Biochemistry, Biophysics, and Molecular Biology

Undergraduate Study

The department offers majors in biochemistry or biophysics in the College of Liberal Arts and Sciences and a major in agricultural biochemistry in the College of Agriculture and Life Sciences. Biochemists and biophysicists seek to understand life processes in terms of chemical and physical principles. They conduct research in the frontiers of biology such as metabolic networking; structure and function of enzymes, membranes, and hormones; computational approaches; genomic and proteomic technology; protein engineering; plant biotechnology; muscle structure and function; and the design and evaluation of drugs for the treatment of disease. Biochemistry, biophysics and molecular biology provide the basis for much of modern biotechnology. Graduates have opportunities in industry, especially the biotechnology sector, in universities, veterinary and medical schools, and government laboratories. Students who meet the necessary high scholastic standards have the opportunity to continue their education to pursue advanced degrees in graduate school, medicine, pharmacy or veterinary medicine.

Graduates of biochemistry, agricultural biochemistry and biophysics understand the chemical principles of biological systems including molecular biology. They have developed laboratory expertise in modern biochemical techniques, including the ability to analyze data and prepare scientific reports. Most have participated in undergraduate research and have developed the skills necessary for both written and oral presentations at a level that will serve the student both within the university and in postgraduate professional life. Graduates have the experience of interacting with persons of different disciplines and cultures. Students have the training in biological and physical science and mathematics to solve problems of broad scope in biological, biomedical and environmental sciences and to provide leadership in diverse scientific and technological arenas.

Graduate Study

The department offers work for the degrees master of science and doctor of philosophy with majors in biochemistry and biophysics and with interdepartmental majors in genetics, immunobiology, MCB (molecular, cellular, and developmental biology), plant physiology, and toxicology. Minor work is offered to students taking major work in other departments. Prerequisite to graduate work is a sound undergraduate background in biology, chemistry, mathematics, and physics.

All graduate students are required by the department to teach as part of their training for an advanced degree.

The department offers a B.S./M.S. program in biochemistry that allows students to obtain both the B.S. and M.S. degrees in five years. The program is open to students in the College of Liberal Arts and Sciences and in the College of Agriculture. Students interested in this program should contact the department office for details. Application for admission to the Graduate College should be made near the end of the junior undergraduate (third) year. Students would begin research for the M.S. thesis during the summer semester after their junior year and are eligible for research assistantships.

Agricultural Biochemistry Major in the College of Agriculture and Life Sciences

For the undergraduate curriculum leading to the degree bachelor of science, see College of Agriculture, Curricula. Agricultural biochemistry is recommended to students interested in the areas of agriculture requiring strong preparation in biochemistry, chemistry, physics, and mathematics, or in preparation for the study of veterinary medicine. Employment opportunities exist in agrochemical industries, biochemistry, chemistry, physics, and mathematics, or in preparation for the study of veterinary medicine. Employement opportunities exist in agrochemical industries, biochemistry, chemistry, physics, and mathematics, or in preparation for the study of veterinary medicine. Employment opportunities exist in agrochemical industries, biochemistry, chemistry, physics, and mathematics, or in preparation for the study of veterinary medicine.

Agricultural Biochemistry program of study

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BBMB 101</td>
<td>Introduction to Biochemistry</td>
<td>1</td>
</tr>
<tr>
<td>BBMB 102</td>
<td>Introduction to Biochemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>BBMB 201</td>
<td>Chemical Principles in Biological Systems</td>
<td>2</td>
</tr>
<tr>
<td>BBMB 404</td>
<td>Biochemistry I</td>
<td>3-4</td>
</tr>
<tr>
<td>or BBMB 501</td>
<td>Comprehensive Biochemistry I</td>
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<tr>
<th>Course Code</th>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BBMB 405</td>
<td>Biochemistry II</td>
<td>3-4</td>
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<tr>
<td>or BBMB 502</td>
<td>Comprehensive Biochemistry II</td>
<td></td>
</tr>
<tr>
<td>BBMB 411</td>
<td>Techniques in Biochemical Research</td>
<td>4</td>
</tr>
<tr>
<td>BBMB 490</td>
<td>Independent Study (Not required)</td>
<td>arr</td>
</tr>
<tr>
<td>BBMB 499</td>
<td>Undergraduate Research (Not required but strongly encouraged)</td>
<td>1-5</td>
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Take one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 201</td>
<td>Advanced General Chemistry</td>
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<tr>
<td>CHEM 177 &amp; CHEM 178</td>
<td>General Chemistry I &amp; General Chemistry II</td>
<td></td>
</tr>
<tr>
<td>CHEM 201L</td>
<td>Laboratory in Advanced General Chemistry</td>
<td></td>
</tr>
<tr>
<td>or CHEM 177N</td>
<td>Laboratory in General Chemistry I</td>
<td></td>
</tr>
<tr>
<td>or CHEM 177L</td>
<td>Laboratory in General Chemistry I</td>
<td></td>
</tr>
<tr>
<td>CHEM 211</td>
<td>Quantitative and Environmental Analysis</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 211L</td>
<td>Quantitative and Environmental Analysis Laboratory</td>
<td>2</td>
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One of the following:

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 322L</td>
<td>Laboratory in Physical Chemistry</td>
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<tr>
<td>BBMB 461 &amp; BBMB 561L</td>
<td>Molecular Biophysics and Laboratory in Molecular Biophysics</td>
<td></td>
</tr>
<tr>
<td>CHEM 324</td>
<td>Introductory Quantum Mechanics</td>
<td>3</td>
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<tr>
<td>CHEM 325</td>
<td>Chemical Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 331</td>
<td>Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 332</td>
<td>Organic Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 333L</td>
<td>Laboratory in Organic Chemistry (for Chemistry and Biochemistry Majors)</td>
<td>1-2</td>
</tr>
<tr>
<td>or CHEM 331L</td>
<td>Laboratory in Organic Chemistry I</td>
<td></td>
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<tr>
<td>CHEM 334L</td>
<td>Laboratory in Organic Chemistry II (for Chemistry and Biochemistry Majors)</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 332L</td>
<td>Laboratory in Organic Chemistry II</td>
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<tr>
<td>MATH 165</td>
<td>Calculus I</td>
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<tr>
<td>MATH 166</td>
<td>Calculus II</td>
<td>4</td>
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<tr>
<td>MATH 265</td>
<td>Calculus III</td>
<td>3-4</td>
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<tr>
<td>or MATH 266</td>
<td>Elementary Differential Equations</td>
<td></td>
</tr>
<tr>
<td>or MATH 267</td>
<td>Elementary Differential Equations and Laplace Transforms</td>
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<tr>
<td>PHYS 221</td>
<td>Introduction to Classical Physics I</td>
<td>5</td>
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<tr>
<td>PHYS 222</td>
<td>Introduction to Classical Physics II</td>
<td>5</td>
</tr>
<tr>
<td>BIOL 211</td>
<td>Principles of Biology I</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 211L</td>
<td>Principles of Biology Laboratory I</td>
<td></td>
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<tr>
<td>or BIOL 212L</td>
<td>Principles of Biology Laboratory II</td>
<td></td>
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<tr>
<td>or BIOL 313L</td>
<td>Genetics Laboratory</td>
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<tr>
<td>BIOL 212</td>
<td>Principles of Biology II</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 313</td>
<td>Principles of Genetics</td>
<td>3</td>
</tr>
<tr>
<td>BIOL 314</td>
<td>Principles of Molecular Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>Biological Science electives from Biology, Genetics or Microbiology</td>
<td>4</td>
<td></td>
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</table>

Total Credits 73-81

† Arranged with instructor.

The College of Agriculture and Life Sciences requires the following:

Communications Proficiency (with a C or better)

<table>
<thead>
<tr>
<th>Course Code</th>
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</tr>
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<tbody>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition</td>
<td>3</td>
</tr>
<tr>
<td>SP CM 212</td>
<td>Fundamentals of Public Speaking</td>
<td>3</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Information Literacy</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Credits 10

Ethics

Courses from an approved list. 3

Humanities and Social Sciences

Humanities course 3

Social Science course 3

Total Credits 6
Curriculum in Agricultural Biochemistry

Administered by the Department of Biochemistry, Biophysics and Molecular Biology.

Total Degree Requirement: 128 cr.

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

International Perspective: 3 cr.

U.S. Diversity: 3 cr.

Communications Proficiency:

6 cr. of English composition with a C or better and 3 cr. of speech fundamentals with a C or better.

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 201. Chemical Principles in Biological Systems.

(2-0) Cr. 2. S. Prereq: CHEM 163, CHEM 167, or CHEM 177

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. 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.


(3-0) Cr. 3. F. Prereq: CHEM 231 or CHEM 331; BIOL 212

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. Nonmajor graduate credit. 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. 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. Nonmajor graduate credit. 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. Nonmajor graduate credit. 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 501; CHEM 211  
Introduction to laboratory techniques for studying biochemistry, including: chromatographic methods; electrophoresis; spectrophotometry; enzyme purification; enzyme kinetics; and characterization of carbohydrates, proteins, lipids, and nucleic acids. Nonmajor graduate credit.

BBMB 420. Physiological Chemistry.  
(3-0) Cr. 3. F. Prereq: CHEM 332, BBMB 301 or 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. Nonmajor graduate credit. Not acceptable for credit toward a major in agricultural biochemistry, biochemistry or biophysics. Credit for both BBMB 420 and the BBMB 404 - 405 sequence may not be applied toward graduation.

(Dual-listed with BBMB 530). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. S., offered 2013. Prereq: MICRO 302, MICRO 302L  
Survey of the diverse groups of procaryotes 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  
Study of the fundamental techniques and theory of studying the cellular mechanisms and diversity of microbial life. Experimental techniques will include isolation and physiological characterization of bacteria that inhabit different environments. Also included are techniques for the phylogenetic characterization, and genetic manipulation of diverse species of bacteria.

BBMB 461. Molecular Biophysics.  
(Dual-listed with BBMB 561). (2-0) Cr. 2. S. Prereq: Credit or enrollment in CHEM 324 and CHEM 325  
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. arr. Repeatable. F.S.S. Prereq: College of Agriculture; junior or senior classification and permission of instructor; College of Liberal Arts and Sciences: permission of instructor  
College of Agriculture: a maximum of 6 credits of 490 may be applied toward graduation. College of Liberal Arts and Sciences: a maximum of 9 credits may be applied toward graduation.

BBMB 490H. Independent Study, Honors.  
Cr. arr. Repeatable. F.S.S. 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. College of Agriculture: a maximum of 6 credits of 490 may be applied toward graduation. College of Liberal Arts and Sciences: a maximum of 9 credits of 490 may be applied toward graduation.

BBMB 499. Undergraduate Research.  
Cr. 1-5. Repeatable. F.S.S. 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 501. Comprehensive Biochemistry I.  
(4-0) Cr. 4. F. Prereq: CHEM 211, CHEM 332; a previous course in biochemistry is strongly recommended  
Chemical composition of living matter and the chemistry of life processes. Chemical characterization of amino acids, proteins, carbohydrates and lipids; enzymology and co-enzymes; metabolism of carbohydrates; biological oxidations, biosynthesis of DNA, RNA, and proteins; gene regulation; selected topics.

BBMB 502. Comprehensive Biochemistry II.  
(4-0) Cr. 4. S. Prereq: BBMB 501  
Chemical composition of living matter and the chemistry of life processes. Metabolism of lipids, amino acids, and nucleotides; membrane biochemistry;

BBMB 503. Bioinorganic Chemistry.  
(Cross-listed with CHEM). (2-0) Cr. 2. Alt. S., offered 2012. Prereq: CHEM 402 or BBMB 405  
Essential elements: transport and storage of ions and of oxygen; metalloenzymes and metallocoenzymes; electron-transfer processes in respiration and photosynthesis; metabolism of nonmetals and redox processes involved in it; medicinal aspects of inorganic chemistry.

BBMB 520. Genetic Engineering.  
(Cross-listed with GDCB, MCDIB). (3-0) Cr. 3. Alt. S., offered 2012. Prereq: GEN 411 or BBMB 405  
Strategies and rationale of recombinant DNA technologies. The methodology of genetic engineering in basic research and implications for applied research will be considered. Topics include: basic tools of molecular cloning, targeted mutagenesis, fluorescent proteins, protein expression systems, and transgenic model systems.

BBMB 530. Procaryotic Diversity and Ecology.  
(Dual-listed with BBMB 430). (Cross-listed with MICRO). (3-0) Cr. 3. Alt. S., offered 2013. Prereq: MICRO 302, MICRO 302L  
Survey of the diverse groups of procaryotes emphasizing important and distinguishing metabolic, phylogenetic, morphological, and ecological features of members of those groups.

BBMB 542. Introduction to Molecular Biology Techniques.  
Cr. 1. Repeatable. F.S. Prereq: Graduate classification  
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

BBMB 542A. DNA Techniques.  
(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPM). Cr. 1. Repeatable. F.S. Prereq: Graduate classification  
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, V MPM, VDPM). Cr. 1. Repeatable. F.S. Prereq: Graduate classification  
Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, introduction to high-performance computing, immunophenotyping, and monoclonal antibody production. Offered on a satisfactory-fail basis only.

BBMB 542C. Cell Techniques.  
Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, and image analysis. (F.S.). Cr. 1. Repeatable. F.S. Prereq: Graduate classification  
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

BBMB 542D. Plant Transformation.  
Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. (S.). Cr. 1. Repeatable. F.S. Prereq: Graduate classification  
Sessions in basic molecular biology techniques and related procedures. 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, VDPM). Cr. 1. Repeatable. F. Prereq: Graduate classification  
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, VDPM). Cr. 1. Repeatable. F. Prereq: Graduate classification  
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. Genomic Techniques.  
Cr. 1. Repeatable. F.S. Prereq: Graduate classification  
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.
BBMB 552. Biomolecular NMR Spectroscopy.
(2-0) Cr. 2. Alt. S., offered 2013. 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 CHEM
324 and CHEM 325
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 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 Genome Informatics),
(Cross-listed with BCB, COM S, CPR E), (3-0) Cr. 3. F. Prereq: BCB 567, GEN
411, STAT 420
Algorithmic and statistical approaches in structural genomics including protein,
DNA and RNA structure. Structure determination, refinement, representation,
comparison, visualization, and modeling. Analysis and prediction of protein
secondary and tertiary structure, disorder, protein cores and surfaces, protein-
protein and protein-nucleic acid interactions, protein localization and function.

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:
(2-0) Cr. 2. Alt. F., offered 2012. Prereq: BBMB 405 or BBMB 502
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 2013. Prereq:
BBMB 405 or BBMB 502
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 2012. Prereq: BBMB 404 or BBMB 501
Structure, occurrence, properties, function, and chemical and enzymatic
modifications of monosaccharides, oligosaccharides, polysaccharides, and
glycoproteins.

(2-0) Cr. 2. Alt. F., offered 2014. Prereq: BBMB 501
Fundamental and advanced enzyme kinetics. Topics include integrated rate
equations, methods for deriving initial-rate equations, inhibition, product effects,
methods for verifying kinetic mechanisms, allosteric, hysteresis, isotope effects,
and complex kinetic mechanisms.

(2-0) Cr. 2. Alt. S., offered 2013. Prereq: BBMB 404, BBMB 420, or BBMB 501
The chemical basis of enzymatic catalysis with emphasis on mechanisms of
substrate recognition, general acid-base catalysis and stereo-electronic factors.