

- 499 Senior Thesis**
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to students in the Biochemistry or the Biochemistry/Biotechnology major. Total credits in BMB 490 and BMB 499 may not exceed 8. Approval of department. SA: BCH 499
Laboratory research culminating in a thesis.
- 514 Medical Biochemistry**
Fall. 3 credits. R: Restricted to students enrolled in M.D. (CHM) or D.O. (COM) programs. SA: BCH 514 Not open to students with credit in BMB 521.
Basic biochemical principles and terminology; metabolism and function of biomolecules of importance in medical biology and human pathophysiology.
- 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. 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.

Biological Science—BS

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.

148H Honors Organismal Biology
Fall. 3(3-0) Interdepartmental with Lyman
Briggs School. Administered by Lyman
Briggs School. R: Honors College student or
approval of 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. Administered by
Lyman Briggs School. P:M: (CEM 141 or
concurrently or CEM 151 or concurrently or
CEM 181H or concurrently or LBS 171 or
concurrently) R: Honors College student or
approval of school. 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. Administered by Lyman
Briggs School. Not open to students with
credit in BS 110 or LBS 144. C: LBS 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. Administered by
Lyman Briggs School. Not open to students
with credit in BS 111L or LBS 145. C: LBS
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

424 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 and MSE 250) SA: MSM 424

Materials science of human implants. Design
requirements imposed by the body's milieu and the
need to protect the body.

441 Tissue Mechanics
Spring of odd years. 3(3-0)
Interdepartmental with Materials Science
and Mechanics. Administered by
Department of Materials Science and
Mechanics. P:M: (MSM 211)

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

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.

491B Occupational Biomechanics
Fall. 3(3-0)
Special topics in occupational biomechanics of
current interest and importance.

491C Biological Surface Science
Spring of even years. 3(3-0)
Special topics in biological surface science of
current interest and importance.

491D Low Temperature Biotechnology
Spring of odd years. 3(3-0)
Special topics in low temperature biotechnology of
current interest and importance.

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.

BIOSYSTEMS ENGINEERING BE

Department of 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 Principles of Biosystems Engineering
Fall. 3(3-0) P:M: (MTH 132 or MTH 152H or
LBS 118)

Concepts of biosystems. Hard and soft systems.
Conceptual and computer modeling of components
of biosystems.

**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 229) and (MTH 126 or
LBS 118) and (PHY 231 or LBS 164) RB:
(FSC 211) SA: FE 329

Unit operations in food industry: fluid mechanics,
heat transfer, rate processes, refrigeration, freezing,
and dehydration. Thermal process calculations.

**331 Machinery Principles in Biosystems
Engineering**
Fall. 3(3-0) P:M: (MTH 235 or MTH 255H or
LBS 220) and (MSM 206 or MSM 211 or
concurrently) and (CE 321) RB: Upper
division standing in the College of
Engineering

Functional processes of machines used in
biosystems engineering, including pumping,
blowing, conveying, mixing, separation, atomization,
size reduction and mobility. Power requirements,
efficiency and failure modes

333 Biosystems Engineering Laboratory
Fall. 1(0-3) P:M: (BS 110 or BS 111 or BOT
105 or ENT 205 or MMG 205 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 and properties that characterize
engineered biosystems. Data collection and
analysis. Experiment design.

337 Machinery Systems for Food Processing
Spring. 3(3-0) P:M: (BE 230) and (LBS 220
or concurrently or MTH 235 or concurrently
or MTH 255H or concurrently) SA: AE 338,
FE 338

Principles of design, operation, and performance of
equipment for processing raw materials into finished
or intermediate products.