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. Approved by department.
Reading course in special topics adapted to the individual preparation and needs of the student.

899. Research
Fall, Winter, Spring, Summer. Variable credit. Approved by department.

922. Thermal Biophysics
Spring of odd-numbered years. 3(3-6)

990. Biophysics Seminar
Fall, Winter, Spring, Summer. 1 credit. May re-enroll for a maximum of 3 credits. Approved by department.

999. Research
Fall, Winter, Spring, Summer. Variable credit. Approved by department.

BOTANY AND PLANT PATHOLOGY

College of Natural Science

200. Resource Ecology and Man
Spring. 3(3-6)
For course description, see Interdisciplinary Courses.

201. Plants and Man
Winter. 3(3-6)
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 aesthetic importance.

205. Plant Biology
Winter. 3(3-2) 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) ESM 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 213 or approval of department.
Structures and life cycles of representative plant groups showing progressive evolutionary development.

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) or B S 212 or approval of department.
Plant diversity with emphasis on identification, classification, monocotyledons, 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, palaeoclimates 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. Non-technical 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 12 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. Winter. 4(2-4) B S 212 or approval of department.
Survey of plant disease organisms and their classification and identification. Characteristics of fungal and parasitic diseases including causative organisms, methods of infection, and host resistance and disease control.

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
Spring. 4(3-4) 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, Spring. 4(3-6) 302.
Preparation of plant materials for microscopic study. Special emphasis on the many variations in microtechnique, including paraffin and cellulose embedding, freezing microtomy and ultrathin sectioning for electron microscopy.

434. Plant Anatomy
Fall. Summer of even-numbered years. 4(3-4) 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. Geologic 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, 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
Interrelationships of plants and environment. Factors which govern their distribution.

455. Experimental Ecology
Spring, Fall. 3(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.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Credits</th>
<th>Prerequisites</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>459.</td>
<td>Insects in Relation to Plant Diseases</td>
<td>Winter of even-numbered years. 4(2-4)</td>
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<tr>
<td>392.</td>
<td>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. Modes of transmission and means of control. Transmission techniques and important plant-pathogen-insect relationships.</td>
<td>Winter. 11(0-0) May re-enroll for a maximum of 3 credits. A 3 312 and 1 course in botany or approval of department. Reports by students, faculty, and guest lecturers, with emphasis on current developments in research.</td>
<td>15 credits.</td>
<td>800.</td>
<td>Approval of department.</td>
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<tr>
<td>499.</td>
<td>Senior Seminar</td>
<td>Winter. 11(0-0) May re-enroll for a maximum of 3 credits. 83 312 and 1 course in botany or approval of department.</td>
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<tr>
<td>800.</td>
<td>Special Problems in Taxonomy</td>
<td>Fall, Winter, Spring. 1 to 15 credits. Approval of department.</td>
<td>15 credits.</td>
<td>801.</td>
<td>Approval of department.</td>
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<tr>
<td>801.</td>
<td>Special Problems in Anatomy and Morphology</td>
<td>Fall, Winter, Spring. 1 to 15 credits. Approval of department.</td>
<td>15 credits.</td>
<td>802.</td>
<td>Approval of department.</td>
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<tr>
<td>802.</td>
<td>Special Problems in Pathology</td>
<td>Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.</td>
<td>15 credits.</td>
<td>803.</td>
<td>Approval of department.</td>
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<tr>
<td>803.</td>
<td>Special Problems in Physiology</td>
<td>Fall, Winter, Summer, Summer. 1 to 15 credits. Approval of department.</td>
<td>15 credits.</td>
<td>804.</td>
<td>Approval of department.</td>
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<tr>
<td>804.</td>
<td>Special Problems in Cytology and Genetics</td>
<td>Fall, Winter, Spring. 1 to 15 credits. Approval of department.</td>
<td>15 credits.</td>
<td>805.</td>
<td>Approval of department.</td>
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<tr>
<td>805.</td>
<td>Special Problems in Algae</td>
<td>Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.</td>
<td>15 credits.</td>
<td>806.</td>
<td>Approval of department.</td>
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<tr>
<td>806.</td>
<td>Special Problems in Ecology</td>
<td>Fall, Winter, Spring, Summer. 1 to 15 credits. Approval of department.</td>
<td>15 credits.</td>
<td>807.</td>
<td>Approval of department.</td>
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<td>807.</td>
<td>Ecology and Epidemiology of Plant Pathogens</td>
<td>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.</td>
<td>813.</td>
<td>Approval of department.</td>
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<tr>
<td>813.</td>
<td>Special Problems</td>
<td>Fall, Winter, Spring. 1 to 4 credits. May re-enroll for a maximum of 16 credits. Approval of department.</td>
<td>4 credits.</td>
<td>816.</td>
<td>Approval of department.</td>
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<td>816.</td>
<td>Industrial Mycology</td>
<td>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, mushroom, and antibiotics. Several field trips will be taken.</td>
<td>820.</td>
<td>Approval of department.</td>
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<td>820.</td>
<td>Ecology of Hydrophytes</td>
<td>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.</td>
<td>15 credits.</td>
<td>824.</td>
<td>Approval of department.</td>
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<tr>
<td>824.</td>
<td>Tropical Biology: An Ecological Approach</td>
<td>Winter, Summer. 12 credits. Approval of department and acceptance by Organization for Tropical Studies. Interdepartmental with the Zoology Department. An introduction to the field of the principles of ecology as they operate in the tropics, especially concerning the tropical environment and biota, ecological relations, communities and evolution in the tropics. Given in Costa Rica by Organization for Tropical Studies.</td>
<td>15 credits.</td>
<td>825.</td>
<td>Approval of department.</td>
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<tr>
<td>825.</td>
<td>Advanced Tropical Botany</td>
<td>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 graminaceous, biology of tropical ferns, etc.</td>
<td>15 credits.</td>
<td>826.</td>
<td>Approval of department.</td>
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<td>826.</td>
<td>Cytogenetics</td>
<td>Fall. 11(4-3) 427 or ZOL 441 or approval of department. Detailed discussions on mitosis and meiosis; mechanisms of chromosome movement; fine structure of chromosomes and spindle apparatus; changes of chromosome number and structure and their genetic significance.</td>
<td>829.</td>
<td>Approval of department.</td>
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<td>829.</td>
<td>Paleoecology</td>
<td>Fall. 3(4-3) Approval of department. Interdepartmental with the Geology Department. Survey of fossil plants: their preservation, occurrence, geology, paleogeography, palaeoecology, evolutionary history, classification and representative types. One weekend field trip to a plant fossil locality.</td>
<td>831.</td>
<td>Approval of department.</td>
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<td>831.</td>
<td>Palynology</td>
<td>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 palaeoecological interpretation of most sedimentary accumulations and rocks. (Includes certain algae, protozoans, similar organisms certain affinity and dissociated fragments of larger organisms.)</td>
<td>835.</td>
<td>Approval of department.</td>
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<td>835.</td>
<td>Morphogenesis of Reproductive Structures</td>
<td>Spring of even numbered years. 4(3-4) Principles underlying the differentiation and growth of plant structures with special emphasis upon their functional and developmental genetic relationships.</td>
<td>836.</td>
<td>Approval of department.</td>
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<td>836.</td>
<td>Advanced Mycology: Current Biological Advances</td>
<td>Spring of even-numbered years. 4(3-4) Approval of department. Recent and current advances in the biology of fungi, with emphasis upon experimental studies of structural and functional differentiation during conjugation.</td>
<td>837.</td>
<td>Approval of department.</td>
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<td>837.</td>
<td>Advanced Mycology: Morphology and Taxonomy</td>
<td>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.</td>
<td>838.</td>
<td>Approval of department.</td>
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<td>838.</td>
<td>Advanced Paleobotany</td>
<td>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, transfer, peels, polished and etched surfaces, and macerations.</td>
<td>839.</td>
<td>Approval of department.</td>
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<td>839.</td>
<td>Population Ecology</td>
<td>Spring of even-numbered years. 3(0) 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.</td>
<td>845.</td>
<td>Approval of department.</td>
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<td>846.</td>
<td>Seminar in Plant Pathology</td>
<td>Fall, Winter, Spring. 1(1-0) Approval of department.</td>
<td>850.</td>
<td>Approval of department.</td>
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<td>850.</td>
<td>Agrostology</td>
<td>Fall of even-numbered years. 2(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.</td>
<td>855.</td>
<td>Approval of department.</td>
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<td>855.</td>
<td>Effects of Ionizing Radiations on Plants</td>
<td>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.</td>
<td>878.</td>
<td>Approval of department.</td>
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<td>878.</td>
<td>Comparative Limnology</td>
<td>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 freshwater. Comparative field investigations of lakes, streams, and other aquatic habitats.</td>
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</table>
880. Plant Virology
Fall of odd-numbered years. 5(2-6) 
Approval of department.
External and internal symptomatology, transmis-
sion, interactions, purifications, assay and se-
erology of plant viruses.

881. Pathogenesis and Disease Resistance
Winter of odd-numbered years. 4(3-2)
Approval of department.
Lectures, readings, and discussions on mech­
anisms of pathogenicity and infectivity; physi­
ology and biochemistry of disease development;
tumorogenesis; metabolic consequences of infec-
tion; nature of disease resistance; and para-
sitism.

883. Plant Disease Control
Fall of even-numbered years. 3(2-3)
Application of methods controlling plant dis-
cases. Considerable emphasis is placed on the
chemistry of fungicides, and their role in con-
trolling 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 develop-
ments of plant diseases in the field.

889. Research
Fall, Winter, Spring, Summer. Varia-
table credit. Approval of department.
Research for thesis at the master's degree level
in one of the following fields: anatomy, cyto-
ology, ecology, genetics, lichenology, morphol-
ogy, mycology, palaeobotany, pathology, phy-
ology, physiology, and taxonomy.

918. Advanced Genetics
Winter of odd-numbered years. 3(3-0)
Approval of department.
Role of the gene in differentiation and develop-
ment, with special emphasis upon the genetic
mechanisms responsible for the control of pheno-
gensis.

920. Advanced Plant Taxonomy
Spring of even-numbered years. 4(4-0)
834, ZOL 441.
Consideration of the recent scientific develop-
ments affecting plant classification.

930. Advanced Plant Ecology
Winter of odd-numbered years. 3(2-4)
Approval of department.
Fundamental theories and modern research hori-
zons.

951. Advanced Plant Physiology I
(943.) Winter of odd-numbered years.
3(3-0) Approval of department.
Selected topics concerning absorption and in-
organic nutrition.

952. Plant Physiology and Biochemistry I
(944.) Winter of odd-numbered years.
3(3-0) of department. Interdepart-
mental with and administered by the Biochem-
dey 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, physi-
ology 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. Interdepart-
mental with and administered by the Bioch-
demy 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, cyto-
ology, ecology, genetics, lichenology, morphol-
ogy, mycology, palaeobotany, pathology, phy-
ology, physiology, and taxonomy.

BUILDING CONSTRUCTION
See Packaging

BUSINESS LAW, INSURANCE
AND OFFICE ADMINISTRATION

College of Business

201. Shorthand I
Fall, Winter, Spring. 3(4-0)
3rd or 1 term typewriting.
Gregg shorthand theory, dictation and tran-
scription for students with no previous training.

202. Shorthand II
Fall, Winter, Spring. 3(3-1)
2nd or 1 term shorthand and typewriting.
Development of theory and transcription compet-
ency, speed building.

234. Typewriting I
Fall, Winter, Spring. 3(3-2)
Approval of department.
Mastery of keyboard; building speed and accu-
rance; elementary typewriting problems.

235. Typewriting II
Fall, Winter, Spring. 2(2-3) 3rd or approval of department.
Improvement of speed and accuracy; arrange-
ment of business letters, tabulation and manu-
scripts; production typewriting.

236. Advanced Typewriting
Fall, Winter, Spring. 3(3-1)
3rd or 3rd to 2 years typing.
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,
234.
Continuation of 202.

368. Secretarial Administration I
Winter. Spring. 4(4-0) 206, 304.
Sophomores.
Development of proficiency in transcription skills.

390. Secretarial Administration II
Fall, Winter. Spring. 4(4-3) 206,
Sophomores.
Machine dictation - transcription; duplication and
printing processes; machine calculations; record
management.

326. Business Writing
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 instrumen-
tes, real and personal property, including
bailments and liens. Textbook and lecture rather
than case approach.

350. Principles of Risk and
Insuroane
(495, 296.) Fall, Winter, Spring, Summer.
Juniors or approval of depart-
ment.
Risk and risk meeting methods with emphasis on
the insurance mechanism. Fundamental prin-
ciples, legal relationships, types of carriers and
organization principles types of coverage and
industry regulation.

370. Office Administration
Juniors.
Analysis of office function and relationship to
business organization; information handling and
data processing; office design and layout; re-
sponsibilities of office administrators.

395. Principles of Urban Real
Estate Administration
(495.) 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 tech-
iques of valuing urban real estate.

396. Personal Risks and Insurance
(496.) Fall, Spring. 5(5-0)
330 or Juniors in business administration.
Personal risk analysis and personal insurance.
Emphasis on life, health, automobile, fire and
liability insurance. Programming personal in-
urance. Estate analysis and trusts. Social and
economic aspects of personal insurance anal-
alyzed.

397. Social Insurance Topics
(497.) Fall. 4(4-0) EC 200.
Systematic study of the legal, economic, social
and political aspects of social insurance. Fed-
eral and State programs will be analyzed.
Problems, solutions and potential alternatives to
be discussed.

400H. Honors Work
Fall, Winter, Summer. 1 to 15
credits. Approval of department.
Independent and informal study in law, office
administration or business communications.