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.

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.

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.

418 Plant Systematics
Spring. 3(2-3) Summer. 3 credits. 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. 4(2-4) Summer of odd years. 4 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Zoology. P:M: (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: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 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: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
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:M: (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:M: (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 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: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. 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
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: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.

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.

824 Principles and Methods of Plant Systematics
Spring. 3(3-0) SA: BOT 824
Classification methods; quantification of evolutionary relationships; phenetic, phyletic, molecular, and cladistic approaches.

826 Tropical Biology: An Ecological Approach
Spring, Summer. 8 credits. Given in 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. RB: (ZOL 341) SA: BOT 856
Recent advances in genetics and molecular biology of higher plants.

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