

## PHYSIOLOGY PSL

**Department of Physiology**  
**College of Human Medicine**  
**College of Natural Science**  
**College of Osteopathic Medicine**  
**College of Veterinary Medicine**

**101 Current Issues in Physiology**  
 Fall. 2(2-0) Not open to students with credit in PSL 250 or PSL 431 or PSL 432.

Physiological bases of health issues of broad social significance, and new approaches for the treatment of specific disorders.

**250 Introductory Physiology**  
 Fall, Spring. 4(4-0) R: Not open to students in Physiology.

Function, regulation and integration of organs and organ systems of higher animals emphasizing human physiology.

**323 Physiology and Hygiene of the Eye**  
 Fall of odd years. Summer of even years. 3(3-0) R: Not open to Physiology majors.

Basic anatomy, physiology, and hygiene of the visual system: normal and abnormal visual function, methods of correction, and educational implications.

**331 Cell Physiology: Function of Specialized Cells**

Fall. 3(3-0) P:M: (BS 111 or LBS 145)

Functions of differentiated cells, including mechanisms of cell communication, excitable membranes, contraction, motility, transport, secretion, and extra cellular matrix.

**410 Computational Problem Solving in Physiology**

Fall, Spring. 3(3-0) RB: (PSL 432) R: Approval of department.

Quantitative analysis of physiological data: mathematical models, curve fitting, data analysis and interpretation. Problem solving involving exponential and logistic growth. Cerebral blood flow, convective cooling, oxygen consumption, thermoregulation, other applications.

**420 Membrane Biophysics: An Introduction**

Fall, Spring. 2(2-0) RB: One year of college physics or chemistry, and one year of college mathematics.

Biophysical and chemical aspects of biomembranes. Experimental model membrane systems including planar lipid bilayers and liposomes. Biotechnological applications of lipid bilayer sensors.

**431 Human Physiology I**

Fall. 3(3-0) RB: (BS 111 and CEM 142)

Neural function including autonomic nervous system, physiological control systems, endocrinology, reproduction and digestive function.

**432 Human Physiology II**

Spring. 3(3-0) RB: (PSL 431)

Continuation of PSL 431. Function and regulation of the cardiovascular, respiratory, and renal systems. Control of tissue blood flow, blood pressure, blood gases, body fluid volume and electrolytes.

**440 Topics in Cell Physiology**

Fall, Spring. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.

Critical discussion and evaluation of a selected problem of mammalian cell physiology including cell biophysics, molecular biology of the cell.

**881 Subatomic Physics**

Fall. 3(3-0) RB: (PHY 851)

Application of conservation laws and physical principles to basic quantum mechanical problems in MeV energy range and femtometer size range. Application to nuclear data.

**891 Elementary Particle Physics**

Spring. 3(3-0) RB: (PHY 853)

Nonabelian gauge theory, spontaneously broken gauge theory, electroweak interaction, QCD, W and Z boson coupling to quarks and leptons, charm, top and bottom quarks, particle generations.

**899 Master's Thesis Research**

Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to graduate students in Physics.

Master's thesis research.

**901 Frontiers in Physics and Astronomy**

Spring. 1(1-0)

Seminar and discussions in physics. Attendance at weekly colloquium.

**902 Case Studies in Physics Applications**

Fall, Spring, Summer. 1 to 3 credits. RB: (PHY 471 and PHY 481)

Assessment of an application of physics; written report and oral presentation required. Projects from industry and government agencies; optional internship.

**905 Special Problems**

Fall, Spring. 1 to 4 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to graduate students in the Department of Physics and Astronomy.

In-depth study of a topic in physics or in astrophysics and astronomy.

**961 Non-Linear Beam Dynamics**

Fall, Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. RB: (PHY 861)

Dynamics of particle beams.

**962 Particle Accelerators**

Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. RB: (PHY 861)

Theory of particle accelerator design.

**963 U.S. Particle Accelerator School**

Fall, Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. RB: (PHY 861) SA: PHY 962C

Participation in suitable courses offered by the U.S. Particle Accelerator School.

**964 Seminar in Beam Physics Research**

Fall, Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. RB: (PHY 861) SA: PHY 962D

Presentation of current research topics in beam physics or accelerator design.

**971 Atomic and Electronic Structure of Matter**

Spring. 3(3-0) RB: (PHY 491 and PHY 852 and PHY 841 and PHY 831) SA: PHY 871

Atomic structure, bravais lattices, x-ray scattering. Vibrations, phonons, neutron scattering. Electron in solids, electron gas. Bloch's theorem. Metals, semiconductors and insulators. Introduction to cooperative phenomena.

**972 Transport and Dynamics in Bulk and Mesoscopic Systems**

Fall. 3(3-0) RB: (PHY 971 and PHY 831 and PHY 841 and PHY 852)

Transport theory. Weak and strong localization. Quantum effects in small structures. Quantum hall effects and Wigner crystal. Superconductivity and other cooperative phenomena.

**973 Special Topics in Condensed Matter Physics**

Fall, Spring. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. RB: (PHY 971 and PHY 972)

Topics vary and may include quantum optics, scattering methods and Green's functions.

**980 Advanced Reading in Physics**

Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department.

**981 Nuclear Structure**

Fall, Spring. 3(3-0) RB: (PHY 492 and PHY 831 and PHY 841 and PHY 852)

Nuclear forces, nuclear matter, nuclear-structure models, few-nucleon systems, electromagnetic and weak transitions.

**982 Nuclear Dynamics**

Fall, Spring. 3(3-0) RB: (PHY 492 and PHY 831 and PHY 841 and PHY 852)

Scattering theory, resonance reactions, compound nuclear decay and fission, direct and breakup reactions, time-dependent Hartree-Fock, Vlasov equation, nuclear transport equations, particle production, nuclear liquid-gas phase transition, quark-gluon plasma.

**983 Nuclear Astrophysics**

Fall, Spring. 3(3-0) RB: (PHY 410 and PHY 472 and PHY 482) SA: PHY 982A, PHY 982B

Low energy reaction theory, survey of astrophysics, physics of nuclei and reaction relevant to astrophysics, nuclear reaction rates in stellar environments, stellar evolution, solar neutrinos, big bang nucleosynthesis, dark matter, supernova explosions, r-process, hot CNO and rp-process, cosmochronology

**992 Quantum Chromodynamics**

Fall. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. RB: (PHY 854)

Hadron-hadron interactions, interaction of hadrons with leptons.

**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 graduate students in Physics.

Doctoral dissertation research.

## Physiology—PHL

- 441 Topics in Endocrinology**  
Fall, Spring. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.  
Selected topic on the role of hormones in the regulation of growth, metabolism, differentiation.
- 442 Topics in Cardiovascular Physiology**  
Fall. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.  
Selected topic in blood flow physiology.
- 443 Topics in Respiratory Physiology**  
Fall of odd years. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.  
Selected topic in the physiology of gas exchange and lung mechanics.
- 445 Topics in Environmental Physiology**  
Spring of odd years. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.  
Selected topic in environmental physiology with an emphasis on thermoregulation.
- 446 Topics in Visual Physiology**  
Fall of even years. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.  
Selected topic in the functioning of the visual system in health and disease.
- 447 Topics of Brain Function**  
Fall. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.  
Selected topic on the functioning of the mammalian brain.
- 448 Topics in Gastrointestinal Physiology**  
Fall. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.  
Selected topic in the physiology of the digestive system.
- 449 Developmental Neurophysiology**  
Fall. 2(2-0) RB: (PSL 432) R: Open only to Physiology majors. Completion of Tier I writing requirement.  
Development of the nervous system in invertebrate and vertebrate animals.
- 473 Environmental Fish Physiology**  
Fall of even years. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:M: (BS 111) R: Not open to freshmen or sophomores.  
Survey of physiological adaptations of fish to environmental factors; bioenergetics, homeostasis, senses adaptations to diverse and extreme aquatic environments.
- 475 Capstone Laboratory in Physiology**  
Spring. 2(1-3) RB: (PSL 432) R: Open only to Physiology majors.  
Laboratory exercises in animal physiology including osmoregulation, receptor mediated regulation, nervous and hormonal control of function.
- 480 Special Problems**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 5 credits in all enrollments for this course. RB: (PSL 432) R: Open only to Physiology majors.  
Independent study under the auspices of a faculty member.
- 483 Environmental Physiology**  
Spring. 4(4-0) Interdepartmental with Zoology. Administered by Department of Zoology. P:M: (BS 110 or LBS 144 or LBS 148H) and (BS 111 or LBS 145 or LBS 149H) and (CEM 141 or CEM 151 or CEM 181H or LBS 171) and completion of Tier I writing requirement.  
Aspects of physiology important to the environmental relations of vertebrates and invertebrates: energetics, thermal relations, osmotic-ionic relations, and exercise physiology.
- 501 Introductory Medical Physiology**  
Fall. 3(3-0) R: Graduate-professional students in colleges of Human and Osteopathic Medicine.  
Physiological basis of medical practice.
- 511 Veterinary Physiology**  
Spring. 5(5-0) R: Completion of Semester 1 of the graduate professional program in the College of Veterinary Medicine.  
Physiology of the nervous, cardiovascular, renal, respiratory, digestive, endocrine, and reproductive systems. Homeostasis.
- 534 Cell Biology and Physiology I**  
Fall. 3 credits. Interdepartmental with Human Anatomy; Biochemistry and Molecular Biology. 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 Human Anatomy; Biochemistry and Molecular Biology. 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.
- 552 Medical Neuroscience**  
Spring. 4(3-2) Interdepartmental with Neurology and Ophthalmology; Radiology; Human Anatomy. Administered by Department of Neurology and Ophthalmology. R: Graduate-professional students in the Colleges of Human Medicine and Osteopathic Medicine. SA: ANT 552  
Correlation of normal structure and function of the human nervous system with clinical testing, classical lesions, and common diseases.
- 825 Cell Structure and Function**  
Spring. 3(3-0) Interdepartmental with Biochemistry and Molecular Biology; Microbiology and Molecular Genetics. Administered by Department of Biochemistry and Molecular Biology. 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.
- 827 Physiology and Pharmacology of Excitable Cells**  
Fall. 4(4-0) Interdepartmental with Pharmacology and Toxicology; Zoology; Neuroscience. Administered by Department of Pharmacology and Toxicology. RB: (PSL 431 or PSL 432 or BMB 401 or BMB 461 or ZOL 402)  
Function of neurons and muscle at the cellular level: membrane biophysics and potentials, synaptic transmission, sensory nervous system function.
- 828 Cellular and Integrative Physiology**  
Spring. 4(4-0) RB: (PSL 827)  
Cellular physiology as basis for understanding integrative functions of various body systems, including nervous, cardiovascular, respiratory, urinary, gastrointestinal, endocrine, reproductive, and immune.
- 839 Systems Neuroscience**  
Spring of odd years. 4(4-0) Interdepartmental with Anatomy; Pharmacology and Toxicology. Administered by Department of Anatomy. R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Agriculture and Natural Resources, Natural Science, and Veterinary Medicine. SA: ANT 839, PHM 839  
Anatomy, pharmacology, and physiology of multicellular neural systems. Sensory, motor, autonomic, and chemo-regulatory systems in vertebrate brains.
- 841 Advanced Endocrine Physiology and Pharmacology**  
Fall. 4(4-0) Interdepartmental with Animal Science; Pharmacology and Toxicology; Psychology. RB: (BMB 461 and PSL 432) R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Veterinary Medicine, Natural Science, and Agriculture and Natural Resources. SA: ANS 841, PHM 841, PSY 841  
Basic and advanced concepts of endocrine and reproductive physiology and pharmacology.
- 850 Research Topics in Physiology**  
Spring. 1(0-2) RB: (PSL 432 and PSL 910) R: Open only to graduate students in Physiology.  
Readings, presentations and discussions of selected research literature in physiology.
- 885 Vertebrate Neural Systems**  
Spring of odd years. 3(2-2) Interdepartmental with Anatomy. Administered by Department of Anatomy. SA: ANT 885  
Comparative analysis of major component systems of vertebrate brains. Evolution, ontogeny, structure, and function in fish, amphibians, reptiles, birds and mammals.
- 899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course.  
Master's thesis research.

**901 Investigating the Lung**  
Fall of even years. 2(2-0) Interdepartmental with Large Animal Clinical Sciences; Pathology. Administered by Department of Large Animal Clinical Sciences. R: Open only to graduate students.

Integrative biology of the lung; structure and function; molecular, cellular, and organ responses to injury.

**910 Cellular and Molecular Physiology**  
Fall. 4(4-0) RB: BMB 802; PSL 432 or PSL 501 or PSL 511; one calculus course. R: Open only to graduate students in Physiology or Pharmacology and Toxicology.

Readings in cell physiology and physiological aspects of molecular biology.

**950 Topics in Physiology**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Approval of department.

Classical and modern concepts in selected areas of physiology.

**980 Problems in Physiology**  
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.

Individual research problems in physiology.

**999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 99 credits in all enrollments for this course.

Doctoral dissertation research.

**218 Plants of Michigan**  
Fall. 3(2-3) P:M: (BS 110 or PLB 105 or LBS 144 or LBS 148H) SA: BOT 218

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. Field trips required.

**301 Introductory Plant Physiology**  
Fall, Spring. 3(2-3) P:M: (CEM 141 or CEM 151 or LBS 171 or CEM 181H) and (CEM 161 or LBS 171L) and (PLB 105 or BS 111 or LBS 145 or LBS 149H) and completion of Tier I writing requirement. SA: BOT 301

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.

**319 Introduction to Earth System Science**  
Fall. 3(3-0) Interdepartmental with Entomology; Geological Sciences; Zoology; Sociology. Administered by Department of Entomology. RB: Completion of one course in biological or physical science.

Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.

**335 Plants Through Time**  
Spring of odd years. 3(3-0) Interdepartmental with Geological Sciences. P:M: (BS 110 or PLB 105 or GLG 201 or LBS 144 or LBS 148H) R: Open only to juniors or seniors. SA: BOT 335

Evolutionary history of plants, development of ecosystems, and use of plant fossils in the reconstruction of ancient environments and climate.

**336 Useful Plants**  
Fall of odd years. 3(3-0) P:M: (CEM 142 or CEM 143 or CEM 152 or CEM 182H) and (PLB 105 or LBS 145) or (BS 110 and BS 111 and BS 111L) or (LBS 148H and LBS 149H) SA: BOT 336

Use of plants for myriad purposes from food and construction materials to medicines and perfumes. Potential for expanding the uses of plants through biotechnology.

**341 Fundamental Genetics**  
Fall, Spring, Summer. 4(4-0) Interdepartmental with Zoology. Administered by Department of Zoology. P:M: (BS 111 or LBS 145 or LBS 149H)

Principles of heredity in animals, plants and microorganisms. Classical and molecular methods in the study of gene structure, transmission, expression and evolution.

**355 Ecology**  
Fall, Summer. 3(3-0) Interdepartmental with Zoology. Administered by Department of Zoology. P:M: (BS 110 or LBS 144 or LBS 148H) SA: ZOL 250

Plant and animal ecology. Interrelationships of plants and animals with the environment. Principles of population, community, and ecosystem ecology. Application of ecological principles to global sustainability.

**355L Ecology Laboratory**  
Fall, Summer. 1(0-3) Interdepartmental with Zoology. Administered by Department of Zoology. P:M: (ZOL 355 or concurrently or PLB 355 or concurrently) and completion of Tier I writing requirement.

Population, community and ecosystem ecology utilizing plant and animal examples to demonstrate general field principles.

**402 Biology of Fungi**  
Fall. 3(2-3) Interdepartmental with Plant Pathology. P:M: (BS 110 or BS 111 or PLB 105 or LBS 145 or LBS 148H or LBS 149H) SA: BOT 402

Major groups of fungi: characteristics, habitats and diversity. Significance of fungi in nature and their economic importance.

**407 Diseases and Insects of Forest and Shade Trees**  
Spring. 4(3-3) Interdepartmental with Plant Pathology; Entomology. Administered by Department of Plant Pathology. P:M: (PLB 105 or BS 110 or LBS 144 or LBS 148H) and (PLB 218 or FOR 204 or HRT 211) and completion of Tier I writing requirement. SA: BOT 407

Diseases, insects, and environmental problems affecting trees in forests, parks, suburbs, and nurseries. Methods of control.

**412 Environmental Plant Physiology**  
Fall. 3(3-0) P:M: (PLB 105 or BS 111 or LBS 145 or LBS 149H) and (CEM 141 or CEM 151) and (CEM 161) SA: BOT 412

General concepts underlying interactions between plants and the environment. Light sensing and utilization. Energy budgets. Water uptake and utilization. Mineral nutrition.

**414 Plant Physiology: Metabolism**  
Fall. 3(3-0) P:M: (CEM 251 or CEM 351) and (PLB 105 or LBS 145) or (BS 110 and BS 111 and BS 111L) or (LBS 148H and LBS 149H) SA: BOT 414

General principles underlying metabolic processes of plants. Photosynthesis, translocation and water relations, nitrogen metabolism, cell wall biosynthesis, and structures associated with these processes.

**415 Plant Physiology: Growth, Development and the Environment**  
Spring. 3(3-0) P:M: (PLB 105 or BS 111 or LBS 145 or LBS 149H) and (CEM 251) SA: BOT 415

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.

**416 Experiments in Plant Physiology and Molecular Biology**  
Fall. 4(2-5) P:M: (PLB 414 or PLB 415) and completion of Tier I writing requirement. RB: Laboratory course in biochemistry. SA: BOT 416

Experiments illustrating principles of plant physiology and molecular biology. Advanced techniques such as agrobacterium mediated gene transfer, DNA cloning, enzyme linked immunoassays (ELISA), protein and DNA electrophoresis.

## PLANT BIOLOGY PLB

### Department of Plant Biology College of Natural Science

**105 Plant Biology**  
Fall, Spring. 3(3-0) SA: BOT 105  
Plant structure, function, development, genetics, diversity and ecology.

**106 Plant Biology Laboratory**  
Fall, Spring. 1(0-3) P:M: (PLB 105 or concurrently) SA: BOT 106  
Cell structure, anatomy, physiology, growth and development, and diversity of plants.

**111L Cell and Molecular Biology Laboratory**  
Fall, Spring, Summer. 2(1-3) Interdepartmental with Biological Science; Microbiology and Molecular Genetics; Zoology. Administered by Natural Science. 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.

**202 The Plant Kingdom**  
Spring. 3(2-3) P:M: (BS 110 or BS 111 or PLB 105 or LBS 144 or LBS 148H or LBS 149H) SA: BOT 202

Morphology of the major plant groups with an emphasis on structure, reproduction and evolution. Field trips required.