

- 978. Seminar in Biochemistry**
Fall, Winter, Spring. 0 or 1(1-0)
Presentation and discussion of reports by graduate students on biochemical topics of current interest.
- 999. Research**
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

BIOLOGICAL SCIENCE B S

College of Natural Science

- 202. Foundations of Biological Science**
Fall, Winter, Spring. 4(3-3) N S 193.
Primarily for elementary education majors. Fundamental principles of biology.

- 211. General Biology**
Fall, Winter, Spring. 5(4-3) Organic chemistry or concurrently.
Integrated course emphasizing cell structure and function, genetics, comparative morphology and physiology of living organisms and their developmental and community relationships.

- 212. General Biology**
Fall, Winter, Spring. 5(4-3) 211.
Continuation of 211.

- 401. Biological Science for Teachers**
Fall. 4(3-3) Bachelor's degree.
Designed to show the nature of biological science in both its empirical and conceptual aspects. Emphasis is placed on life processes. The theories of the gene and of evolution are stressed. Macromorphology and micromorphology are covered as well as the topics of reproduction, metabolism, physiology, nutrition, enzymes, taxonomy and ecology. Quantitative developments are included whenever possible.

- 402. Biological Science for Teachers**
Fall, Winter. 4(3-3) 401.
Continuation of 401.

- 403. Biological Science for Teachers**
Spring. 4(3-3) 402.
Continuation of 402.

- 410. Biotic and Environmental Relationships**
Summer. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station.
Interrelationship of the biota with its environment. Factors determining distribution and abundance. Interaction of organisms.

- 420. Seminar in Recent Advances in Biological Science**
Fall, Winter, Spring, Summer. 3(3-0)
May re-enroll for a maximum of 6 credits if different topic is taken. Approval of department.
A series of lectures by senior faculty of topics on the history, development, the most recent advances and the possible future and limits of the Biological Sciences.

- 421. Seminar on Man, "The Human Organism"**
Fall, Winter, Spring, Summer. 3(3-0)
Approval of department.
The importance of new discoveries in biology for our understanding of the human organism with emphasis from the fields of genetics, molecular biology, behavior, developmental biology, physiology, and ecology.

- 800. Problems in Biological Science**
Fall, Winter, Spring. Variable credit.
B.S. degree in biological science.

- 999. Research**
Fall, Winter, Spring. Variable credit.
M.S. degree in biological science or equivalent.
Research in some phase of biological science, data to form the basis for the thesis required for the doctoral degree in biological science.

BIOPHYSICS BPY

**College of Human Medicine
College of Natural Science**

- 402. Introduction to Biophysics**
Spring. 5(5-0) PHY 259, MTH 113,
1 year organic chemistry and 1 year biology.
Salient features of biophysics, methods and principles. Structure and organization of biological materials, bioenergetics, radiation biophysics, bioelectric phenomena, biomechanics and psychophysics.

- 804. Experimental Biophysics**
Fall of odd-numbered years. 3 credits.
Approval of department.
Neuro-electric properties of cells, organs and animals, and methods of processing information in humans.

- 805. Experimental Biophysics**
Winter of even-numbered years. 3 credits. Approval of department.
Electrical and physical properties of significant biological molecules and structures.

- 806. Experimental Biophysics**
Spring of even-numbered years. 3 credits. Approval of department.
Interaction of protons and high energy particles with biological molecules and structures.

- 811. Principles of Biophysics**
Fall of even-numbered years. 5(5-0)
Approval of department.
Intensive lecture course treating biophysical characterization of biological materials, quantum biology, information theory, properties of biological systems.

- 812. Principles of Biophysics**
Winter of odd-numbered years. 5(5-0)
Approval of department.
Biophysical investigations of exciton theory, charge migration, radiation biophysics, primary photophysical processes in photosynthesis, surface chemistry and interfacial phenomena.

- 813. Principles of Biophysics**
Spring of odd-numbered years. 5(5-0)
Approval of department.
Consideration of membrane characteristics, the initiation and propagation of bioelectrical signals, sensory mechanisms, information processing in humans, invertebrate and vertebrate central nervous system functions, psychophysics, and cybernetics.

- 880. Special Topics in Biophysics**
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits.
Special topics within the five subdivisions of biophysics: structure, organization and function of biological phenomena, sensory perception, and psychophysics and biomechanics.

- 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.

- 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.

- 301. Elementary Plant Physiology**
Fall, Winter, Spring. 4(2-4) B S 212 or one course in botany. Not open to majors.
Processes concerned in plant life.

- 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.

- 304. Plant World**
(432.) Fall, Winter, Spring, Summer. 4(2-6) N S 191 or approval of department.
Basic plant science and its use in teaching. Lectures cover basic subject matter necessary to understanding plant kingdom, evidence and trends of evolution, economic uses and importance, basic principles of ecology. Laboratories give students opportunity to expand subject matter in one of several types of special projects: greenhouse, trees and shrubs, spring or summer flora, what plants do for man.

- 305. Poisonous Plants**
Spring. 2(0-4) N S 193. Primarily for Veterinary Medicine students.
Plants poisonous to livestock and human beings, particularly those occurring in Michigan.

- 318. Introductory Plant Taxonomy**
Spring. 3(2-3) 302 or B S 212 or approval of department.
Principles of identification, classification, nomenclature, and evolutionary relationships of vascular plants.

- 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. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station.

Taxonomy and evolutionary relationships among vascular plants illustrated by the local flora; extensive field collections.

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.

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 celloid 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. 3(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. 3(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.

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. Advanced Plant Pathology

Winter. 4(2-4) 402, 405; or approval of department.

Epidemiology of plant diseases. Detailed study, primarily from the literature of selected classical examples of plant diseases.

813. Special Problems

Fall, Winter, Spring. 1 to 4 credits. May re-enroll for a maximum of 16 credits. Approval of department.

814. Bryology

Summer of odd-numbered years. 3 credits. 318, 420, or approval of department. Given at W. K. Kellogg Biological Station.

Systematic and ecological relationships of the liverworts and mosses.

815. Lichenology

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

Morphology and taxonomy of lichens. The laboratory will be devoted to the collection and identification of lichens.

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.

817. Plant Morphology I

Fall. 4(2-6) 302.

First course in a series dealing with evolutionary morphology within the various groups of plants. The morphology and life histories of the several phyla of both fresh water and marine algae as a basis for an evolutionary study of land plants.

818. Plant Morphology II

Winter. 4(2-6) 817.

Structure and life histories of mosses and ferns in relation to origin of land flora and evolution of higher plants. Contributes to understanding of relationships between existing groups of plants.

819. Plant Morphology III

Spring. 4(2-6) 818.

Morphology and evolution of seed plants. Development and evolution of plant structures and habits which play critical roles in human economy and social evolution.

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.

821. Pteridology

Summer of even-numbered years. 3 credits. 318, 420, or approval of department. Given at W. K. Kellogg Biological Station.

Taxonomic, evolutionary, and ecological relationships of ferns; emphasis on local forms.

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, cytotaxonomy 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

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.

827. General Cytology

Spring and Summer of odd-numbered years. 4(3-2) One year general chemistry and 1 year general botany or general zoology. Designed primarily for biological science students.

Plant and animal materials. Cell morphology and variation, organization and distribution of standard inclusions, structure of the nucleus and the mechanism of mitosis.

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

Winter. 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 of odd-numbered years. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Zoology Department.

A synopsis of growth and regulation of plant and animal populations; interrelationships of biotic and environmental factors that control population responses and interactions. Laboratory and field experiments.

841. Physiology of the Algae

Spring. 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.

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.

880. Plant Virology

Fall. 5(2 6) 405 or approval of department.

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

881. Parasitism and Pathogenesis

Winter of odd-numbered years. 4(2-4) 415, 405, or approval of department.

Physiology of parasitism and disease development in plants. Parasitism by plant pathogens is compared with parasitism in other groups.

883. Plant Disease Control

Fall. 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.

919. Cytogenetics

Fall. 3(3-0) 918.

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

Spring of odd-numbered years. 3(2-4) 415, 450, 824.

Fundamental theories and modern research horizons.

943. Advanced Plant Physiology I

Fall of even-numbered years. 3(3-0) 414.

Selected topics concerning absorption and inorganic nutrition.

944. Advanced Plant Physiology II

Winter of odd-numbered years. 3(3-0) 414.

Selected topics concerning photosynthesis and related processes.

945. Advanced Plant Physiology III

Spring of odd-numbered years. 3(3-0) 415.

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

946. Advanced Plant Physiology IV

Fall of odd-numbered years. 3(3-0) 414.

Selected topics from environmental physiology.

947. Advanced Plant Physiology V

Winter of even-numbered years. 3(3-0) 414.

Metabolic pathways of unique significance to plants.

948. Advanced Plant Physiology VI

Spring of even-numbered years. 3(3-0) 415.

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, pathology, phycology, physiology, and taxonomy.

BUILDING CONSTRUCTION

See Packaging

BUSINESS LAW AND OFFICE ADMINISTRATION BOA

College of Business

201. Shorthand I

Fall, Winter, Spring, Summer. 4(4-0) 234 or 1 term typewriting.

Basic principles, elementary vocabulary, beginning dictation, and transcription for students with no previous training.