

## Biochemistry and Molecular Biology—BMB

- 521 Medical Biochemistry**  
Fall. 5(5-0) R: Graduate-professional students in colleges of Human and Osteopathic Medicine. SA: BCH 521  
Basic biochemical principles and terminology; metabolism and function of biomolecules of importance in medical biology and processes pertinent to human pathophysiology.
- 523 Genetics for Medical Practice**  
Summer. 1(1-0) Interdepartmental with Pediatrics and Human Development. Administered by Department of Pediatrics and Human Development. R: Graduate-professional students in colleges of Human and Osteopathic Medicine. SA: BCH 523  
Basic principles of genetics for medical students.
- 526 Molecular Biology and Medical Genetics**  
Fall. 2 credits. Interdepartmental with Pediatrics and Human Development. R: Restricted to students enrolled in the M.D. (CHM) or D.O. (COM) programs. SA: BCH 526 Not open to students with credit in PHD 523.  
Basic principles of human medical genetics; storage and expression of genetic information; transmission of genetic information to progeny.
- 534 Cell Biology and Physiology I**  
Fall. 3 credits. Interdepartmental with Physiology; Human Anatomy. Administered by Department of Physiology. R: Open only to graduate-professional students in the College of Human Medicine or College of Osteopathic Medicine.  
Modern concepts of cell biology as a basis for understanding the physiology of human tissues and organ systems in health and disease.
- 535 Cell Biology and Physiology II**  
Spring. 4 credits. Interdepartmental with Physiology; Human Anatomy. Administered by Department of Physiology. R: Open only to graduate-professional students in the College of Human Medicine or the College of Osteopathic Medicine.  
Modern concepts of cell biology as a basis for understanding the physiology of human tissues and organ systems in health and disease. Continuation of PSL 534.
- 801 Molecular Biology**  
Fall. 3(3-0) RB: BMB 462, CEM 383. SA: BCH 801 Not open to students with credit in BMB 897A or BMB 897A.  
Organization of genes. Regulation of gene expression, replication, and recombination.
- 802 Metabolic Regulation and Signal Transduction**  
Spring. 3(3-0) RB: BMB 801. SA: BCH 802  
Molecular basis for metabolic regulation. Molecular signalling mechanisms and mechanisms for allosteric and covalent protein modifications.
- 803 Protein Structure and Function**  
Fall. 2(2-0) RB: BMB 462, CEM 383 SA: BCH 803  
Protein structure and relationship of function to structure. Applications of kinetic methods to elucidation of enzyme mechanisms and regulation.
- 804 Biochemical Mechanisms and Structure**  
Spring. 3(3-0) RB: (BMB 462 or concurrently and CEM 383 or concurrently) SA: BCH 804  
Structures, methods of structural analysis, synthesis, and reaction mechanisms of biological substances including proteins, carbohydrates, lipids, porphyrins, phosphate esters, enzymes, and coenzymes.
- 825 Cell Structure and Function**  
Spring. 3(3-0) Interdepartmental with Microbiology and Molecular Genetics; Physiology. RB: BMB 401 or BMB 461. SA: BCH 825  
Molecular basis of structure and function. Cell properties: reproduction, dynamic organization, integration, programmed and integrative information transfer. Original investigations in all five kingdoms.
- 829 Methods of Macromolecular Analysis and Synthesis**  
Fall. 2(2-0) RB: (BMB 462 or concurrently) SA: BCH 829  
Techniques of isolation and characterization of macromolecules. Computer use in structure-function analysis of macromolecules.
- 831 Physiological Biochemistry**  
Spring of even years. 4(4-0) RB: BMB 401 or BMB 462. SA: BCH 831  
Mammalian physiological biochemistry. Metabolic interpretation of normal and altered physiological states of humans and other mammals.
- 855 Special Problems**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Approval of department. SA: BCH 855  
Laboratory or library research on special problems in biochemistry.
- 856 Plant Molecular Biology**  
Spring. 3(3-0) Interdepartmental with Plant Biology; Crop and Soil Sciences. Administered by Department of Plant Biology. RB: (ZOL 341) SA: BOT 856  
Recent advances in genetics and molecular biology of higher plants.
- 864 Plant Biochemistry**  
Spring. 3(3-0) Interdepartmental with Plant Biology. RB: BMB 401 or BMB 462. SA: BCH 864  
Biochemistry unique to photosynthetic organisms. Photosynthetic and respiratory electron transport, nitrogen fixation, carbon dioxide fixation, lipid metabolism, carbon partitioning, cell walls, biosynthesis of plant hormones.
- 888 Laboratory Rotation**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in Biochemistry. SA: BCH 888  
Participation in research laboratories to learn experimental techniques and approaches, broaden research experience, and assess research interests prior to selecting a thesis or dissertation adviser.
- 899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to master's students in Biochemistry. SA: BCH 899  
Master's thesis research.
- 960 Selected Topics in Biochemistry I**  
Fall, Spring. 1 to 2 credits. A student may earn a maximum of 7 credits in all enrollments for this course. R: Open only to graduate students in Biochemistry or approval of department. SA: BCH 960  
Contemporary biochemical research topics in such areas as biochemical genetics, biochemistry of development, biochemical evolution, complex proteins, or lipid metabolism.
- 961 Selected Topics in Biochemistry II**  
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 7 credits in all enrollments for this course. R: Open only to graduate students in the Department of Biochemistry. SA: BCH 961  
Contemporary biochemical research topics in such areas as bioenergetics, bioinstrumentation, complex carbohydrates, mass spectrometry, biomolecular spectroscopy or computer-based modeling and analysis of DNA and protein sequences and structures.
- 978 Seminar in Biochemistry**  
Fall, Spring. 1(1-0) A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to graduate students in Biochemistry. SA: BCH 978  
Seminars on biochemistry research mainly with visiting scientists.
- 999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 120 credits in all enrollments for this course. R: Open only to doctoral students in Biochemistry. SA: BCH 999  
Doctoral dissertation research.

## BIOLOGICAL SCIENCE BS

### College of Natural Science

- 110 Organisms and Populations**  
Fall, Spring. 4(3-3) Not open to students with credit in LBS 144 or LBS 148H.  
Biological diversity and organismal biology. Principles of evolution, population biology, and community structure.
- 111 Cells and Molecules**  
Fall, Spring, Summer. 3(3-0) P:M: (CEM 141 or CEM 151 or LBS 171 or CEM 181H) Not open to students with credit in LBS 145 or LBS 149H.  
Macromolecular synthesis; energy metabolism; molecular aspects of development; principles of genetics.
- 111L Cell and Molecular Biology Laboratory**  
Fall, Spring, Summer. 2(1-3) Interdepartmental with Microbiology and Molecular Genetics; Plant Biology; Zoology. P:M: (BS111 or concurrently) Not open to students with credit in LBS 159H.  
Principles and applications of common techniques used in cell and molecular biology.

## BIOSYSTEMS ENGINEERING BE

### Department of Biosystems and Agricultural Engineering College of Agriculture and Natural Resources

- 130 Engineering Design Fundamentals for Biological Systems**  
Fall. 2(1-2) P:M: (MTH 132 or concurrently or MTH 114 or concurrently or MTH 116 or concurrently or LBS 117 or concurrently or LBS 118 or concurrently or MTH 152H)  
Professional and fundamental methods of biosystems engineering. Basic engineering methods. Analysis and design. Interdisciplinary design.
- 230 Engineering Analysis of Biological Systems**  
Spring. 3(3-0) P:M: (MTH 132 or MTH 152H or LBS 118) and (BS 110 or concurrently)  
Biosystems modelling of growth and dynamic interactions. Conservation of mass, and sustainability. Steady-state and stability analysis. Ecological concepts. Life-cycle analysis. Design for environment.
- 232 Food Production and Processing Systems**  
Fall. 1(0-2)  
Crop and animal production systems. Food processing systems. Field trips required.
- 329 Fundamentals of Food Engineering**  
Spring. 3(3-0) Interdepartmental with Food Science. P:M: (FSC 325) and (MTH 126 or LBS 118) and (PHY 231 or LBS 271) RB: (FSC 211) SA: FE 329  
Unit operations in food industry: fluid mechanics, heat transfer, rate processes, refrigeration, freezing, and dehydration. Thermal process calculations.
- 332 Engineering Properties of Biological Materials**  
Fall. 3(3-0) P:M: (BS 111 or PLB 105 or MMG 201) and (ME 221) C: BE 333 concurrently.  
Physical, thermal, and electromagnetic properties of biological materials necessary for the design and analysis of processes and equipment in biosystems.
- 333 Biosystems Engineering Laboratory**  
Fall. 1(0-3) P:M: (BS 110 or BS 111 or PLB 105 or ENT 205 or MMG 201 or MMG 301 or PSL 250 or ZOL141) R: Open only to students in the Biosystems Engineering major.  
Measurement of physical, chemical, and biological parameters. Properties that characterize engineered biosystems. Data collection and analysis. Experiment design.
- 350 Heat and Mass Transfer in Biosystems**  
Spring. 3(3-0) P:M: (MTH 235 or MTH 255H or LBS 220) and (CSE 131) and (CE 321 or concurrently or CHE 311 or concurrently or ME 332 or concurrently) and (CEM 143 or concurrently) R: Open only to students in the College of Engineering. Not open to students with credit in ME 410.  
Steady state and transient heat conduction. Radiation and convection heat transfer. Heat exchangers. Mass transfer application problems in biosystems engineering.

- 148H Honors Organismal Biology**  
Fall. 3(3-0) Interdepartmental with Lyman Briggs School. Not open to students with credit in BS 110 or LBS 144.

Diversity and basic properties of organisms, with emphasis on genetic principles, ecological interactions, and the evolutionary process. Historical approach to knowledge discovery.

- 149H Honors Cell and Molecular Biology**  
Spring. 3(3-0) Interdepartmental with Lyman Briggs School. P:M: (CEM 141 or concurrently or CEM 151 or concurrently or CEM 181H or concurrently or LBS 171 or concurrently) Not open to students with credit in BS 111 or LBS 145.

Exploration of the physicochemical and molecular organization of cells as the unifying framework for genetics, evolution, and the social relevance of biology.

- 158H Honors Organismal Biology Laboratory**  
Fall. 2(1-3) Interdepartmental with Lyman Briggs School. Not open to students with credit in BS 110 or LBS 144. C: BS 148H concurrently.

Basic procedures used by organismal biologists, including experimental design and statistical methods. Development and implementation of research projects to test hypotheses in genetics, ecology, and evolution.

- 159H Honors Cell and Molecular Biology Laboratory**  
Spring. 2(1-3) Interdepartmental with Lyman Briggs School. Not open to students with credit in BS 111L or LBS 145. C: BS 149H concurrently.

Basic techniques of cellular and molecular biology including experimental design and hypothesis formulation. Student-initiated projects to test hypothesis-driven projects in biochemistry, molecular biology or genetics.

## BIOMEDICAL ENGINEERING BME

### College of Engineering

- 401 Quantitative Human Biology**  
Spring. 3(4-0) Interdepartmental with Materials Science and Engineering; Radiology; Human Anatomy. P:M: (MTH 235 and PHY 184) and (PSL 250 or concurrently or PSL 431 or concurrently) and (CEM 141 or CEM 151) and (ANTR 350 or concurrently) RB: (CSE 131 or concurrently or CSE 231 or concurrently or PSL 410)

Qualitative description and quantitative engineering analysis of selected, tractable human-biological systems. Multi-disciplinary problem-solving among medical and engineering professionals.

- 425 Biomaterials and Biocompatibility**  
Spring. 3(3-0) Interdepartmental with Materials Science and Engineering. Administered by Department of Chemical Engineering and Materials Science. P:M: (PSL 250 or concurrently and MSE 250) SA: MSM 424, BME 424, BME 324, MSE 324

Materials science of human implants. Design requirements imposed by the human body, and need for bodily protection.

- 490 Independent Study**  
Fall, Spring. 3 to 12 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.

Individualized reading and research in biomedical engineering or bioengineering.

- 490A Independent Study in Clinical Biomechanics**  
Fall. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

Individualized reading and research in the application of biomechanics to clinical cases.

- 490B Independent Study in Biomaterials**  
Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

Individualized reading and research in the application of biomaterials.

- 491 Special Topics**  
Fall, Spring. 3 to 12 credits. A student may earn a maximum of 12 credits in all enrollments for this course.

Special topics in biomedical engineering or bioengineering.

- 495 Tissue Mechanics**  
Spring. 3(3-0) Interdepartmental with Mechanical Engineering. Administered by Department of Mechanical Engineering. P:M: (ME 222) R: Open only to students in the College of Engineering. SA: MSM 441

Application of solid mechanics to understanding mechanical responses of biological tissues. Microstructure and biological function for soft and hard connective tissues and muscle.

- 496 Biodynamics**  
Fall. 3(2-2) Interdepartmental with Mechanical Engineering. Administered by Department of Mechanical Engineering. P:M: (ME 361) R: Open only to students in the Engineering Mechanics major.

Fundamentals of motion analysis of human movement and its application to the study of function and dysfunction of the musculoskeletal system. Solution methods of the inverse dynamics problem.

- 497 Biomechanical Design**  
Spring. 3(3-0) Interdepartmental with Mechanical Engineering. Administered by Department of Mechanical Engineering. R: Open only to juniors or seniors in the College of Engineering. SA: BME 491A, MSM 445

Biomechanical product design with application to people or animals. Synthesis, prototyping, and analysis of designs. Project management. Market research.