

**410. Terrestrial Ecology**  
*Summer. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the departments of Botany and Plant Pathology and Zoology.*

Factors determining distribution and abundance. Interrelationship of plants, animals, and environment. Extensive field investigations of several types of terrestrial communities in light of current theory.

**420. Seminar in Recent Advances in Biological Science**  
*Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits if different topic is taken. Approval of department.*

A series of lectures by senior faculty of topics on the history, development, the most recent advances and the possible future and limits of the Biological Sciences.

**440. Man and Environment Workshop for Teachers**  
*Summer. 3 credits. Approval of department. Given at W. K. Kellogg Biological Station.*

Discussions and practical work sessions concerning the development of ideas and activities for environmental studies in and outside the classroom. Designed for intermediate and secondary inservice teachers.

**450. Outdoor Environmental Studies**  
*Summer. 3 credits. May reenroll for a maximum of 9 credits when new topics are given. Teaching experience or approval of department. B S 451 must be taken same summer. Given at W. K. Kellogg Biological Station.*

Emphasis on environmental understanding. Planning and developing interdisciplinary program for elementary and intermediate children.

**451. Outdoor Environmental Studies: Laboratory**  
*Summer. 2 to 5 credits. May reenroll for a maximum of 15 credits when new topics are given. Teaching experience, B S 450. Given at W. K. Kellogg Biological Station.*

Testing instructional materials and strategies developed in B S 450 with elementary and middle school children in an outdoor environmental education program.

**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.

**800. Problems in Biological Science**  
*Fall, Winter, Spring. Variable credit. B.S. degree in biological Science.*

**999. Doctoral Dissertation Research**  
*Fall, Winter, Spring. Variable credit. M.S. degree in biological science or equivalent. Research in some phase of biological science, data to form the basis for the thesis required for the doctoral degree in biological science.*

## **BIOMECHANICS BIM**

### **College of Osteopathic Medicine**

**590. Special Problems in Biomechanics**  
*Fall, Winter, Spring, Summer. 1 to 8 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.

**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.

**880. Athletic Medical Systems**  
*(581.) Fall, Spring. 3(3-0) Bachelor's degree and involvement with secondary school athletics.*

Health care systems for athletes in growth years. Physiological and psychological concepts applied to human development, training and care. Injury preventions, emergency medicine and rehabilitation stressed.

**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.

## **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.

## **BIOPHYSICS BPY**

### **College of Human Medicine College of Natural Science College of Osteopathic Medicine**

**400H. Honors Work in Biophysics**  
*Fall, Winter, Spring, Summer. 3 to 6 credits. May reenroll for a maximum of 6 credits. Approval of department.*

Independent study and investigation under the direction of a faculty member.

**402. Introductory Biophysics: Molecular and Thermal**  
*Spring. 3(3-0) One year organic chemistry or biochemistry; 1 year biology, PHY 239, PHY 259, MTH 113, or approval of department.*

Salient features of biophysics; principles and methods. Structure, function, and organization of biologic molecules; molecular biophysics; thermal biophysics; bioenergetics and photobiology.

**403. Introductory Biophysics: Membranes and Electrical**  
*Fall. 3(3-0) One year organic chemistry or biochemistry, PHY 239, PHY 259; MTH 113 or approval of department.*

Salient features of biophysics, principles and methods; radiation biophysics; membrane biophysics; bioelectric phenomena; neurobiology; and psychophysics.

**IDC. Biological Membranes**  
*For course description, see Interdisciplinary Courses.*

**480. Special Topics in Biophysics**  
*Fall, Winter, Spring, Summer. 2 to 4 credits. Approval of department; BPY 402 recommended.*

Special topics within five areas of biophysics: structure-function correlation, neurobiophysics, membrane biophysics, molecular biophysics, or theoretical biophysics.

**Descriptions – Biophysics  
of  
Courses**

**499. Independent Study**  
Fall, Winter, Spring, Summer. 1 to 5 credits. May reenroll for a maximum of 15 credits. Approval of department.  
Undergraduate research under one of our faculty.

**804A. Neuroscience Laboratory I**  
Winter. 4(2-4) Approval of instructor. Interdepartmental with the departments of Physiology, Psychology and Zoology and administered by the Department of Psychology.  
Development of skills in the methods, techniques and instrumentation necessary for research in a variety of areas concerned with neuroscience.

**804B. Neuroscience Laboratory II**  
Spring. 4(2-4) PSY 804A. Interdepartmental with the departments of Physiology, Psychology and Zoology and administered by the Department of Psychology.  
Continuation of BPY 804A.

**821. Molecular Biophysics**  
Winter of even-numbered years. 4(4-0) Approval of department  
Theoretical/experimental methods for determination of electronic structure, excited states and spectroscopy of biological systems. Biological energy transfer. Quantum processes in photosynthesis. Exciton effects in photoreceptors and pigments. Conformational changes.

**822. Charge Transport and Solid State Processes**  
Spring of even-numbered years. 4(4-0) Approval of department.  
Fundamental electrical properties, dielectric properties and photoconductivity effects and their relevance to the biological functioning of these molecules.

**824. Membrane Biophysics**  
Winter of odd-numbered years. 4(3-2) Approval of department.  
Membrane biophysics will cover interfacial phenomena in biology and chemistry; structure and function, theoretical and experimental models for biological membranes; membrane biochemistry. Labs will emphasize biomolecular lipid membrane (BLM) techniques.

**826. Cellular Biophysics**  
Spring of odd-numbered years. 4(4-0) Approval of department.  
Basic cell structure and function at the molecular level. Emphasis will be on genetic and molecular controls of cellular systems.

**827. Basic Neurobiology**  
(825.) Fall. 4(4-0) Approval of department. Interdepartmental with the Department of Zoology.  
Neural structure and function at cellular and intercellular levels. Membrane and synaptic potentials, receptor transduction, and intracellular transport with an introduction to comparative and evolutionary aspects.

**834. Membranes: Natural and Artificial**  
Spring of odd-numbered years. 2 to 3 credits. May reenroll for a maximum of 3 credits. Approval of department.  
Emphasis is placed on the biophysical and biochemical characterization of biological membranes and their theoretical and experimental models. Presentation and discussion by students and staff of recent advances in membrane research.

**865. Advanced Neurobiology**  
Spring. 4(4-0) BPY 827. Interdepartmental with the departments of Physiology, Psychology and Zoology and administered by the Department of Anatomy.  
Basic organization structure and function of neural networks comprising sensory, motor, and autonomic systems including examples from invertebrates and vertebrates. Attendance at neuroscience seminar is required.

**880. Special Topics in Biophysics**  
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 15 credits.  
Special topics within the five subdivisions of biophysics; structure, organization and function of biological phenomena, sensory perception, and psychophysics and biomechanics.

**885. Vertebrate Neural Systems I**  
Fall of odd-numbered years. 5(3-4) Approval of department: ANT 815 and BPY 827 recommended. Interdepartmental with the departments of Zoology, Physiology and Psychology and administered by the Department of Psychology  
Structure and function of major component systems of vertebrate brains, their evolution, ontogeny and comparative analysis in mammals, birds, reptiles, amphibians and fish. Interrelation of behavioral, anatomical and physiological studies.

**886. Vertebrate Neural Systems II**  
Winter of even-numbered years. 5(3-4) PSY 885. Interdepartmental with the departments of Psychology, Physiology and Zoology and administered by the Department of Zoology.  
Continuation of BPY 885. Major component systems of vertebrate brains, their evolution, ontogeny, and comparative analysis in mammals, birds, reptiles, amphibians and fish. Interrelation of behavioral, anatomical, and physiological studies.

**890. Readings in Biophysics**  
Fall, Winter, Spring, Summer. 3 to 6 credits. Approval of department.  
Reading course in special topics adapted to the individual preparation and needs of the student.

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

**990. Biophysics Seminar**  
Fall, Winter, Spring, Summer. 1 credit. May reenroll for a maximum of 3 credits. Approval of department.

**999. Doctoral Dissertation Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**201. Plants, Man and the Environment (N)**  
Winter, Spring. 3(3-0)  
Relevance of plants to modern society on issues such as food production, environmental quality, drug use and abuse, and the exploitation of plants in natural areas for commercial purposes.

**205. Plant Biology**  
Winter. 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.

**301. Introductory Plant Physiology**  
Fall, Spring. 4(2-4) CEM 131 or CEM 141; CEM 161; BOT 205 or B S 210 or LBC 141. Introductory organic chemistry recommended.  
General principles of plant physiology relating plant structure to function. Topics include cell physiology, water relations, effects of light and temperature, respiration, photosynthesis, mineral nutrition, and hormone action.

**302. Introductory Morphology**  
Fall, Winter. 4(2-4) B S 212 or approval of department.  
Structures and life cycles of representative plant groups showing progressive evolutionary developments.

**318. Introductory Plant Systematics**  
Spring. 4(2-3) BOT 302 or B S 212 or approval of department.  
Plant diversity with emphasis on identification, classification, nomenclature, and evolutionary relationships of vascular plants.

**335. Fossil Plants, Their History and Paleoecology**  
Spring. 3(3-0) One course in geology or botany or biology or approval of department. Interdepartmental with and administered by the Department of Geology  
History of plants through geologic time; their form and evolution; how and where found, identified and reconstructed; their use in determining ancient geographic patterns, paleoenvironments, paleoclimates and community structure. Field trip.

**336. Economic Plants**  
Spring. 3(3-0)  
Histories, characteristics, and origins of plants used in industrial processes, drug manufacture, and agriculture. Nontechnical to broaden student's cultural interest in plants.

**400. Aquatic Plants**  
Fall. 3(2-3) BOT 318 and/or BOT 302.  
Aquatic plants, their classification, ecology and economic importance. Relationships to problems in fisheries, in wildlife management, and to role in limnology. Experience for student in plant ecology, aquatic biology, and water sanitation.

**400H. Honors Work**  
Fall, Winter, Spring. 3(0-6) Approval of department; Seniors.

**401. Special Problems**  
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 16 credits. BOT 302, Seniors, approval of department.  
Students with special ability may carry on laboratory research or study of published literature on a selected topic.

**BOTANY AND  
PLANT PATHOLOGY BOT**

**College of Agriculture and Natural Resources  
College of Natural Science  
IDC. Resource Ecology and Man**  
For course description, see Interdisciplinary Courses.