

- 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: (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: (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: (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.

- 203 Biology of Plants**  
Fall. 3(2-3) P: (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(2-3) P: (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: (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: (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 organismal level.
- 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: (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: (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: (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, Spring, Summer. 3(3-0) Interdepartmental with Zoology. Administered by Department of Zoology. P: (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, Spring, Summer. 1(0-3) Interdepartmental with Zoology. Administered by Department of Zoology. P: (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: (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: (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: (PLB 105 or BS 111 or LBS 145 or LBS 149H) and (CEM 141 or CEM 151) and (CEM 161) SA: BOT 412  
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: (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  
Principles underlying metabolic processes of plants. Photosynthesis, translocation and water relations, nitrogen metabolism, cell wall biosynthesis, and associated structures.
- 415 Plant Physiology: Growth, Development and the Environment**  
Spring. 3(3-0) P: (PLB 105 or BS 111 or LBS 145 or LBS 149H or CEM 251) SA: BOT 415  
Principles of plant growth and development. Environmental and hormonal factors that control progression of the plant through its life cycle. Tissue culture and genetic engineering in plants.

## Plant Biology—PLB

- 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 immunoassays (ELISA), protein and DNA electrophoresis.
- 418 Plant Systematics**  
Spring, Summer. 3(2-3) Spring: Given only at W.K. Kellogg Biological Station. P: (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: (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: (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: Given only at W.K. Kellogg Biological Station. Interdepartmental with Zoology. P: (BS 110 or LBS 144 or LBS 148H) and completion of Tier I writing requirement. RB: (ZOL 355 and ZOL 355L) or (PLB 441) SA: BOT 424  
Algal taxonomy, systematics, physiology, ecology, and environmental assessment. Lab focus on identification of freshwater algal genera collected from regional habitats. Field trips required.
- 431 Comparative Limnology**  
Summer. 4(2-6): Given only at W.K. Kellogg Biological Station. Interdepartmental with Zoology; Fisheries and Wildlife. Administered by Department of Zoology. P: (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**  
Spring. 4(2-4) P: (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 meristems of vegetative and reproductive plant parts.
- 440 Field Ecology and Evolution**  
Summer. 4 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Zoology. Administered by Department of Zoology. P: (ZOL 355)  
Solving conceptual and practical research problems in ecology and evolution under field conditions.
- 441 Plant Ecology**  
Fall. 3(3-0) P: (BS 110 or LBS 144 or PLB 105 or LBS 148H or ZOL 355) and completion of Tier I writing requirement. SA: BOT 441  
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.
- 445 Evolution**  
Fall. 3(3-0) Interdepartmental with Zoology. Administered by Department of Zoology. P: (ZOL 341) and completion of Tier I writing requirement. R: Not open to freshmen. SA: ZOL 345  
Processes of evolutionary change in animals, plants. Microbes. Population genetics, microevolution, speciation, adaptive radiation, macroevolution. Origin of Homo sapiens.
- 485 Tropical Biology**  
Spring. 3(3-0) Interdepartmental with Zoology; Entomology. Administered by Department of Zoology. P: (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: Completion of Tier I writing requirement. RB: One year of college biology. R: Approval of department. SA: BOT 490  
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: 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. 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: (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  
Laboratory 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: (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.
- 800 Seminar in Plant Biology**  
Fall, Spring. 1(1-0) A student may earn a maximum of 4 credits in all enrollments for this course. R: Open only to graduate students. SA: BOT 800  
Current research and approaches in plant biology.
- 802 Selected Topics in Botany**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Agriculture and Natural Resources. SA: BOT 802  
Recent developments in botany.
- 805 Special Problems in Physiology and Biochemistry**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Agriculture and Natural Resources. SA: BOT 805  
Faculty directed individualized study of a selected problem.
- 806 Special Problems in Genetics and Molecular Biology**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Agriculture and Natural Resources. SA: BOT 806  
Faculty directed individualized study of a selected problem.
- 807 Special Problems in Mycology**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science and College of Agriculture and Natural Resources. SA: BOT 807  
Faculty directed individualized study of a selected problem.
- 809 Special Problems in Ecology, Systematics, and Evolution**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in College of Natural Science or College of Agriculture and Natural Resources. SA: BOT 809  
Faculty directed individualized study of a selected problem.
- 811 Plant Developmental Genetics**  
Fall. 3(2-2) Interdepartmental with Horticulture. Administered by Department of Horticulture. RB: (ZOL 341 and CSS 350) and (PLB 415 and ZOL 320)  
Genetic mechanisms controlling plant development. Model systems and internal, nonenvironmental factors. Methods for the study of plant development. The plant genome. Genetics underlying developmental diversity in higher plants.
- 820 Plant Reproductive Biology and Polyploidy**  
Spring. 1 credit. Interdepartmental with Horticulture; Crop and Soil Sciences; Forestry; Plant Pathology. Administered by Department of Horticulture. RB: Introductory Genetics and Plant Biology  
Genetic processes underlying variations in plant reproductive biology and polyploidy and the utilization of these characteristics in plant breeding.

**821 Crop Evolution**  
Spring of odd years. 1 credit. Interdepartmental with Horticulture; Crop and Soil Sciences; Forestry; Plant Pathology. Administered by Department of Horticulture. RB: Introductory Genetics and Plant Biology  
Cultural and biological aspects of the evolution of domestic plants.

**822 Historical Geography of Crop Plants**  
Spring of odd years. 1 credit. Interdepartmental with Horticulture; Crop and Soil Sciences; Forestry; Plant Pathology. Administered by Department of Horticulture. RB: Introductory Genetics and Plant Biology  
Development and spread of the major crop species.

**826 Tropical Biology: An Ecological Approach**  
Spring, Summer. 8 credits. Spring: Costa Rica. Summer: Costa Rica. Interdepartmental with Zoology. R: Approval of department; application required. SA: BOT 826  
Principles of tropical ecology at the population, community, and ecosystem levels. Given at various sites in Costa Rica by the Organization for Tropical Studies.

**828 Conservation and Genetics**  
Fall of even years. 3(2-2) Interdepartmental with Fisheries and Wildlife; Zoology. Administered by Department of Fisheries and Wildlife. RB: (ZOL 341 or CSS 350 or ANS 314)  
Population and evolutionary genetic principles applied to ecology, conservation, and management of fish and wildlife at the individual, population, and species level.

**835 Biogeography**  
Spring of odd years. 3(3-0) Interdepartmental with Fisheries and Wildlife; Geography; Zoology. Administered by Department of Fisheries and Wildlife. RB: Courses in evolution and ecology at undergraduate level.  
Geographical distributions of plants and animals; biogeographic realms. Ecological and evolutionary mechanisms determining distributional patterns. Application of biogeography to conservation problems.

**842 Application of Ecological Principles**  
Spring. 2 credits. A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Zoology. SA: BOT 842  
Workshops and discussions with experts from industry, regulatory agencies, conservation groups, and academe on application of basic ecology and evolutionary biology to real-world problems.

**847 Advanced Mycology**  
Spring of even years. 4(2-4) Interdepartmental with Plant Pathology. Administered by Department of Plant Pathology. RB: (BOT 402) SA: BOT 847  
Systematics, identification, physiology, genetics, and molecular biology of plant pathogenic fungi.

**849 Evolutionary Biology**  
Spring. 3(3-0) Interdepartmental with Zoology. RB: (ZOL 341 and STT 422 or concurrently) SA: BOT 849  
Major conceptual, theoretical and empirical questions in evolutionary biology. Readings and lectures are synthesized in student discussions and papers.

**851 Quantitative Methods in Ecology and Evolution**  
Fall. 3(3-0) Interdepartmental with Zoology. Administered by Department of Zoology. RB: (STT 465)  
Interpretation and analysis of ecological and evolutionary biology data. Statistical computer software.

**855 Molecular Evolution: Principles and Techniques**  
Fall of odd years. 3(3-0) Interdepartmental with Zoology; Microbiology and Molecular Genetics. Administered by Department of Zoology. RB: (ZOL 341 or ZOL 445)  
Current techniques used to characterize and compare genes and genomes. Genetic variation, assays of variation. Data analysis and computer use to conduct a phylogenetic analysis to compare organisms and infer relationships.

**856 Plant Molecular Biology**  
Spring. 3(3-0) Interdepartmental with Biochemistry and Molecular Biology; Crop and Soil Sciences. RB: (ZOL 341) SA: BOT 856  
Recent advances in genetics and molecular biology of higher plants.

**857 Theoretical Ecology**  
Spring of even years. 3(2-2) Interdepartmental with Fisheries and Wildlife; Zoology. Administered by Department of Fisheries and Wildlife. RB: One course in ecology and calculus. Programming experience helpful.  
Theoretical ecology of animal behavior, population dynamics, and multispecies communities. Basic mathematical approaches and use of modeling software to perform mathematical functions and develop models.

**863 Environmental Plant Physiology**  
Spring of odd years. 3(3-0) Interdepartmental with Horticulture. RB: (PLB 301 or PLB 414 or PLB 415) SA: BOT 863  
Interaction of plant and environment. Photobiology, thermophysiology, and plant-water relations.

**864 Plant Biochemistry**  
Spring. 3(3-0) Interdepartmental with Biochemistry and Molecular Biology. Administered by Department of Biochemistry and Molecular Biology. RB: BMB 401 or BMB 462. SA: BCH 864  
Biochemistry unique to photosynthetic organisms. Photosynthetic and respiratory electron transport, nitrogen fixation, carbon dioxide fixation, lipid metabolism, carbon partitioning, cell walls, biosynthesis of plant hormones.

**865 Plant Growth and Development**  
Fall. 3(3-0) RB: (PLB 415) SA: BOT 865  
Physiology and biochemistry of growth and development as regulated by internal and external factors. Biosynthesis and action of plant hormones. Environmental factors: light and temperature.

**891 Current Topics in Ecology and Evolution**  
Summer. 1 credit. Summer: Given only at W.K. Kellogg Biological Station. A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Zoology; Crop and Soil Sciences. Administered by Department of Zoology.  
Presentation and critical evaluation of theoretical and empirical developments by visiting scientists.

**896 Population and Community Ecology**  
Fall. 4(4-0) Interdepartmental with Zoology. Administered by Department of Zoology.  
Population dynamics of animals and plants utilizing life tables and projection matrices. Species interaction. Life history theory. Structure and dynamics of communities. Succession.

**897 Ecosystem Ecology**  
Spring. 4(4-0) Interdepartmental with Zoology; Fisheries and Wildlife. Administered by Department of Zoology.  
Structure and function of natural ecosystems. Succession, food web analysis, energy flow, nutrient cycling, and effects of human activities on ecosystems. Global environmental change. Ecosystem management and restoration.

**899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 24 credits in all enrollments for this course. R: Open only to graduate students. SA: BOT 899  
Research in anatomy, bryology cell biology, ecology, genetics, molecular biology, morphology, mycology, paleobotany, pathology, physiology and systematics.

**999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to doctoral students. SA: BOT 999  
Research in anatomy, bryology cell biology, ecology, genetics, molecular biology, morphology, mycology, paleobotany, pathology, physiology and systematics.

## 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**  
Fall, Spring. 3(3-0) Interdepartmental with Entomology. Administered by Department of Entomology.  
Nature of pests and their impact on society. Principles of integrated pest management in relation to environmental quality and sustainable development.

**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: (CSS 232)  
Chemical, biological, and cultural methods of managing weeds, diseases, and insect pests of turfgrass. Environmental considerations in pest management.