

## BIOLOGICAL SCIENCE

111. **Cells and Molecules**

Fall, Spring. 4(3-3)  
P: CEM 141 or CEM 151.

Cell structure and function; macromolecular synthesis; energy metabolism; molecular aspects of development; principles of genetics.

## BIOMECHANICS BIM

590\*. **Special Problems in Biomechanics**

Fall, Spring, Summer. 1(01-00) May reenroll for a maximum of 22 credits.  
R: Not open to freshmen and sophomores.

Approval of department.

Each student works under faculty direction on an experimental, theoretical, or applied problem.

QP: DEPT.APP QA: BIM 590

601\*. **Osteopathic Manipulative Medicine Clerkship**

Fall, Spring, Summer. 4 to 12 credits in increments of 2 credits.

P: Units I and II. R: Open only to graduate-professional students in the College of Osteopathic Medicine.

Advanced training in the diagnosis of musculoskeletal dysfunction and application of osteopathic manipulative techniques.

QA: BIM 601

620\*. **Directed Studies**

Fall, Spring, Summer. 2 to 10 credits in increments of 2 credits. May reenroll for a maximum of 10 credits.

R: Open only to students in the College of Osteopathic Medicine. Approval of department. Individual or group work on special problems related primarily to the biomechanics of the musculoskeletal system.

QA: BIM 620

800\*. **Special Topics**

Fall, Spring, Summer. 1(01-00) May reenroll for a maximum of 3 credits.

R: Open only to graduate students. Approval of department.

Directed study in topics of biomechanics.

QP: DEPT.APP QA: BIM 800

810\*. **Tissue Biomechanics**

Fall. 3(02-02)

R: Open only to Biomechanics graduate

students.

Integrate concepts of tissue mechanics and microstructure, develop experimental methods to study connective tissue mechanics using engineering principles.

QA: BIM 812 BIM 871

811\*. **Biomechanical Analysis**

Fall. 2(02-00)

R: Open only to Biomechanics graduate

students.

Methods for analysis of biokinematic and biokinetic data.

QA: BIM 805

812\*. **Experimental and Analytical**

**Biodynamics**

Spring. 3(02-02)

P: BIM 811.

Experimental and analytical methods to measure and interpret biodynamics of musculoskeletal system.

QP: BIM 805 QA: BIM 811 BIM 873

813\*. **Biokinematics**

Spring. 3(02-02)

P: BIM 811.

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

QP: BIM 805 QA: BIM 810 BIM 872

840\*. **Therapy of Connective Tissue Mechanics**

Fall. 3(03-00)

P: BIM 810.

Mechanical properties, chemical content, and anatomical structure in connective tissues.

QP: BIM 812 QA: BIM 812

841\*. **Theory of Neuromuscular Mechanics**

Fall. 3(03-00)

R: Open only to Biomechanics graduate

students.

Neurological control of joint mechanics.

QA: BIM 810 BIM 805

842\*. **Theory of Joint Mechanics**

Fall. 3(03-00)

P: BIM 813.

Motion and force transmission, and their relationship

to anatomical structure and tissue function in joints.

QP: BIM 810 QA: BIM 810 BIM 805

860\*. **Occupational Biomechanics**

Fall. 3(03-00)

P: BIM 813.

Applications of biomechanics in ergonomics with emphasis on the whole body.

QP: BIM 810 QA: BIM 810

861\*. **Clinical Biomechanics**

Fall. 3(03-00)

R: Open only to Biomechanics graduate

students.

Application of biomechanics to medicine.

890\*. **Independent Study**

Fall, Spring, Summer. 1 to 3 credits.

May reenroll for a maximum of 22

credits.

R: Open only to graduate students in

Biomechanics. Approval of department.

Individual or group work related to biomechanics

and/or neuromuscular system.

QP: P

895\*. **Experimental Research Methods**

Fall. 1(00-02)

R: Open only to Biomechanics graduate

students.

Methods of experimental research in biomechanics.

QA: BIM 871 BIM 872 BIM 873

899\*. **Master's Thesis Research**

Fall, Spring, Summer. 1 to 25 credits.

May reenroll for a maximum of 25

credits.

R: Open only to Biomechanics graduate

students. Approval of department.

QP: DEPT.APP QA: BIM 899

## BIOMEDICAL ENGINEERING BME

311\*. **Introduction to Biomedical Engineering**

Fall. 3(3-0) Interdepartmental with

the Department(s) of Metallurgy,

Mechanics, and Materials Science,

Chemical Engineering, Mechanical

Engineering, Electrical Engineering,

Metallurgy, Mechanics, and Materials

Science.

P: MTH 235, PHY 184, BS 210

Physical and mechanical properties of soft and hard

tissues. Biomaterials. Biocompatibility. Biochemical

processes, biological transport and thermodynamics.

Bioelectronics and instrumentation.

QP: MTH 310 PHY 289BS 210

405\*. **Biomedical Electronics**

Fall of even-numbered years. 3(3-0)

Interdepartmental with the

Department(s) of Electrical

Engineering.

P: MTH 132, PHY 184.

Electronic components and circuits. Physiological measurements, transduction of physiological events to electrical signals. Ultrasonic techniques, biomedical applications of lasers, x-ray and magnetic resonance imaging.

QP: MTH 112 PHY 238 QA: BME 410

424\*. **Biomaterials and Biocompatibility**

Spring of even-numbered years. 3(3-0)

Interdepartmental with the

Department(s) of Metallurgy,

Mechanics, and Materials Science,

Metallurgy, Mechanics, and Materials

Science.

P: BME 311, PSL 245

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

QP: PSL 240 ORPSL 430 QA: BME 424

431\*. **Biological Transport Mechanisms**

Fall of odd-numbered years. 3(3-0)

Interdepartmental with the

Department(s) of Chemical

Engineering, Mechanical Engineering.

P: BME 311 and MTH 235

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

QP: MTH 215 QA: BME 431

441\*. **Tissue Mechanics**

Spring of odd-numbered years. 3(3-0)

Interdepartmental with the

Department(s) of Metallurgy,

Mechanics, and Materials Science,

Metallurgy, Mechanics, and Materials

Science.

P: BME 311.

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

QP: ANT 316 QA: BME 481

491\*. **Special Topics (MTC)**

Fall, Spring. 3 to 12 credits. May

reenroll for a maximum of 12 credits.

P: BME 311.

Special topics in biomedical engineering or bioengineering such as biochemical design, occupational biomechanics, biological surface science, or low temperature biotechnology.

QP: APPROVAL QA: BME 499

491A\*. **Biomechanical Design**

. 3(3-0)

P: BME 311, MMM 211, MMM 306.

Special topics in biomedical engineering or bioengineering of current interest and importance.

QP: APPROVAL QA: BME 499

491B\*. **Occupational Biomechanics**

. 3(3-0)

P: BME 311.

Special topics in biomedical engineering or bioengineering of current interest and importance.

QP: APPROVAL QA: BME 499

491C\*. **Biological Surface Science**

. 3(3-0)

P: BME 311.

Special topics in biomedical engineering or bioengineering of current interest and importance.

QP: APPROVAL QA: BME 499

**BIOMEDICAL ENGINEERING**

**491D\***. **Low Temperature Biotechnology**  
 3(3-0)  
 P: BME 311.

Special topics in biomedical engineering or bioengineering of current interest and importance.  
 QP: APPROVAL QA: BME 499

**BOTANY AND PLANT PATHOLOGY/NATURAL SCIENCE BOT**

**105. Plant Biology**  
 Fall, Spring. 3(3-0)

Plant structure, function, development, genetics, diversity and ecology.  
 QA: BOT 205

**106. Plant Biology Laboratory**  
 Fall, Spring. 1(0-3)  
 P: BOT 105 or concurrently.

Cell structure, anatomy, physiology, growth and development, and diseases of plants.  
 QA: BOT 206

**202. The Form and Evolution of Plants**  
 Spring. 4(2-4)  
 P: BS 110 or BOT 105.

Divergent and convergent evolution throughout the plant kingdom. Basic principles underlying the structure, function, and reproduction of plants.  
 QP: BS 212 ORBOT 205 QA: BOT 302

**218. Plants of Michigan**  
 Fall. 3(2-3)  
 P: BS 110 or BOT 105.

Plant taxa of Michigan and the Great Lakes region and the major habitats in which they occur. Principles and rationale of classification. Relationships between life histories, morphology and environment.  
 QP: BOT 205 ORBS 212

**301. Introductory Plant Physiology**  
 Fall, Spring. 3(2-3)  
 P: CEM 141 or CEM 151; CEM 161; BOT 105 or BS 111 or LBS 141; organic chemistry

General principles of plant physiology relating plant structure to function. Cell physiology, water relations, effects of light and temperature, respiration, photosynthesis, mineral nutrition, and hormone action.  
 QP: CEM 141 ORCEM 151CEM 161BOT 205 QA: 301

**335. Plants Through Time**  
 Spring of odd-numbered years. 3(3-0)  
 Interdepartmental with the Department(s) of Geological Sciences.  
 P: BS 110 or BOT 105 or GLG 201. R: Juniors and above.

Evolutionary history of plants, the development of ecosystems, and the use of plant fossils in the reconstruction of ancient environments and climate.  
 QP: BOT 205 ORBS 212ORLBS 140 QA: GLG 335 BOT 335

**336. Useful Plants**  
 Spring. 3(3-0)  
 P: CEM 142 or CEM 143 or CEM 152; BOT 105 or BS 110 and BS 111.

Ways in which plants are used for myriad purposes from food and construction materials to medicines and perfumes. The potential for expanding the uses of plants through biotechnology will be explored.  
 QP: BOT 205 ORBS 212 QA: BOT 336

**402. Biology of Fungi**  
 Fall. 3(2-3)  
 P: BS 110, BS 111 or BOT 105 or LBS 140 or MPH 302.

Major groups of fungi: characteristics, habitats and diversity. Significance of fungi in nature and their economic importance.  
 QP: BOT 205 ORLBS 140ORBS 212 QA: BOT 402 BOT 320

**405. Introductory Plant Pathology**  
 Fall. 4(2-4)  
 P: BS 110, BS 111 or BOT 105 or LBS 140. R: Not open to students with credit in BOT 407.

Important plant diseases and the organisms that cause them. Principles of disease management including application of chemicals, plant breeding, biological control, and genetic engineering.  
 QP: BOT 302 ORBS 212ORLBS 140 QA: 405

**406\*. Medical Mycology**  
 Spring. 3(2-3) Interdepartmental with the Department(s) of Medical Technology, Microbiology and Public Health.  
 P: BOT 402; MPH 302

Characteristics and laboratory identification of fungal diseases in humans and other animals, emphasizing laboratory techniques and morphological characteristics of the causative fungi.  
 QP: BOT 320 MPH 302 QA: BOT 406

**407\*. Diseases and Insects of Forest and Shade Trees**  
 Spring. 4(3-3) Interdisciplinary with the Department(s) of Entomology.  
 P: BOT 301 and BOT 318 or FOR 204 or HRT 210 and 211 R: Students not receive credits in both BOT 407 & BOT 407

Diseases, insects, and environmental problems which affect trees in forests, parks, suburbs, and nurseries, and methods of control.  
 QP: BOT 301 BOT 302BOT 318FOR 204 QA: BOT 407 ENT 337 FOR 330

**414. Plant Physiology: Metabolism**  
 Fall. 3(3-0)  
 P: CEM 251, BOT 105 or BS 110, BS 111 or LBS 140.

General principles underlying metabolic processes of plants. Photosynthesis, translocation and water relations, nitrogen metabolism, cell wall biosynthesis, and structures associated with those processes.  
 QP: BOT 205 ORBS 210ANDBS 211 QA: BOT 414

**415. Plant Physiology: Growth, Development and the Environment**  
 Spring. 3(3-0)  
 P: CEM 251; BOT 105 or BS 110, BS 111 or LBS 140.

Principles of plant growth and development with emphasis on environmental and hormonal factors that control progression of the plant through its life cycle. Tissue culture and genetic engineering in plants.  
 QP: CEM 241 BOT 205ORBS 210AND QA: BOT 415

**416. Experiments in Plant Physiology and Molecular Biology**  
 Fall. 4(2-5)  
 P: BOT 414 or BOT 415.

Experiments illustrating principles of plant physiology and molecular biology. Advanced techniques such as agrobacterium mediated gene transfer, DNA cloning, enzyme linked immunosassays (ELISA), protein and DNA electrophoresis.  
 QP: BOT 414 BOT 415 QA: BOT 416

**418. Plant Systematics**  
 Spring, Summer. 3(2-3)  
 P: BOT 105 or BS 110, BS 111 or LBS 140.

Classification and evolution of higher plants, with emphasis on identification, characteristics of plant families, and systematic theory and practice.  
 QP: BOT 205 ORLBS 140ORBS 212 QA: BOT 318

**423\*. Aquatic Plant Biology**  
 Fall, Summer of even-numbered years. 4(2-4)  
 P: BS 110, BS 111 or BOT 105, BOT 106.

Identification, ecology and community relations of algae and aquatic vascular plants common to the Great Lakes area. Algae and Aquatic Plants as indicators of environmental change.  
 QP: BOT 205 ANDBOT 206ORBS 210 AND LBS 141 QA: 423 447

**434. Plant Structure and Function**  
 Fall of odd-numbered years. 4(2-4)  
 P: BS 110, BS 111 or BOT 105, BOT 106 or BOT 202 or LBS 140.

Plant anatomy from a structure and function perspective. The physiological, developmental, and ecological significance of cell types, tissue types, and meristems of vegetative and reproductive plant parts.  
 QP: BS 210 BS 211ANDBS 212OR AND LBS 242 QA: BOT 434

**441\*. Plant Ecology**  
 Fall. 3(3-0)  
 P: BS 110 or BOT 105.

Ecology of plants and their communities. Effects of biotic and climatological factors influencing global distribution of plant communities. Community structure and function, microclimatology, ecophysiology, and adaptation.  
 QP: BS 212 ORBOT 205ORLBS 140 QA: BOT 441

**490\*. Directed Studies**  
 Fall, Spring, Summer. 1 to 4 credits.  
 May reenroll for a maximum of 6 credits.  
 R: Approval of department.

Directed study of published literature in an area of botany and plant pathology.  
 QA: BOT 401

**490H\*. Honors Directed Studies**  
 Fall, Spring, Summer. 1 to 4 credits.  
 May reenroll for a maximum of 6 credits.  
 R: Approval of department.

Directed study of published literature in an area of botany and plant pathology.  
 QA: BOT 400H

**496\*. Undergraduate Research**  
 Fall, Spring, Summer. 1 to 4 credits.  
 May reenroll for a maximum of 12 credits.  
 R: Approval of department.

Laboratory and/or field research in an area of botany and plant pathology.

**499\*. Senior Seminar**  
 Spring. 2(2-0) May reenroll for a maximum of 4 credits.  
 P: 3 credits of BOT 498

A capstone experience that focuses on current developments and issues in plant biology. Scientific writing and oral presentation.  
 QA: 499

**800\*. Seminar in Plant Biology**  
 Fall, Spring. 1(1-0) May reenroll for a maximum of 4 credits.  
 R: Open only to graduate students.

Current research and approaches in plant biology.

**801\*. Seminar in Plant Pathology**  
 Fall, Spring. 1(1-0) May reenroll for a maximum of 4 credits.  
 R: Open only to graduate students.

Current research and approaches in plant pathology.  
 QA: BOT 846