphasis on new methods for protein expression, purification and crystallization; and structure solution implementation. Formerly CHEM 7781.

**Requisites:** Restricted to graduate students only.

**BCHM 7791 (1) Seminar: Topics in Ribonucleoprotein Assemblies**

Studies aspects of the biochemical and structural analysis of ribonucleic acid (RNA) and its interactions with proteins and assemblies into functional ribonucleoprotein (RNP) enzymes. Techniques focus on x-ray crystallography, spectroscopic methods, and biochemical probing. Formerly CHEM 7791.

**Requisites:** Restricted to graduate students only.

**BCHM 8991 (1-10) Doctoral Dissertation**

All doctoral students must register for 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School section.

**Repeatable:** Repeatable for up to 30.00 total credit hours.

**Requisites:** Restricted to graduate students only.