

- 983 Nuclear Astrophysics**
Fall, Spring. 3(3-0) RB: (PHY 410 and PHY 472 and PHY 482)

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

PSL

Department of Physiology College of Natural Science

- 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.

- 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**
Spring of odd years. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:M: (BS 111 or LBS 145 or LBS 149H) R: Not open to freshmen or sophomores.
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.

Physiology—PSL

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.

611 Research Problems in Physiology Clerkship
Fall, Spring, Summer. 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. RB: (PSL 511) Completion of Semester 5 in the graduate professional program in the College of Veterinary Medicine.

Individual work on a research problem.

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. 4(4-0) Interdepartmental with Neuroscience; Human Anatomy; Pharmacology and Toxicology; Psychology; Zoology. Administered by Program in Neuroscience. R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Agriculture and Natural Resources, Natural Science, Social Science, and Veterinary Medicine. SA: ANT 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 Neuroscience; Human Anatomy. Administered by Program in Neuroscience. 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 36 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 24 credits. A student may earn a maximum of 120 credits in all enrollments for this course.

Doctoral dissertation research.

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 College of 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.

203 Biology of Plants
Fall. 3(2-3) P:M: (BS 110 and BS 111) or (PLB 105)
Evolution and diversification of plants. Structural innovations and physiological attributes of vascular land plants.

218 Plants of Michigan
Fall. 3(2-2) 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.

316 Experiments in Plant Biology
Spring. 4(2-5) P:M: (CEM 142 or concurrently and CEM 161 or concurrently and CEM 251 or concurrently) or (CEM 152 or concurrently and CEM 161 or concurrently and CEM 251 or concurrently) and (PLB 203) and completion of Tier I writing requirement.
Exploration of fundamental topics in plant biology using modern techniques for studies at the molecular and ecological levels.

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.