

811. Nucleic Acid Structure and Function

Fall. 4(4-0) One year of organic chemistry, one year of physical chemistry, and one year of basic biochemistry or BCH 453; or approval of department. A course in fundamental genetics is strongly recommended. Limited to graduate students in biochemistry or other students needing a similar professional preparation.

Organization and expression of procaryotic and eucaryotic genes, including gene structure, regulation of gene expression, replication, and recombination. Molecular cloning, DNA sequencing, and gene transfer techniques.

812. Protein Structure and Function

Winter. 4(4-0) One year of organic chemistry, one year of physical chemistry, and one year of basic biochemistry; or approval of department. Limited to graduate students in biochemistry or other students needing a similar professional preparation.

Protein structure and function relationships, macromolecule-ligand interactions, enzyme kinetics and principles of methods used in enzymology.

813. Metabolism and Its Regulation

Spring. 4(4-0) One year of organic chemistry, one year of physical chemistry, and one year of basic biochemistry; or approval of department. Limited to graduate students in biochemistry or other students needing a similar professional preparation.

Molecular basis of metabolic regulation, compartmentation and interrelationships of metabolic cycles involving carbohydrates, proteins and lipids.

821. Biochemical Mechanisms and Structure

Fall. 4(4-0) One year of organic chemistry; introductory biochemistry; and physical chemistry or concurrently.

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. 4(4-0) BCH 451 or BCH 401 or approval of instructor. Interdepartmental with the departments of Microbiology and Public Health, and Physiology.

Molecular basis of structure and function of cells. Fundamental properties of cells: reproduction, dynamic organization, integration, programmed and interactive information transfer considered through original investigations in all five kingdoms.

831. Physiological Biochemistry I

Winter. 3(3-0) BCH 401.

Physiological biochemistry, with emphasis on metabolic interpretation of normal and altered physiological states of the human organism and appropriate animal models.

832. Physiological Biochemistry II

Spring. 3(3-0) BCH 831.

Continuation of BCH 831.

855. Special Problems

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.

Consideration of current problems.

856. Plant Genetics and Molecular Biology

Spring. 3(3-0) Approval of department and a course in introductory genetics. Interdepartmental with Genetics, and the Department of Botany and Plant Pathology. Administered by the Department of Botany and Plant Pathology. Recent advances in genetics and molecular biology of higher plants.

864. Plant Biochemistry

Spring. 4(4-0) BCH 401, BOT 301 or approval of department. Interdepartmental with the Department of Botany and Plant Pathology.

Metabolism of nitrogen-compounds, carbohydrates, and lipids unique to plants' cell organelles; photosynthesis; photorespiration; dark respiration; cell walls; lectins; nitrogen cycle including nitrogen fixation; sulfur cycle.

888. Laboratory Rotation

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 18 credits. Graduate student majors; approval of department.

Participation in research laboratories to learn experimental techniques and research approaches, broaden research experience, and assess research interests prior to selecting a thesis adviser.

899. Master's Thesis Research

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

960. Selected Topics in Biochemistry

Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 10 credits if different topics are taken. Approval of department.

Topics will be selected from the areas of biochemical genetics, biochemistry of development, biochemical evolution, complex proteins, lipid metabolism, immunochemistry, hormones, control mechanisms and structure of biological macromolecules.

961. Selected Topics in Biochemistry

Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 10 credits if different topics are taken. Approval of department.

Topics will be selected from the areas of bioenergetics, bioinstrumentation, complex carbohydrates, mechanisms of enzyme action, natural products, carbohydrate metabolism, mass spectrometry and biochemistry of isoprenoid compounds.

978. Seminar in Biochemistry

Fall, Winter, Spring. 1(1-0). May reenroll for a maximum of 8 credits. Approval of department.

999. Doctoral Dissertation Research

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

202. Introductory Biology for Non-Science Majors

Fall, Winter, Spring, Summer. 4(3-3) 12 credits in general education natural science courses.

Concepts, procedures, and perspectives appropriate to developing a basic literacy in biology with emphasis on fundamental biological principles and their relation to world society. Appropriate preparation for pre-service elementary teachers.

210. General Biology

Fall, Spring. 4(4-2) Not open to students with credit in LBS 141.

Principles of biological organization: scientific method, biochemistry, cell biology, and evolution.

211. General Biology

Fall, Winter, Summer. 4(4-2) CEM 140 or high school chemistry. Not open to students with credit in LBS 242.

Principles of biological regulation and integration: genetics, development, and selected physiological topics.

212. General Biology

Winter, Spring, Summer. 4(4-2) Not open to students with credit in LBS 140.

Principles of biological diversity: taxonomy and systematics, comparative physiology, and ecology.

400. Biological Science for Teachers

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Teacher certification with science major or minor.

A course for in-service teachers, topics will be selected from actual classroom problems of the participants. Stress will be placed on field, laboratory and inquiry teaching.

405. Topics in Biological Science

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 8 credits if different topic is taken. Approval of department.

Presentation of single topics from the biological sciences by senior faculty and guest lecturers. Topics are selected to facilitate development of strong biological science programs in schools.

418. Field Biology for Teachers

Fall, Winter, Spring, Summer. 4 credits. Biology course or approval of department.

Field investigation and interpretation of prairie, dune, forest and wetland communities. An ecosystem approach to ecological concepts. Natural history and identification of key species. Field trips required.

460. Ornithology for Teachers

Summer. 3 credits. A course in biology or approval of department. Not open to Zoology majors. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Department of Zoology.

Distribution, breeding cycles, migration, food and feeding habits, voice and other important areas of avian biology. Emphasis on field identification and natural history.

499. Research

Fall, Winter, Spring. 2 to 4 credits. May reenroll for a maximum of 12 credits. Approval of director of biological science program and student's adviser.

Undergraduates are invited on an individual basis into research laboratories of faculty in biological departments of the college. After three terms of research, a presentation in thesis form is produced and defended.

BIOLOGICAL SCIENCE B S

College of Natural Science

The content of courses 400 and 405, as well as the research and problems courses 499, 800 and 899, may vary from term to term. Brochures giving detailed information about individual courses are available in the Office of the Assistant Dean for Lifelong Education in the College of Natural Science. These courses are primarily designed for in-service teachers and interested adults and are offered in off-campus locations.

Descriptions — Biological Science

of Courses

800. Problems in Biological Science
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 18 credits. B.S. degree in biological science.

805. Outdoor Environmental Studies
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 9 credits if different topics are taken. B S 418 or ZOL 460 or approval of department.

Emphasis on environmental understanding. Development of educational materials through team research and testing. Trials of materials with elementary, middle, secondary school or college students.

899. Master's Thesis Research
Fall, Winter, Spring. Variable credit. Approval of department.

BIOMECHANICS

BIM

College of Osteopathic Medicine

500. Basic Concepts in Biomechanics
Winter. 2(2-0) Admission to a college of medicine or approval of department. Interdepartmental with the College of Osteopathic Medicine.

Basic concepts of biomechanics and their relationship to functional anatomy and osteopathic manipulative therapy.

590. Special Problems in Biomechanics
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 32 credits. Approval of department.

Each student will work under direction of a faculty member on an experimental, theoretical or applied problem.

601. Osteopathic Manipulative Medicine Clerkship
Fall, Winter, Spring, Summer. 6 credits. May reenroll for a maximum of 12 credits. Grade P in all courses offered in terms 1 through 8.

Advanced training in the diagnosis of musculoskeletal dysfunctions and application of osteopathic manipulative techniques in patient care.

620. Directed Studies
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 24 credits. Approval of department.

Individual or group work on special problems related to biomechanics, neuromusculoskeletal system primarily.

800. Special Topics
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 9 credits. Approval of department.
Independent study in topics of biomechanics.

805. Biomechanical Analysis
Fall. 3(3-0) Approval of department.
Methods for analysis of biokinematic and biokinetic data.

810. Biokinematics
Winter. 3(3-0) BIM 805 or approval of department.

Size, position and mobility of the human body as a mechanical linkage system. Detailed study of body joints and kinematic models.

811. Biokinetics
Spring. 3(3-0) BIM 810 or approval of department.

Application of Newtonian mechanics to problems of force transmission and related motions in the muscular-skeletal system.

812. Theory of Tissue Mechanics
Fall. 3(3-0) Approval of department.

Introduces the concepts of stress and strain in tissue and the dependency of mechanical parameters on biological factors.

850. Research Seminar
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Approval of department.

Discussion of current research topics in biomechanics with strong clinical application.

871. Research Methods in Biomechanics I
Fall. 2(1-3) BIM 812 or concurrently or approval of department.

Measurement of responses of biological tissues to internal and external demands. Techniques include visual, palpatory, electrophysiological, and mechanical assessment methods.

872. Research Methods in Biomechanics II
Winter. 2(1-3) BIM 810 or concurrently or approval of department.

Measurement of body geometry and mass distribution. Measurements include anthropometry, goniometry, volume and inertial properties of the human body.

873. Research Methods in Biomechanics III
Spring. 2(1-3) BIM 811 or concurrently or approval of department.

Measurements of dynamics of human motion. Measurements include force plate and photogrammetric kinematic assessment methods.

890. Independent Study
Fall, Winter, Spring, Summer. 1 to 8 credits. May reenroll for a maximum of 32 credits. Approval of department.

Individual or group work related to biomechanics and/or neuromusculoskeletal system.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 12 credits. Approval of department.
Conduct research for master's thesis.

BIOMEDICAL ENGINEERING

BME

College of Engineering

410. Electronic Instrumentation in Biology and Medicine
Fall. 4(4-0) MTH 112, PHY 238 or approval of instructor.

Electronic components and circuits. Physiological measurements. Transduction of physiological events to electrical signals. Detection of physiological events by electrical impedance measurements. Ultrasonic techniques in biomedical systems. Biomedical applications of lasers.

411. Electric Theory of Nerves
Winter of odd-numbered years. 4(4-0) MTH 310; PHY 288.

Neurophysiology: basic organization, structure, function and electrical activity of neurons. Sub-threshold membrane phenomena: Nernst-Planck equations, constant field membrane model, electrotonus. Membrane action potentials: voltage clamp experiments, Hodgkin-Huxley equations, computer simulation.

414. Clinical Instrumentation
Winter of even-numbered years. 3(3-0) BME 410.

Ultrasound theory and applications in medicine. Photoelectric, piezoelectric and temperature transducers. Detection of physiological events by impedance measurements. Radiology and x-ray techniques. Isotopes and nuclear medicine. Lasers in medicine. Field trips required.

424. Materials in Biomedical Engineering
Winter. 3(3-0) PSL 240 or PSL 431 or approval of department.

Basics of materials science. Biocompatibility of metals, polymers and ceramics. Internal and external prosthetic materials.

431. Biological Transport Mechanisms
Spring. 3(3-0) MTH 215.

Mechanisms which govern transport or momentum, heat and mass. Application to mathematical description of transport processes in biological systems and to solution of biomedical problems.

481. Tissue Biomechanics
Fall. 3(3-0) ANT 316 or approval of department.

Fundamentals of continuum mechanics in relation to morphological classification of tissue. Mechanical properties of connective and muscle tissue.

499. Independent Study
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 9 credits. Approval of instructor.

Individual reading and research under the supervision of a member of the Biomedical Engineering Committee.

BOTANY AND

PLANT PATHOLOGY

BOT

College of Agriculture and Natural Resources College of Natural Science

201. Plants, People and the Environment (N)
Fall, Spring. 3(3-0)

Relevance of plants to modern society. Basic botanical concepts and socially significant groups of plants. Natural resource exploitation. Plants as they relate to human population growth, food production, and energy resource depletion.

205. Plant Biology
Fall. 3(3-0) High school chemistry and high school algebra.

An introduction to plant science for students seeking a general knowledge of the principles of plant biology as well as for prospective plant science majors.