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 148H) 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.

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: (BS 111 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.

218 Plants of Michigan
Fall. 3(2-3) P:M: (BS 110 or PLB 105 or LBS 145 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 geochemo, 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 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) SA: BOT 341. 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, Spring, 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. 3(3-0) 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(3-0) 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 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 Biotechnology, Physiology and Molecular Biology**  
Fall. 4(2-5) RB: (PLB 414 or PLB 415) and completion of Tier I writing requirement. SA: BOT 416  
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.

418 **Plant Systematics**  
Spring, Summer. 3(2-3) Spring: Given only at W.K. Kellogg Biological Station. P.M.: (PLB 105 or BS 110 or LBS 144 or LBS 148H) SA: BOT 418  
Classification and evolution of higher plants, with emphasis on identification, characteristics of plant families, and systematic theory and practice.

419 **Advanced Earth System Science**  
Spring. 3(2-2) Interdepartmental with Entomology; Geological Sciences; Zoology; Sociology. Administered by Department of Entomology. P.M.: (ENT 319)  
Systems science theory applied to analysis of the biological, geological, physical, and social causes and consequences of global changes. Issues of sustaining the Earth system.

423 **Wetland Plants and Algae**  
Fall. 4(2-4) P.M.: (PLB 105 or BS 110 or LBS 144 or LBS 148H) SA: BOT 423  
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. Field trips required.

424 **Algal Biology**  
Fall of even years. Summer of odd years. 4(2-4) Summer: KBS. Interdepartmental with Zoology. P.M.: (BS 110 or LBS 144 or LBS 148H) and completion of Tier I writing requirement. RB: (ZOL 341 and ZOL 355L) or (PLB 441) SA: BOT 424  
Algal taxonomy, systematics, physiology, ecology, and environmental assessment. Lab focused on identification of freshwater algal genera collected from regional habitats. Field trips required.

431 **Comparative Limnology**  
Summer. 4(2-6) Summer: Given only at W.K. Kellogg Biological Station. Interdepartmental with Zoology; Fisheries and Wildlife. Administered by Department of Zoology. P.M.: (CEM 141 or CEM 151) and (ZOL 355) Not open to students with credit in FW 472.  
Physical, chemical, and biological aspects of lakes and streams. Introduction to freshwater biology, and population and community ecology.

434 **Plant Structure and Function**  
Fall of odd years. 4(2-4) P.M.: (BS 110 and BS 111) or (PLB 105 and PLB 106) or (LBS 144 and LBS 145) or (LBS 148H and LBS 149H) SA: BOT 434  
Plant anatomy from a structural and functional perspective. Physiological, developmental, and ecological significance of cell types, tissue types, and systems of vegetative and reproductive plant parts.

440 **Field Ecology and Evolution**  
Summer. 4 credits. Summer: Given only at W.K. Kellogg Biological Station. Interdepartmental with Zoology. Administered by Department of Zoology. P.M.: (ZOL 355)  
Solving conceptual and practical research problems in ecology and evolution under field conditions.

441 **Plant Ecology**  
Fall. 3(3-0) P.M.: (BS 110 or LBS 144 or PLB 105 or LBS 148H or ZOL 355) and completion of Tier I writing requirement. SA: BOT 441  

445 **Evolution**  
Fall. 3(3-0) Interdepartmental with Zoology. Administered by Department of Zoology. P.M.: (ZOL 341) and completion of Tier I writing requirement. R: Not open to freshmen. SA: ZOL 345  

485 **Tropical Biology**  
Spring. 3(3-0) Interdepartmental with Zoology; Entomology. Administered by Department of Zoology; (ZOL 355) R: Open only to juniors or seniors. Tropical biota emphasizing evolutionary and ecological principles compared across tropical ecosystems.

490 **Directed Studies**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P.M.: Completion of Tier I writing requirement. RB: One year of college biology. R: Approval of department. SA: BOT 490H  
Directed study of published literature in an area of plant biology.

490H **Honors Directed Studies**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P.M.: Completion of Tier I writing requirement. RB: One year of college biology. R: Approval of department. SA: BOT 490H  
Directed study of published literature in an area of plant biology.

495 **Botanical Garden Internship**  
Fall, Spring, Summer. 2 to 8 credits. A student may earn a maximum of 8 credits in all enrollments for this course. P.M.: Completion of Tier I writing requirement. R: Approval of department. SA: BOT 495  
Activities, functions and organization of botanical gardens. Principles of live plant curation.

498 **Undergraduate Research**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. P.M.: (BS 110 and BS 111) or (PLB 105 and PLB 106) or (LBS 144 and LBS 145) or (LBS 148H and LBS 149H) and completion of Tier I writing requirement. R: Approval of department. SA: BOT 498  
Lab research and/or field research in an area of plant biology.

499 **Senior Seminar**  
Spring. 2(2-0) A student may earn a maximum of 4 credits in all enrollments for this course. P.M.: (PLB 498) and completion of Tier I writing requirement. SA: BOT 499  
A capstone experience that focuses on current developments and issues in plant biology. Scientific writing and oral presentation.

**PLANT PAThOLOGY PLP**

**Department of Plant Pathology**

**College of Agriculture and Natural Resources**

101 **Current Issues and Frontiers in Plant Pathology**  
Fall. 1(1-0) Basic principles of plant disease and plant pathogens. Current topics and future opportunities in the discipline of plant pathology.

205 **Pests, Society and Environment**  

362 **Management of Turfgrass Pests**  
Fall. 4(3-2) Interdepartmental with Crop and Soil Sciences; Entomology. Administered by Department of Crop and Soil Sciences. P.M.: (CSS 232) Chemical, biological, and cultural methods of managing weeds, diseases, and insect pests of turfgrass. Environmental considerations in pest management.

402 **Biology of Fungi**  
Fall. 3(2-2) Interdepartmental with Plant Biology. Administered by Department of 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.

405 **Plant Pathology**  
Spring. 3(3-0) P.M.: (BS 110 and BS 111) or (PLB 105 and PLB 106) or (LBS 144 and LBS 145) or (LBS 148H and LBS 149H) and completion of Tier I writing requirement. SA: BOT 405 Not open to students with credit in BOT 407.  
Plant diseases and the organisms that cause them. Principals of disease management including application of chemicals, plant breeding, biological control, and genetic engineering.

407 **Diseases and Insects of Forest and Shade Trees**  
Spring. 4(3-3) Interdepartmental with Entomology; Plant Biology. 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.

490 **Independent Study**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.  
Independent study of plant pathology on a laboratory, field or library research program of special interest to the student.