

495. Undergraduate Seminar
Spring. 2(2-0) P: (BCH 462 or concurrently) R:
Open only to students in the Biochemistry or
Biochemistry/Biotechnology majors.
Extension and synthesis of concepts of biochemis-
try. Relationships to societal issues.

499. Senior Thesis
Fall, Spring, Summer. 1 to 8 credits. A student
may earn a maximum of 8 credits in all enroll-
ments for this course. R: Open only to students in
the Biochemistry or the Biochemis-
try/Biotechnology major. Total credits in BCH
490 and BCH 499 may not exceed 8. Approval of
department.
Laboratory research culminating in a thesis.

521. Medical Biochemistry
Fall. 5(5-0) R: Graduate-professional students in
colleges of Human Medicine and Osteopathic
Medicine.

Basic biochemical principles and terminology;
metabolism and function of biomolecules of im-
portance in medical biology and processes perti-
nent to human pathophysiology.

523. Genetics for Medical Practice
Summer. 1(1-0) Interdepartmental with *Pediat-
rics and Human Development*. Administered by
Pediatrics and Human Development. R: Gradu-
ate-professional students in colleges of Human
Medicine and Osteopathic Medicine.
Basic principles of genetics for medical students.

801. Molecular Biology
Fall. 3(3-0) P: BCH 462, CEM 383. Not open to
students with credit in BCH 897A or BCH 897A.
Organization of genes. Regulation of gene expres-
sion, replication, and recombination.

**802. Metabolic Regulation and Signal
Transduction**
Spring. 3(3-0) P: BCH 801.
Molecular basis for metabolic regulation. Molecu-
lar signalling mechanisms and mechanisms for
allosteric and covalent protein modifications.

803. Protein Structure and Function
Fall. 2(2-0) P: BCH 462, CEM 383
Protein structure and relationship of function to
structure. Applications of kinetic methods to
elucidation of enzyme mechanisms and regula-
tion.

**804. Biochemical Mechanisms and
Structure**
Spring. 3(3-0) P: (BCH 462 or concurrently and
CEM 383 or concurrently)
Structures, methods of structural analysis, syn-
thesis, 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 *Microbiol-
ogy and Physiology*. P: BCH 401 or BCH 461.
Molecular basis of structure and function. Cell
properties: reproduction, dynamic organization,
integration, programmed and integrative infor-
mation transfer. Original investigations in all five
kingdoms.

**829. Methods of Macromolecular
Analysis and Synthesis**
Fall. 2(2-0) P: (BCH 462 or concurrently)
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) P: BCH 401 or BCH
462.
Mammalian physiological biochemistry. Meta-
bolic interpretation of normal and altered physio-
logical 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 enroll-
ments for this course. R: Approval of department.
Laboratory or library research on special prob-
lems in biochemistry.

856. Plant Molecular Biology
Spring. 3(3-0) Interdepartmental with *Botany and
Plant Pathology*. Administered by *Botany and
Plant Pathology*. P: ZOL 341.
Recent advances in genetics and molecular biol-
ogy of higher plants.

864. Plant Biochemistry
Spring. 3(3-0) Interdepartmental with *Botany and
Plant Pathology*. P: BCH 401 or BCH 462.
Biochemistry unique to photosynthetic organ-
isms. Photosynthetic and respiratory electron
transport, nitrogen fixation, carbon dioxide fixa-
tion, 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 enroll-
ments for this course. R: Open only to graduate
students in Biochemistry.
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 24 credits in all enroll-
ments for this course. R: Open only to master's
students in Biochemistry.

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 Bio-
chemistry or approval of department.
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.
Contemporary biochemical research topics in
such areas as bioenergetics, bioinstrumentation,
complex carbohydrates, mass spectrometry, bio-
molecular spectroscopy or computer-based model-
ing and analysis of DNA and protein sequences
and structures.

978. Seminar in Biochemistry
Fall, Spring. 1(1-0) A student may earn a maxi-
mum of 8 credits in all enrollments for this course.
R: Open only to graduate students in Biochemis-
try.
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 99 credits in all enroll-
ments for this course. R: Open only to doctoral
students in Biochemistry.

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: CEM 141 or CEM
151. Not open to students with credit in LBS 145.
Cell structure and function; 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; Botany and Plant Pathology;
and Zoology*. P: BS 111 or concurrently
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 interac-
tions, 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: (CEM 141 or concurrently or CEM 151
or concurrently or CEM 181H or concurrently or
LBS 165 or concurrently) R: Honors College stu-
dent 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.

Descriptions—Biological Science of Courses

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

Department of Materials Science and Mechanics College of Engineering

424. Biomaterials and Biocompatibility
Spring of even years. 3(3-0) Interdepartmental with Materials Science and Mechanics. P: (PSL 250 and MSM 250)

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. P: (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.

445. Biomechanical Design

Spring. 3(3-0) Interdepartmental with Materials Science and Mechanics. R: Open only to juniors or seniors in the College of Engineering.

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

SA: BME 491A

491. Special Topics (MTC)

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 such as biochemical design, occupational biomechanics, biological surface science, or low temperature biotechnology.

BIOSYSTEMS ENGINEERING

BE

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

180. Current Issues in Biosystems

Fall, Spring. 2(2-0) P: MTH 110 or MTH 116. R: Open only to freshmen or sophomores.

The relationship of biosystems engineering to current problems in food production and processing. Environment, natural resources, harvesting, handling, safety, and water quality.

230. Principles of Biosystems Engineering

Fall. 3(3-0) P: MTH 132. R: Open only to sophomores or juniors in College of Agriculture and Natural Resources, College of Engineering, or College of Natural Science.

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) R: Open only to students in College of Agriculture and Natural Resources or College of Engineering.

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: FSC 211, MTH 124, PHY 231. R: Not open to freshmen or sophomores.

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

SA: FE 329

336. Machinery Systems for Food Production

Fall. 3(3-0) P: MTH 235.

Processes performed by agricultural production machines. Power systems, tillage mechanics, traction, metering, distribution, conveying, fluidization, mixing, separation, and atomization. Machinery management.

SA: AE 336

337. Machinery Systems for Food Processing

Spring. 3(3-0) P: MTH 235.

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

SA: AE 338, FE 338

350. Heat Transfer in Biosystems

Spring. 2(2-0) P: MTH 235; CSE 101 or CSE 131. Not open to students with credit in CHE 311 or ME 410.

Steady state and transient heat conduction. Radiation and convection heat transfer. Heat exchangers. Application problems in biosystems engineering.

351. Environmental Thermodynamics

Spring. 3(3-0) P: MTH 235. Not open to students with credit in CHE 321 or ME 201.

First and Second Laws of Thermodynamics with applications in food, biosystems, and environmental engineering. Refrigeration cycles. Entropy. Thermodynamic aspects of fluid flow. Psychrometrics.

402. Agricultural Climatology

Fall of even years. 3(3-0) Interdepartmental with Geography. Administered by Geography. P: MTH 116. R: Not open to freshmen and sophomores.

Relationships between climate and agriculture in resource assessment, water budget analysis, meteorological hazards, pests, crop-yield modeling, and impacts of global climate change.

SA: AE 402

403. Microclimate and Its Measurement

Fall of odd years. 4(3-3) Interdepartmental with Geography. P: MTH 116 R: Not open to freshmen or sophomores.

The climate near the Earth's surface. Energy balance, thermal radiation exchange, heat fluxes, temperature sensors, wind speed and direction, humidity and evapotranspiration and their measurement.

419. Applications of Geographic Information Systems to Natural Resources Management

Spring. 4(2-4) Interdepartmental with Fisheries and Wildlife; Forestry; Geography; Park, Recreation and Tourism Resources; and Resource Development. Administered by Fisheries and Wildlife. P: (GEO 221)

The application of geographic information systems, remote sensing, and global positioning systems to integrated planning and management for fish, wildlife, and related resources.

430. Power and Control Hydraulics

Spring. 3(2-2) P: CE 321 or CHE 311 or ME 332. R: Open only to majors in College of Engineering.

Hydraulic fluid properties. Pump and motor performance parameters. Control valves and hydraulic circuitry components. Analysis and design of hydraulic systems.

SA: AE 430

431. Resource Optimization

Spring. 3(2-2) P: BE 230, MTH 235 Not open to students with credit in BE 831.

Optimal solutions to problems with multiple and conflicting objectives and constraints. Applications to natural and manufactured biological systems.

438. Design of Machinery Structures

Fall. 3(3-0) P: MSM 211. R: Open only to majors in College of Engineering. Not open to students with credit in ME 471.

Design of structural components and systems in machines. Tension, compression, torsion, bending and combined loadings. Joint connections.

SA: AE 438

443. Restoration Ecology

Spring. 3(2-2) Interdepartmental with Fisheries and Wildlife; Zoology. Administered by Fisheries and Wildlife. P: (CSS 210 or BE 230) and (FOR 404 or FW 364 or ZOL 355)

Principles of ecological restoration of disturbed or damaged ecosystems. Design, implementation, and presentation of restoration plans. Field trips required.