

and comparative analysis in mammals, birds, reptiles, amphibians and fish. Interrelation of behavioral, anatomical, and physiological studies.

**890. Readings in Biophysics**

Fall, Winter, Spring. 3 to 6 credits.  
Approval of department.  
Reading course in special topics adapted to the individual preparation and needs of the student.

**899. Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**922. Thermal Biophysics**

Spring of odd-numbered years. 3(3-0)  
Approval of department.

Applications of thermodynamics and statistical mechanics to biology. Absolute theory of rate processes. Thermal denaturation of biomacromolecules. Thermal death of viruses, unicellular organisms and poikilotherms. Aging and death in mammals.

**990. Biophysics Seminar**

Fall, Winter, Spring, Summer. 1 credit. May re-enroll for a maximum of 3 credits. Approval of department.

**999. Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**BOTANY AND PLANT PATHOLOGY BOT**

**College of Natural Science**

**200. Resource Ecology and Man**

For course description, see Interdisciplinary Courses.

**201. Plants and Man**

(304.) Winter, Spring. 3(3-0)  
The relevance of plants to modern society with emphasis on those plants which supply drugs, food, fuel and oxygen, and those which have historical or esthetic importance.

**205. Plant Biology**

Winter. 3(3-0) High school chemistry and high school algebra.  
An introduction to plant science for students seeking a general knowledge of the principles of plant biology as well as for prospective plant science majors.

**301. Introductory Plant Physiology**

Fall, Spring. 4(2-4) CEM 131 or 141; 161; B S 211 and introductory organic chemistry recommended.  
General principles of plant physiology relating plant function to structure.

**302. Introductory Morphology**

Fall, Winter. 4(2-4) B S 212 or approval of department.  
Structures and life cycles of representative plant groups showing progressive evolutionary developments.

**305. Poisonous Plants**

Spring. 2(0-4) Three terms of Natural Science. Primarily for Veterinary Medicine students.  
Plants poisonous to livestock and human beings, particularly those occurring in Michigan.

**318. Introductory Plant Systematics**

Spring. 4(2-3) 302 or B S 212 or approval of department.  
Plant diversity with emphasis on identification, classification, nomenclature, and evolutionary relationships of vascular plants.

**335. Fossil Plants, Their History and Paleocology**

Winter. 3(3-0) One course in geology or botany or biology or approval of department. Interdepartmental with and administered by the Geology Department.

History of plants through geologic time; their form and evolution; how and where found, identified and reconstructed; their use in determining ancient geographic patterns, paleoenvironments, paleoclimates and community structure. Field trip.

**336. Economic Plants**

Fall. 3(3-0)  
Histories, characteristics, and origins of plants used in industrial processes, drug manufacture, and agriculture. Nontechnical to broaden student's cultural interest in plants.

**400. Aquatic Plants**

Spring. 3(1-4) One year of botany and zoology or approval of department.  
Aquatic plants, their classification, ecology and economic importance. Relationships to problems in fisheries, in wildlife management, and to role in limnology. Experience for student in plant ecology, aquatic biology, and water sanitation.

**400H. Honors Work**

Fall, Winter, Spring. 3(0-6) Approval of department; Seniors.

**401. Special Problems**

Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 16 credits. 302, Seniors, approval of department.  
Students with special ability may carry on laboratory research or study of published literature on a selected topic.

**402. Introductory Mycology**

Fall, Winter. 4(2-6) B S 212 or approval of department.  
Survey of the fungi, a background course for students taking plant pathology or other courses in mycology.

**405. Introductory Plant Pathology**

Fall. 4(2-4) 302 or B S 212 or approval of department. Students may not receive credit in both 405 and 407.  
General principles of plant pathology including detailed study of selected diseases as examples of important groups.

**406. Medical Mycology**

Winter, Spring. 4(2-6) 402 or approval of department.  
Characteristics, habits, and laboratory identification of fungus diseases infecting humans. Emphasis on laboratory techniques and morphological characteristics of the various mycoses.

**407. Diseases of Forest and Shade Trees**

Spring. 4(3-3) 301; 302; 318 or FOR 204. Students may not receive credit in both 405 and 407.  
Diseases which affect trees in forests, parks, suburbs and nurseries, and methods of control.

**411. Systematic Botany**

Summer. 4(2-6) B S 212 or approval of department.  
Taxonomy, identification, and evolutionary relationships of vascular plants, illustrated by the local flora; extensive field studies.

**414. Plant Physiology: Metabolism**

Winter. Summer of odd-numbered years. 4(3-4) 302; 1 year chemistry including organic.  
Comprehensive study of metabolic activities of plants. Emphasis on mineral nutrition of plants and processes of photosynthesis, protein synthesis, and respiration.

**415. Plant Physiology: Growth**

Spring. Summer of even-numbered years. 4(3-4) 414.  
Comprehensive study of growth processes of plants, with emphasis on germination, dormancy, hormones, and physiological phenomena associated with phases of development.

**427. Cell Biology**

(827.) Winter. Summer of odd-numbered years. 4(4-0) BCH 200 and one year of general botany or general zoology.  
Cell organization and distribution of standard inclusions. Structure and function of the nucleus and other cytoplasmic organelles.

**431. Histological Techniques**

Winter. 4(2-6) 302.  
Preparation of plant materials for microscopic study. Special emphasis on the many variations in microtechnique, including paraffin and celloidon embedding, freezing microtomy and ultrathin sectioning for electron microscopy.

**434. Plant Anatomy**

Fall. Summer of even-numbered years. 4(2-4) 302.  
Principles underlying the differentiation and growth of vegetative plant structures with special emphasis upon their functional and developmental genetic relationships.

**441. Phytogeography**

Winter. 3(3-0) 302.  
Distribution of plants over the earth, with special reference to North America. Geological history and environmental factors which influence distribution.

**447. Fresh Water Algae**

Spring. 4(2-4) One year botany or zoology. Primarily for students in Fisheries Biology, Wildlife Management and Sanitary Engineering.  
Identification of fresh water algae, especially those forms concerned with fish food problems, water contamination and limnology. Methods for making analyses of samples for biological survey work on lakes and streams. Economic aspects and life histories of the algae.

**450. Ecology**

Spring. 4(2-4) 318; 301 or 414  
Interrelationship of plants and environment. Factors which govern their distribution.

**455. Experimental Ecology**

Spring. 5(2-9) Approval of department. Interdepartmental with and administered by the Zoology Department.  
Dynamics, regulation and production of biological populations, structure composition and stability of biotic communities; biogeochemical and energetic characteristics of ecosystems.

**470. Introductory Nematology**

Winter of odd-numbered years. 3(2-3) Interdepartmental with and administered by the Department of Entomology.  
Biology, taxonomy and control of plant parasitic and saprophytic nematodes.

**480. Insects in Relation to Plant Diseases**

Winter of even-numbered years. 4(2-4)  
302. Interdepartmental with and administered by the Department of Entomology.

Relationships of insects, mites and nematodes to important plant diseases incited by bacteria, fungi, viruses and toxins. Mode of transmission and means of control. Transmission techniques and important plant-pathogen-insect relationships.

**499. Senior Seminar**

Winter. 1(1-0) May re-enroll for a maximum of 3 credits. B S 212 and 1 course in botany or approval of department.

Reports by students, faculty, and guest lecturers, with emphasis on current developments in research.

**800. Special Problems in Taxonomy**

Fall, Winter, Spring. 1 to 15 credits. Approval of department.

**801. Special Problems in Anatomy and Morphology**

Fall, Winter, Spring. 1 to 15 credits. Approval of department.

**802. Special Problems in Pathology**

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

**803. Special Problems in Physiology**

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

**805. Special Problems in Mycology**

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

**806. Special Problems in Cytology and Genetics**

Fall, Winter, Spring. 1 to 15 credits. Approval of department.

**807. Special Problems in Algae**

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

**809. Special Problems in Ecology**

Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.

**812. Ecology and Epidemiology of Plant Pathogens**

Winter of even-numbered years. 402, 405; or approval of department.

Production, liberation and dispersal of inoculum; effect of leaf and root exudates on pathogens; pathogen survival in the absence of the host plant; microbial antagonism. Nature and causes of epidemics.

**813. Special Problems**

Fall, Winter, Spring. 1 to 4 credits. May re-enroll for a maximum of 18 credits. Approval of department.

**816. Industrial Mycology**

Fall of even-numbered years. 3(2-4) 402 or approval of department.

Industrially important fungi, their uses and characteristics. Methods of commercial production, including acids, enzymes, cheeses, mushrooms, and antibiotics. Several field trips will be taken.

**820. Ecology of Hydrophytes**

Summer of every third year; given in 1967. 3 credits. 400 and 447 or approval of department. Given at W. K. Kellogg Biological Station.

Physiological and ecological relationships of periphyton, macroalgae, and vascular aquatic

plants; field and laboratory methods of analysis of growth factors.

**823. Plant Taxonomy I**

Fall of odd-numbered years. 4(3-3) 318; ZOL 441 recommended.

First course of a series on classification and relationships of vascular plants. Family characteristics, patterns, geographic distribution, and evolutionary trends are stressed. Contributions from classical taxonomy, cytobotany and experimental taxonomy are discussed.

**824. Plant Taxonomy II**

Winter of even-numbered years. 4(3-3) 823.

Second course of a series on classification and relationships of vascular plants.

**825. Tropical Biology: An Ecological Approach**

Winter, Summer. 12 credits. Approval of department and acceptance by Organization for Tropical Studies. Interdepartmental with the Zoology Department.

An introduction in the field to the principles of ecology as they operate in the tropics, especially concerning the tropical environment and biota, ecologic relations, communities and evolution in the tropics. Given in Costa Rica by Organization for Tropical Studies.

**826. Advanced Tropical Botany**

Winter, Summer. 12 credits. Approval of department and acceptance by Organization for Tropical Studies.

A field course on the adaptation, evolution, and physiological characteristics of tropical plants. The subject will vary from term to term, but will include such topics as the reproductive biology of tropical plants, tropical forest ecology, biology of tropical epiphytes, biology of tropical grasses, biology of tropical ferns, etc.

**828. Cytogenetics**

(919.) Fall. 4(2-4) 427 or ZOL 441 or approval of department.

Detailed discussions of mitosis and meiosis; mechanisms of chromosome movement; fine structure of chromosomes and spindle apparatus; changes of chromosome number and structure and their genetic significance.

**830. Paleobotany**

Fall. 4(3-4) Approval of department. Interdepartmental with the Geology Department.

Survey of fossil plants: their preservation, occurrence, geology, paleogeography, paleoecology, evolutionary history, classification and representative types. One weekend field trip to fossil plant locality.

**831. Palynology**

Spring. 4(3-4) Approval of department. Interdepartmental with and administered by the Geology Department.

An introduction to the principles and techniques of spore and pollen analysis, both fossil and recent, and utilization of plant microfossils for stratigraphic determinations and paleoecologic interpretation of most sedimentary accumulations and rocks. (Includes certain algae, protozoans, similar organisms of uncertain affinity and dissociated fragments of larger organisms.)

**835. Morphogenesis of Reproductive Structures**

Spring of even numbered years. 4(3-4) 434.

Principles underlying the differentiation and growth of reproductive plant structures with special emphasis upon their functional and developmental genetic relationships.

**836. Advanced Mycology: Current Biological Advances**

Spring of even-numbered years. 4(4-0) Approval of department.

Recent and current advances in the biology of fungi, with emphasis upon experimental studies of structural and functional differentiation during ontogeny.

**837. Advanced Mycology: Morphology and Taxonomy**

Spring. 4(3-2) 402.

Recent morphological studies, taxonomic methods, and phylogeny. The laboratory will be devoted to special problems related to the student's interests.

**838. Advanced Paleobotany**

Winter. 3(2-4) Approval of department. Interdepartmental with the Geology Department.

Morphology, anatomy, phylogenetic relationships and classification of fossil plants. Microscopic analysis of tissues and organs prepared by thin section, transfers, peels, polished and etched surfaces, and macerations.

**839. Population Ecology**

Summer. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Zoology Department.

An experimental-field approach to the study of populations and communities. Selected topics will deal with population growth, composition, predation, community structure and species abundance. This course is intended to complement ZOL 892.

**841. Physiology of the Algae**

Spring of even-numbered years. 4(3-2) Approval of department.

Physiology, chemistry, biochemistry, and aspects of the ultra-structure of the various algal divisions. Discussion of use of algae for the study of classical physiological and developmental problems.

**845. Current Problems in Plant Metabolism**

Fall, Winter, Spring. 1(1-0) 414.

**846. Seminar in Plant Pathology**

Fall, Winter, Spring. 1(1-0) Approval of department.

**850. Agrostology**

Fall of even-numbered years. 3(1-4) One year of botany or approval of department.

Comprehensive treatment of the systematics, evolution, ecology, geography and economic significance of the grass family; including pertinent aspects of genetics, cytology, anatomy and physiology.

**855. Effects of Ionizing Radiations on Plants**

Spring of odd-numbered years. 3(3-0) Approval of department.

Nature of ionizing radiations related to their effects upon plant growth and development including aspects of radiation sensitivity, dosimetry, direct and indirect effects, genetic, evolution and environmental implications related to modes of action at the cell, organism, and population levels.

**878. Comparative Limnology**

Summer. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Zoology Department.

Theoretical concepts and methods of analysis of environmental parameters influencing productivity of freshwaters. Comparative field investigations of lakes, streams, and other aquatic habitats.

**880. Plant Virology**  
Fall of odd-numbered years. 5(2-6)  
405 or approval of department.

External and internal symptomatology, transmission, interactions, purifications, assay and serology of plant viruses.

**881. Pathogenesis and Disease Resistance**  
Winter of odd-numbered years. 4(3-2)  
405 and 415, or approval of department.

Lectures, readings, and discussions on mechanisms of pathogenicity and infectivity; physiology and biochemistry of disease development; tumorigenesis; metabolic consequences of infection; nature of disease resistance; and parasitism.

**883. Plant Disease Control**  
Fall of even-numbered years. 3(2-3)  
405.

Principals and methods in controlling plant diseases. Considerable emphasis is placed on the chemistry of fungicides, and their role in controlling plant diseases. Other factors affecting disease epidemiology are covered.

**885. Plant Diseases in the Field**  
Spring. 4 credits. 405 and approval  
of department.

Diagnosis, distribution and sequential developments of plant diseases in the field.

**890. Selected Topics in Plant Pathology**  
Fall, Winter, Spring. 2 to 5 credits.  
Approval of department.

Topics will be selected from the following areas: parasitism, plant viruses, ecology, genetics, nematology, fungicidal action, and soil microbiology.

**899. Research**  
Fall, Winter, Spring, Summer. Variable  
credit. Approval of department.

Research for thesis at the master's degree level in one of the following fields: anatomy, cytology, ecology, genetics, lichenology, morphology, mycology, pathology, phycology, physiology, and taxonomy.

**918. Advanced Genetics**  
Winter of odd-numbered years. 3(3-0)  
Approval of department.

Role of the gene in differentiation and development, with special emphasis upon the genetic mechanisms responsible for the control of phenogenesis.

**920. Advanced Plant Taxonomy**  
Spring of even-numbered years. 4(4-0)  
824, ZOL 441.

Consideration of the recent scientific developments affecting plant classification.

**930. Advanced Plant Ecology**  
Winter of odd-numbered years. 3(2-4)  
Approval of department.

Fundamental theories and modern research horizons.

**951. Advanced Plant Physiology I**  
(943.) Fall of even-numbered years.  
3(3-0) Approval of department.

Selected topics concerning absorption and inorganic nutrition.

**952. Plant Physiology and Biochemistry I**  
(944.) Winter of odd-numbered years.  
3(3-0) Approval of department. Interdepartmental with and administered by the Biochemistry Department.

Selected topics concerning photosynthesis and related processes.

**953. Advanced Plant Physiology II**  
(945.) Spring of odd-numbered years.  
3(3-0) Approval of department.

Selected topics concerning the chemistry, physiology and mechanism of action of plant growth hormones.

**954. Advanced Plant Physiology III**  
(946.) Fall of odd-numbered years.  
3(3-0) Approval of department.

Selected topics from environmental physiology.

**955. Plant Physiology and Biochemistry II**  
(947.) Winter of even-numbered years.  
3(3-0) Approval of department. Interdepartmental with and administered by the Biochemistry Department.

Metabolic pathways of unique significance to plants.

**956. Advanced Plant Physiology IV**  
(948.) Spring of even-numbered years.  
3(3-0) Approval of department.

Factors influencing vegetative and reproductive physiology.

**999. Research**  
Fall, Winter, Spring, Summer. Variable  
credit. Approval of department.

Research for thesis at the doctor's degree level in one of the following fields: anatomy, cytology, ecology, genetics, lichenology, morphology, mycology, paleobotany, pathology, physiology, and taxonomy.

## BUILDING CONSTRUCTION

See Packaging

## BUSINESS LAW, INSURANCE AND OFFICE ADMINISTRATION BIO

### College of Business

**201. Shorthand I**  
Fall, Winter, Spring, Summer. 3(4-0)  
234 or 1 term typewriting.

Gregg shorthand theory, dictation and transcription for students with no previous training.

**202. Shorthand II**  
Fall, Winter, Spring, Summer. 3(3-1)  
201, 234 or 1 term shorthand and typewriting.

Development of theory and transcription competency, speed building.

**234. Typewriting I**  
Fall, Winter, Spring, Summer. 2(2-2)  
Approval of department.

Mastery of keyboard; building speed and accuracy; elementary typewriting problems.

**235. Typewriting II**  
Fall, Winter, Spring. 2(2-2) 234 or  
approval of department.

Improvement of speed and accuracy; arrangement of business letters, tabulation and manuscripts; production typewriting.

**236. Advanced Typewriting**  
Fall, Winter, Spring, Summer. 3(3-1)  
235 or 1½ to 2 years typewriting.

Instruction in specialized typewriting problems to develop high-level competency.

**304. Advanced Shorthand**  
(204.) Fall, Winter, Spring. 3(3-1)  
May re-enroll for a maximum of 6 credits. 202,  
235.

Continuation of 202.

**308. Secretarial Administration I**  
Winter, Spring. 4(4-0) 236, 304.  
Sophomores.

Development of proficiency in transcription skills.

**309. Secretarial Administration II**  
Fall, Winter, Spring. 4(4-2) 236,  
Sophomores.

Machine dictation-transcription; duplication and copying processes; machine calculations; records management.

**326. Business Writing**  
Fall, Winter, Spring, Summer. 4(4-0)  
Juniors.

Study and analysis of business and industrial communication problems; extensive instruction and practice in writing.

**341. Survey of Business Law**  
Fall, Winter, Spring, Summer. 4(4-0)  
Juniors. Not open to business administration  
students.

Historical development of the law; courts, court procedures and civil remedies, torts, crimes; contracts, agency, sales, negotiable instruments, real and personal property, including bailments and liens. Textbook and lecture rather than case approach.

**350. Principles of Risk and Insurance**  
(AFA 350, 296.) Fall, Winter, Spring,  
Summer. 4(3-0) Juniors or approval of department.

Risk and risk meeting methods with emphasis on the insurance mechanism. Fundamental principles, legal relationships, types of carriers and organization principle types of coverage and industry regulation.

**370. Office Administration**  
Fall, Winter, Spring, Summer. 3(3-0)  
Juniors.

Analysis of office function and relationship to business organization; information handling and data processing; office design and layout; responsibilities of office administrators.

**395. Principles of Urban Real Estate Administration**  
(AFA 395.) Fall, Spring. 5(5-0) AFA  
391 or approval of department; EC 201.

Concepts of urbanism, city functions and city growth. Examines physical, locational, legal, social and economic factors. Role of markets, governments and finance. Theories and techniques of valuing urban real estate.

**396. Personal Risks and Insurance**  
(AFA 396.) Fall, Summer. 5(5-0)  
350 or Juniors in business administration.

Personal risk analysis and personal insurance. Emphasis on life, health, automobile, fire and liability insurance. Programming personal insurance. Estate analysis and trusts. Social and economic aspects of personal insurance analyzed.

**397. Social Insurance Topics**  
(AFA 397.) Fall. 4(4-0) EC 200.

Systematic study of the legal, actuarial, social and political aspects of social insurance. Federal and State programs will be analyzed. Problems, solutions and potential alternatives to be discussed.

**400H. Honors Work**  
Fall, Winter, Spring, Summer. 1 to 15  
credits. Approval of department.

Independent and informal study in law, office administration or business communications.