

BIOCHEMISTRY, BIOPHYSICS, AND MOLECULAR BIOLOGY (BBMB)

Courses primarily for undergraduates:

BBMB 101: Introduction to Biochemistry

(1-0) Cr. 1. F.

Research activities, career opportunities in biochemistry and biophysics, and an introduction to the structure of biologically important compounds. For students majoring in biochemistry, agricultural biochemistry or biophysics or considering one of these majors.

BBMB 102: Introduction to Biochemistry Laboratory

(0-2) Cr. 1. S.

Prereq: Credit or enrollment in CHEM 177 and CHEM 177L or CHEM 201 and CHEM 201L

Topics in the scientific background of biochemistry, such as macromolecules, metabolism, and catalysis. Laboratory experimentation covers biochemical concepts and the study of bio-molecules including proteins, lipids and nucleic acids. A significant component is practice in scientific communication. For students majoring in biochemistry, agricultural biochemistry or biophysics or considering one of these majors.

BBMB 120: The Biochemistry of Beer

(Cross-listed with FS HN). (2-0) Cr. 2. F.

An introduction to the major classes of biomolecules, basic biochemical concepts, enzymology, metabolism and genetic engineering as they apply to the production and flavor of beer. All aspects of the biochemistry of beer will be covered, including the malting of barley, starch conversion, yeast fermentation and the chemical changes that occur during the aging of beer. Intended for non-majors. Natural science majors are limited to elective credit only.

BBMB 201: Chemical Principles in Biological Systems

(2-0) Cr. 2. S.

Prereq: Credit or enrollment in CHEM 332

Survey of chemical principles as they apply in biological systems including: water, organic chemistry of functional groups in biomolecules and biochemical cofactors, weak bonds and their contribution to biomolecular structure, oxidation-reduction reactions and redox potential, thermodynamic laws and bioenergetics, chemical equilibria and kinetics, inorganic chemistry in biological systems, data presentation. The subjects will be taught using molecules from biological systems as examples. Intended for majors in biochemistry, biophysics or agricultural biochemistry.

BBMB 221: Structure and Reactions in Biochemical Processes

(3-0) Cr. 3. F.S.

Prereq: CHEM 163, CHEM 167, or CHEM 177

Fundamentals necessary for an understanding of biochemical processes. Primarily for students in agriculture. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry. Credit for both BBMB 221 and Chem 231 may not be applied toward graduation.

BBMB 301: Survey of Biochemistry

(3-0) Cr. 3. F.S.SS.

Prereq: CHEM 231 or CHEM 331

A survey of biochemistry: structure and function of amino acids, proteins, carbohydrates, lipids, and nucleic acids; enzymology; metabolism; biosynthesis; and selected topics. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry.

BBMB 316: Principles of Biochemistry

(3-0) Cr. 3. F.

Prereq: CHEM 231 or CHEM 331; BIOL 212; BIOL 313 and BIOL 314 strongly recommended.

Understanding biological systems at the molecular level; chemistry of biological macromolecules, enzyme function and regulation, metabolic pathways; integration of metabolism in diverse living systems. For students in biology and related majors who do not require the more rigorous treatment of biochemistry found in BBMB 404/405. Not acceptable for credit toward a major in biochemistry, biophysics, or agricultural biochemistry.

BBMB 404: Biochemistry I

(3-0) Cr. 3. F.

Prereq: CHEM 332

A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical and nutritional sciences. Chemistry of amino acids, proteins, carbohydrates, and lipids, vitamins; protein structure; enzymology; carbohydrate metabolism. Credit for both BBMB 420 and the BBMB 404 - 405 sequence may not be applied toward graduation.

BBMB 405: Biochemistry II

(3-0) Cr. 3. S.

Prereq: BBMB 404

A general overview for graduate and advanced undergraduate students in agricultural, biological, chemical, and nutritional sciences. Metabolism of carbohydrates, amino acids, nucleotides and lipids; formation, turnover, and molecular relationships among DNA, RNA, and proteins; genetic code; regulation of gene expression; selected topics in the molecular physiology of plants and animals. Credit for both BBMB 420 and the BBMB 404 - BBMB 405 sequence may not be applied toward graduation.

BBMB 411: Techniques in Biochemical Research

(2-8) Cr. 4. F.

Prereq: Credit or enrollment in BBMB 404 or BBMB 504 and BBMB 505; CHEM 211

Laboratory experimentation and techniques for studying biochemistry, including: chromatographic methods; electrophoresis; spectrophotometry; enzyme purification; enzyme kinetics; and characterization of carbohydrates, proteins, lipids, and nucleic acids. Scientific communication and technical writing are emphasized.

BBMB 420: Mammalian Biochemistry

(3-0) Cr. 3. F.

Prereq: CHEM 332, BIOL 314

Structure and function of proteins; enzymology; biological oxidation; chemistry and metabolism of carbohydrates, lipids, amino acids and nucleic acids; protein synthesis and the genetic code; relationship of biochemistry to selected animal diseases. Biochemistry of higher animals emphasized. Not acceptable for credit toward a major in agricultural biochemistry or biochemistry. Acceptable for credit toward a major in biophysics. Credit for both BBMB 420 and the BBMB 404 - 405 sequence may not be applied toward graduation.

BBMB 430: Prokaryotic Diversity and Ecology

(Dual-listed with BBMB 530). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: MICRO 302, MICRO 302L

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 440: Laboratory in Microbial Physiology, Diversity, and Genetics

(Cross-listed with MICRO). (2-6) Cr. 4. F.

Prereq: MICRO 302, MICRO 302L, CHEM 332, BIOL 313L

Fundamental techniques and theory for studying the cellular mechanisms, genetic processes and diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments as well as an emphasis on genetic and molecular techniques to understand antibiotic resistance processes and mechanisms. Also included are techniques for phylogenetic characterization, measuring gene expression, and genetic manipulation of bacteria. Essential components for the effective communication of scientific results are also emphasized.

BBMB 461: Molecular Biophysics

(Dual-listed with BBMB 561). (2-0) Cr. 2. S.

Prereq: Credit or enrollment in MATH 166 and CHEM 178 and PHYS 222 or PHYS 112.

Physical methods for the study of molecular structure and organization of biological materials. X-ray diffraction, nuclear magnetic resonance, hydrodynamics and fluorescence spectroscopy. Registration for the graduate credit commits the student to graduate-level examinations, which differ from undergraduate-level examinations in the number and/or difficulty of questions.

BBMB 490: Independent Study

Cr. 1-3. Repeatable. F.S.SS.

Prereq: College of Agriculture: junior or senior classification and permission of instructor; College of Liberal Arts and Sciences: permission of instructor.

Independent study with a faculty mentor. No more than 9 credits of BBMB 490 may count toward graduation.

BBMB 490H: Independent Study, Honors

Cr. 1-3. Repeatable. F.S.SS.

Prereq: College of Agriculture: junior or senior classification and permission of instructor; College of Liberal Arts and Sciences: permission of instructor

Independent study with a faculty mentor. No more than 9 credits of BBMB 490 may count toward graduation.

BBMB 499: Undergraduate Research

Cr. 1-5. Repeatable. F.S.SS.

Prereq: Permission of faculty member with whom student proposes to work. Independent research under faculty guidance.

Courses primarily for graduate students, open to qualified undergraduates:

BBMB 504: Amino Acids and Proteins

(2-0) Cr. 2. F.

Prereq: CHEM 332 or equivalent

Review of amino acids and proteins, including atomic interactions, thermodynamics, structure and properties of amino acids, post-translational modifications, protein expression, purification and analysis, protein secondary, tertiary and quaternary structure, protein folding, oxygen transport and hemoglobin, models for equilibrium binding, elementary reactions and enzyme kinetics, biosynthesis of amino acids: pathways and mechanisms.

BBMB 505: Bioenergetics and Metabolism

(2-0) Cr. 2. F.

Prereq: CHEM 211, CHEM 332; a previous course in biochemistry is strongly recommended

Examination of catabolic pathways involved in the oxidation of organic and inorganic molecules, and energy metabolism involving inputs from light or other non-light sources. Central metabolism and glycolysis, fermentation, aerobic and anaerobic respiration, photosynthesis.

BBMB 506: Membrane Biochemistry

(2-0) Cr. 2.

Prereq: CHEM 332 or equivalent

Analysis of the structure, function, and synthesis of membranes. Bacterial and eukaryotic membrane characteristics. Membrane transport and signaling mechanisms. Analysis of the structure and function of lipids and membrane proteins.

BBMB 507: Biochemistry of Nucleic Acids

(2-0) Cr. 2. S.

Prereq: CHEM 332 or equivalent

Analysis of the chemical structure, function, synthesis, and metabolism of nucleic acids. Chemical characterization of nucleotides, polynucleotides, DNA, and RNA. Analysis of transcription, translation, and the genetic code.

BBMB 510: Molecular Biology and Biochemistry of RNA

(2-0) Cr. 2. F.

Prereq: BIOL 313, BBMB 405, BBMB 502, BBMB 506 and 507 or Gen 409, or equivalent

Biochemical processes that define structure and function of nucleic acids. Emphasis on the molecular processes that take place during synthesis, processing, and function of different RNA species; review of recent advances in RNA research.

BBMB 530: Prokaryotic Diversity and Ecology

(Dual-listed with BBMB 430). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. S., offered odd-numbered years.

Prereq: MICRO 302, MICRO 302L

Survey of the diverse groups of prokaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 542A: Introduction to Molecular Biology Techniques: DNA Techniques

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

BBMB 542B: Introduction to Molecular Biology Techniques: Protein

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS.

Prereq: Graduate classification

Techniques. Includes: fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

BBMB 542C: Introduction to Molecular Biology Techniques: Cell Techniques

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes: immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

BBMB 542D: Introduction to Molecular Biology Techniques: Plant Transformation

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Includes: Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

BBMB 542E: Introduction to Molecular Biology Techniques: Proteomics

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes: two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

BBMB 542F: Introduction to Molecular Biology Techniques: Metabolomics

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes: metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

BBMB 542G: Introduction to Molecular Biology Techniques: Genomic

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

BBMB 552: Biomolecular NMR Spectroscopy

(2-0) Cr. 2. Alt. F., offered even-numbered years.

Prereq: CHEM 325 or permission of instructor

Advanced solution state Nuclear Magnetic Resonance spectroscopy as applied to biological systems. Topics include theoretical principles of NMR, practical aspects of experimental NMR, methodologies for protein structure determination, NMR relaxation, recent advances in NMR spectroscopy.

BBMB 561: Molecular Biophysics

(Dual-listed with BBMB 461). (2-0) Cr. 2. S.

Prereq: Credit or enrollment in MATH 166 and CHEM 178 and PHYS 222 or PHYS 112.

Physical methods for the study of molecular structure and organization of biological materials. X-ray diffraction, nuclear magnetic resonance, hydrodynamics and fluorescence spectroscopy. Registration for the graduate credit commits the student to graduate-level examinations, which differ from undergraduate-level examinations in the number and/or difficulty of questions.

BBMB 561L: Laboratory in Molecular Biophysics

(1-3) Cr. 2. S.

Prereq: Credit or enrollment in BBMB 461/BBMB 561

Practice in methods of X-ray diffraction, nuclear magnetic resonance, hydrodynamics and fluorescence spectroscopy as applied to macromolecules.

BBMB 569: Bioinformatics III (Structural Bioinformatics)

(Cross-listed with BCB, COM S, CPR E, GDCB). (3-0) Cr. 3. F.

Prereq: BCB 567, BBMB 316, GEN 409, STAT 430

Molecular structures including genes and gene products: protein, DNA and RNA structure. Structure determination methods, structural refinement, structure representation, comparison of structures, visualization, and modeling. Molecular and cellular structure from imaging. Analysis and prediction of protein secondary, tertiary, and higher order structure, disorder, protein-protein and protein-nucleic acid interactions, protein localization and function, bridging between molecular and cellular structures. Molecular evolution.

BBMB 590: Special Topics

Cr. arr.

By arrangement.

BBMB 593: Workshop in Biochemistry and Biophysics

Cr. 1. Repeatable. F.S.

Prereq: Permission and signature of course administrator required.

Workshops in selected topics in biochemistry and biophysics. Credit in this course does not meet the requirement for advanced graduate electives in Biochemistry. Spring only. BBMB Undergraduate Research Symposium participation. Scheduled class meetings are required in addition to attending the symposium.

Courses for graduate students:

BBMB 607: Plant Biochemistry

(2-0) Cr. 2. Alt. F., offered even-numbered years.

Prereq: BBMB 405 or BBMB 506 and BBMB 507

Description of unique aspects of plant biochemistry including lipid metabolism, cell wall structure, secondary metabolism, phytoalexin biosynthesis, and plant defenses.

BBMB 615: Molecular Immunology

(Cross-listed with MICRO, V MPM). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: BBMB 405 or BBMB 506 and BBMB 507

Current topics in molecular aspects of immunology: T and B cell receptors; major histocompatibility complex; antibody structure; immunosuppressive drugs and viruses; and intracellular signaling pathways leading to expression of genes that control and activate immune function.

BBMB 622: Carbohydrate Chemistry

(2-0) Cr. 2. Alt. S., offered even-numbered years.

Prereq: BBMB 404 or BBMB 504 and BBMB 505

Structure, occurrence, properties, function, and chemical and enzymatic modifications of monosaccharides, oligosaccharides, polysaccharides, and glycoproteins.

BBMB 632: Kinetics of Enzyme Action

(2-0) Cr. 2. Alt. F., offered even-numbered years.

Prereq: BBMB 504 and BBMB 505

Fundamental and advanced enzyme kinetics. Topics include integrated rate equations, methods for deriving initial-rate equations, inhibition, product effects, methods for verifying kinetic mechanisms, allostery, hysteresis, isotope effects, and complex kinetic mechanisms.

BBMB 642: Mechanisms of Enzymatic Catalysis

(2-0) Cr. 2. Alt. S., offered odd-numbered years.

Prereq: BBMB 404 or BBMB 420; or BBMB 504 and BBMB 505

The chemical basis of enzymatic catalysis with emphasis on mechanisms of substrate recognition, general acid-base catalysis and stereo-electronic factors.

BBMB 645: Molecular Signaling

(2-0) Cr. 2. Alt. S., offered odd-numbered years.

Prereq: BBMB 405 or BBMB 420; or BBMB 506 and BBMB 507

Molecular mechanisms of cellular signaling including receptor activation, desensitization and cross talk, signal transduction pathways, and nuclear receptors. Discussion includes a variety of cell surface receptors and their hormone; growth factor and extracellular matrix activators; protein kinases; caspase and transcription factor downstream signals; lipids, gases and cyclic nucleotides as regulators of cell signaling. Course content includes current literature, student and instructor presentations and research proposal writing.

BBMB 652: Protein Chemistry - Chemical Methods

(2-0) Cr. 1. Alt. F., offered odd-numbered years.

Prereq: BBMB 404 or BBMB 504 and BBMB 505

First 8 weeks. Chemical reactions as a means of determining protein structure and biological function.

BBMB 653: Protein Chemistry - Physical Methods

(2-0) Cr. 1. Alt. F., offered odd-numbered years.

Prereq: BBMB 404 or BBMB 504 and BBMB 505

Second 8 weeks. Protein structure determination as a means of understanding biological function.

BBMB 660: Membrane Biochemistry

(2-0) Cr. 2. Alt. F., offered even-numbered years.

Prereq: BBMB 405 or BBMB 506 and BBMB 507

Protein and lipid constituents of biological membranes. Structure and topography of membrane proteins. Selected topics concerning the membrane proteins involved in diverse biochemical processes, such as energy transduction transport across membranes, neurotransmission and signal transduction.

BBMB 661: Current Topics in Neuroscience

(Cross-listed with GDCB, NEURO). (2-0) Cr. 2-3. Repeatable. Alt. S., offered even-numbered years.

Prereq: NEURO 556 (or comparable course) or permission of instructor

Topics may include molecular and cellular neuroscience, neurodevelopment, neuroplasticity, neurodegenerative diseases, cognitive neuroscience, sensory biology, neural integration, membrane biophysics, neuroethology, techniques in neurobiology and behavior.

BBMB 675: Nucleic Acid Structure and Function

(2-0) Cr. 2. Alt. F., offered even-numbered years.

Prereq: BBMB 405 or BBMB 506 and BBMB 507

In-depth discussion of nucleic acid properties, structures and structure/function relationships. Interactions between nucleic acids and proteins will be emphasized.

BBMB 676: Biochemistry of Gene Expression in Eucaryotes

(Cross-listed with MCDB). (2-0) Cr. 2. Alt. S., offered even-numbered years.

Prereq: BBMB 404 and BBMB 504; and BBMB 506 and BBMB 507; or BBMB 405 or BBMB 505 and or GDCB 511

Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, small RNAs, translational regulation, protein turnover.

BBMB 681: Advanced Seminar

Cr. 1. Repeatable. F.S.

Prereq: Permission of instructor

Student presentations.

BBMB 682: Departmental Seminar

Cr. R. F.S.

Prereq: Permission of instructor

Faculty, staff and invited guest research seminar.

BBMB 696: Research Seminar

(Cross-listed with AGRON, FOR, GDCB, HORT, PLBIO). Cr. 1. Repeatable.

Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

BBMB 698: Seminar in Molecular, Cellular, and Developmental Biology

(Cross-listed with GDCB, MCDB, MICRO, V MPM). (2-0) Cr. 1-2. Repeatable. F.S.

Student and faculty presentations.

BBMB 699: Research

Cr. arr. Repeatable. F.S.

Prereq: Permission of instructor