

**Descriptions - VETERINARY MEDICINE (College of)**

**of**

**Courses**

**594. Veterinary Toxicology**  
(530.) Spring, 4(4-0) Ninth-term  
Veterinary Medicine students.  
Pharmacological basis and pathological features of diseases of animals caused by common toxic chemicals with emphasis on clinical manifestations, diagnosis, prevention, and treatment.

**596. Diseases of Bones and Joints**  
(536.) Spring, 3(3-0) Ninth-term  
Veterinary Medicine students.  
Anatomy and pathophysiology of diseases of bones and joints. Diagnosis, prognosis and treatment of abnormalities involving bones and joints.

**602. Veterinary Practice Management**  
Spring, 2(2-0) Ninth-term Veterinary  
Medicine students, approval of college.  
Establishment of a veterinary practice.

**610. Veterinary Externship**  
Fall, Winter, Spring, Summer, 8 to 16  
credits. May reenroll for a maximum of 16  
credits. Veterinary Medicine students;  
completion of preclinical courses and approval of  
college. Students may not receive credit in both V  
M 610 and LSM 674.  
Clinical or research experience in an off-campus  
setting.

**ZOOLOGY**

**ZOL**

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

**IDC. Resource Ecology and Man**  
For course description, see  
Interdisciplinary Courses.

**301. Nature and Man**  
Fall, 4(2-6) Three terms of natural  
science; not open to zoology majors.  
Relates man to his natural environment. Chief  
emphasis on identifying characteristic animal life  
in broad areas of nature and how man fits or  
misfits into these. Lectures, laboratory and field  
trips illustrate this relationship.

**302. Vertebrate Life of the Past**  
Fall 3(3-0) One course in physical or  
biological science or Juniors. Interdepartmental  
with and administered by the Department of  
Geology.  
Fossil vertebrates from fish to man.

**303. Introductory Animal Systematics**  
Fall, 5(5-0) B S 212.  
General survey of animals including origin,  
evolution and dispersal, morphological  
characteristics, reproductive patterns, behavior,  
ecology and zoogeography of invertebrates and  
vertebrates.

**304. Biology, Behavior and Man**  
Winter 3(3-0) Juniors; not open to  
zoology majors.  
Examines philosophical and biological issues  
which make the study of animal behavior relevant  
to man. Emphasizes history of animal behavior,  
current theories, and experiments relating  
biological and environmental determinants of  
adaptive and non-adaptive behavior patterns.

**317. Principles of Development**  
Fall, Spring, 3(3-0) B S 212.  
Development of animals, especially vertebrates.  
Principles are illustrated by modern experimental  
studies of developmental problems.

**318. Principles of Development Laboratory**  
Fall, Spring, 2(0-6) ZOL 317 or  
concurrently; B S 212.  
Principles of development illustrated by analysis  
of the ontogeny of selected organisms.

**320. Vertebrate Systematics Laboratory**  
Winter, 2(0-6) ZOL 303. Open to  
Zoology majors only; others: approval of  
department.  
Systematics, morphology and natural history of  
vertebrate animals as illustrated by representative  
species within the seven classes.

**325. Invertebrate Systematics Laboratory**  
Winter, 2(0-6) ZOL 303. Open to  
Zoology majors only; others: approval of  
department.  
Comparative morphology and taxonomy of the  
major invertebrate phyla and an examination of  
their characteristic behavior and physiology.

**337. The Fossil Record of Organic Evolution**  
Spring, 3(3-0) One course in a natural  
science; Juniors. Interdepartmental with and  
administered by the Department of Geology.  
The direct evidence for organic evolution in the  
fossil record. Evolution of life from prebiological  
systems to man. Impact of fossil discoveries on  
human thought.

**341. Human Heredity**  
Fall, Winter, Summer, 4(4-0) Three  
terms of Natural Science; Sophomores; not open  
to zoology majors. Students may not receive  
credit in more than one of the following: ZOL  
341, ZOL 441.  
Inheritance of human physiological, and  
psychological traits. Forces that influence human  
evolution. Applications of heredity in fields of  
education, sociology, anthropology, psychology,  
dentistry, and medicine.

**344. Introductory Animal Systematics Laboratory**  
Fall, 2(1-3) ZOL 303 concurrently.  
Interdepartmental with and administered by  
Lyman Briggs College.  
Laboratory examination of form and function of  
representative vertebrate and invertebrate  
animals.

**389. Animal Ecology**  
Winter, 4(3-4) B S 212 or concurrently.  
Animals in relation to their environment. Factors  
affecting the distribution and abundance of  
animals. Interrelationships between climate, soils,  
vegetation, geologic history and animal life.  
Population characteristics as related to  
reproduction and mortality factors.

**391. Zoological Problems**  
Fall, Winter, Spring, Summer, 1 to 8  
credits. May reenroll for a maximum of 12  
credits. Juniors; B S 212; 6 credits in zoology;  
approval of department.  
Advanced work in morphology, field zoology,  
genetics, mammalogy, ornithology, or  
ichthyology.

**400H. Honors Work**  
Fall, Winter, Spring. Variable credit.  
Juniors.

**401. Comparative Physiology I**  
Fall, 4(3-4) PSL 240 or B S 212; CEM  
131 or CEM 141. Interdepartmental with and  
administered by the Department of Physiology.  
A comparison of osmoregulation, digestion,  
respiration, and other physiological processes in a  
wide range of organisms.

**402. Comparative Physiology II**  
Winter, 4(4-0) PSL 401 or approval of  
department. Interdepartmental with the  
Department of Physiology.  
A comparison of sensory, motor, endocrine and  
other integrative mechanisms in animals.

**404. Biological and Ecological Concepts for Engineers and Mathematicians**  
Winter, 3(3-0) Approval of department.  
Interdepartmental with Systems Science.  
Biological and ecological concepts important to  
formal analysis of living systems, vital properties,  
processes, and limitations; population dynamics,  
selection, competition, and predation; ecological  
community structure and function; industrialized  
ecosystem.

**405H. Experiments in Zoology I**  
(405.) Fall, 4(0-12) Approval of  
instructor.  
An integrated series of selected experiments in  
the topics of behavior, ecology, morphology and  
physiology.

**406. Experiments in Zoology II**  
Winter, 5(2-9) Approval of instructor.  
An integrated series of selected experiments in  
topics of cell biology, embryology and genetics.

**407. Experiments in Zoology III**  
Spring, 3(0-9) ZOL 405 or ZOL 406,  
approval of instructor.  
Special problems.

**408. Freshwater Ecology**  
Summer, 6 Credits. B S 212 or  
approval of department. Given at W. K. Kellogg  
Biological Station. Interdepartmental with  
Biological Science and the Department of Botany  
and Plant Pathology and administered by  
Biological Science.  
The ecology of freshwater ecosystems, their biotic  
structure and the functional interrelationships of  
environmental variables regulating population  
dynamics, productivity and community structure.  
Extensive field investigations.

**410. Terrestrial Ecology**  
Summer, 6 credits. B S 212 or approval  
of department. Given at W. K. Kellogg Biological  
Station. Interdepartmental with Biological  
Science and the Department of Botany and Plant  
Pathology and administered by Biological  
Science.  
Factors determining distribution and abundance.  
Interrelationship of plants, animals, and  
environment. Extensive field investigations of  
several types of terrestrial communities in light of  
current theory.

**413. Animal Behavior**  
Spring, 4(4-0) B S 212.  
Description of the known behavior of the various  
vertebrate and invertebrate phyla with emphasis  
upon adaptive significance. Thus, special  
attention will be given to mating, defensive, and  
nutritive behavior. The genetics and ontogeny of  
behavioral patterns will be presented where  
known. Behavior will be related to the ecology of  
various animal populations.

- 414. Biological Mechanisms of Animal Behavior**  
Winter of odd-numbered years. 3(3-0) or 5(3-6) ZOL 413 recommended.  
Consideration of neurological and hormonal mechanisms controlling behavior. Emphasis will be upon mammalian systems, and will deal with the assumptions which underlie current concepts in the biology of behavior.
- 415. Ecological Aspects of Animal Behavior**  
Fall. 4(4-0) ZOL 413.  
Consideration of orientation, navigation and homing behavior, food preferences, habitat selection, exploration, behavioral periodicity, communication, social organization and the embryology of behavior. In both vertebrates and invertebrates.
- 417. Advanced Developmental Biology**  
Spring. 3(3-0) or 5(3-6) ZOL 317.  
Molecular and cellular biology of development. Complementary laboratory exercises with emphasis on experiments.
- 420. Ecology of Animal Parasites**  
Summer. 6 Credits. BS 212 or approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the departments of Microbiology and Public Health, and Fisheries and Wildlife. Administered by the Department of Microbiology and Public Health.  
Parasitism of animals by protozoa, helminths and arthropods with emphasis on the interrelationships of host-parasite associations with the natural environments.
- 428. Morphology of the Chordates**  
(314.) Winter, Spring. 5(3-6) BS 212.  
Comparative and functional morphology of chordates. Laboratory includes dissection of representatives of most vertebrate classes.
- 430. Vertebrate Paleontology**  
Winter. 4(3-3) ZOL 428, or approval of department. Interdepartmental with and administered by the Department of Geology.  
Fossil vertebrates with emphasis on the evolution of major groups. Laboratories on modern techniques and on the identification and interpretation of fossils.
- 437. Invertebrate Paleontology**  
Fall. 4(3-4) GLG 202 or ZOL 303 or approval of department. Interdepartmental with and administered by the Department of Geology.  
Systematics and evolution of marine invertebrates; uses of fossils in correlation and delineation of geologic time; structure and morphology of fossils as related to evolutionary development.
- 438. Paleocology**  
Spring. 4(3-4) GLG 202 or ZOL 389 or approval of department. Interdepartmental with and administered by the Department of Geology.  
Distribution and abundance of marine fossils; response of skeletal morphology to environmental conditions; uses of fossils in reconstructing ancient climates and depositional environments.
- 441. Fundamental Genetics**  
Fall, Spring. 5(5-0) BS 212. Students may not receive credit in more than one of the following: ZOL 341, ZOL 441.  
Survey of principles of heredity in animals, plants, and microorganisms. Serves as single course in genetics for majors in any of the biological sciences, and as prerequisite for further work in genetics.
- 442. Advanced Genetics**  
Winter. 3(3-0) ZOL 441 or approval of instructor.  
Classical and molecular examination of eight to ten advanced topics and recent discoveries in genetics.
- 443. Developmental Genetics**  
Spring. 4(4-0) ZOL 441 and ZOL 317.  
Mechanisms of gene action. Role of genes in the embryology, morphology, and physiology of organisms.
- 450. Comparative Histology**  
Fall. 4(3-3) BS 212.  
The comparative structure of cells of selected invertebrate and vertebrate organisms and their interactions to form tissues.
- 456. Foundations of Developmental Biology**  
Winter of even-numbered years. 3(3-0) ZOL 317; ZOL 417 recommended.  
Reading and discussion of original research which posed significant problems of modern developmental biology.
- 460. Field Ornithology**  
Summer. 3 credits. BS 212 or approval of department. Given at W. K. Kellogg Biological Station.  
The study of birds of the regional area, with emphasis on field techniques in relation to problems in avian identification, ecology and behavior.
- 461. Ornithology**  
Winter. 4(3-2) ZOL 320 or ZOL 428.  
Principles of classification, structure, distribution, migration, population biology and life history of birds. Identification of birds by size, form and song.
- 462. Laboratory in Ornithology**  
Spring. 3(0-9) ZOL 461.  
Field work with avian populations, foraging behavior, territoriality, time-activity, habitat selection and selected research topics.
- 471. Ichthyology**  
Spring. 3(2-3) FW 301 or ZOL 320 or ZOL 428. Interdepartmental with and administered by the Department of Fisheries and Wildlife.  
Classification and Natural history of fishes. Emphasis on food, game, and forage fishes.
- 476. Limnology**  
Winter. 3(3-0) CEM 131 and CEM 161; BOT 450 or ZOL 389. Students may not receive credit for both FW 376 and FW 476. Interdepartmental with and administered by the Department of Fisheries and Wildlife.  
Ecology of lakes and streams with special reference to physical, chemical and biological factors affecting their productivity.
- 477. Limnological Methods**  
Winter. 3(0-9) ZOL 481; FW 476 concurrently; ENT 301, ENT 302 recommended. Interdepartmental with and administered by the Department of Fisheries and Wildlife.  
Methods and instruments of limnological field investigation on lakes and streams.
- 480. Biology of Fresh-Water and Terrestrial Invertebrates**  
Summer. 6 credits. ZOL 325 or approval of department. Given at W. K. Kellogg Biological Station.  
Systematics and ecology of invertebrates with emphasis on the local fauna.
- 481. Invertebrate Zoology**  
Fall. 5(3-6) ZOL 325 or approval of department.  
Biology of invertebrates with special reference to their natural history, classification, distribution, and economic importance.
- 482. Biology of the Protozoa**  
Winter. 3(3-0) or 5(3-6) BS 212.  
Structures and functions of animal-like, eukaryotic microorganisms.
- 483. Physiological Ecology**  
Winter. 4(3-2) BS 212.  
Aspects of physiology that bear particularly on the interrelationships between animals and their environments.
- 484. Herpetology**  
Spring. 5(3-6) ZOL 320 or ZOL 428.  
Classification and natural history of amphibians and reptiles, with emphasis on Michigan species.
- 486. Mammalogy**  
Fall. 4(2-6) ZOL 320 or ZOL 428.  
Classification distribution, natural history of mammals with emphasis on Michigan species. Field studies, preparation of study specimens.
- 489. Animal Distribution**  
Fall. 3(3-0) ZOL 303 or approval of instructor.  
Principles and patterns of animal distribution. Emphasis on major faunal regions, centers of origins, and concepts relating to the distribution of modern vertebrates.
- 492. Cytochemistry**  
Spring. 4(3-3) BS 212.  
General principles of microscopy, microtomy, fixation, embedding and sectioning of animal tissues; study of various cellular organelles and the localization of lipids, carbohydrates, proteins, nucleic acids and various hydrolytic enzymes in the cells.
- 495. Undergraduate Seminar**  
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Juniors, and approval of department.  
Reading and discussion of articles relating to economic, social and environmental impact of new discoveries in biological sciences.
- 497. Principles of Endocrinology**  
Winter. 4(4-0) One year organic chemistry; ZOL 317. Interdepartmental with the Department of Physiology.  
Hormonal principles, illustrated by experimental observations, in vertebrates and invertebrates. Emphasis on cellular endocrinology. Group discussion, background in organic chemistry and cell biology strongly recommended. Term paper required.
- 499. Undergraduate Thesis**  
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Juniors, written approval of instructor.  
Laboratory research culminating in the preparation and defense of an undergraduate thesis.
- 804A. Neuroscience Laboratory I**  
Winter. 4(2-4) Approval of instructor. Interdepartmental with the departments of Biophysics, Physiology, and Psychology. Administered by the Department of Psychology.  
Development of skills in the methods, techniques and instrumentation necessary for research in a variety of areas concerned with neuroscience.

## Descriptions - ZOOLOGY

of

### Courses

#### 804B. Neuroscience Laboratory II

Spring. 4(2-4) PSY 804A.  
Interdepartmental with the departments of Biophysics, Physiology, and Psychology. Administered by the Department of Psychology. Continuation of ZOL 804A.

#### 817. Ecology of Zooplankton

Summer of every third year. Given in 1977. 3 credits. Given at W. K. Kellogg Biological Station.  
Biology, distribution, and abundance of planktonic animals with special emphasis on life tables, filtering rates, food selection, production dynamics, fish predation, niche and species diversity.

#### 820. Behavior of Animal Populations

Fall. 4(4-0) ZOL 413 and written approval of department.  
Behavior on the ecological level. Characteristics of populations rather than individuals will be stressed. Evolution will be considered on the population level.

#### 823. Neurological and Hormonal Correlates of Animal Behavior

Spring. 4(4-0) ZOL 414, ZOL 415.  
Lectures, papers and discussions on the neural and hormonal determinants of animal behavior. Emphasis will be placed upon mammalian behavior.

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

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

#### 827. Basic Neurobiology

Fall. 4(4-0) Approval of department. Interdepartmental with and administered by the Department of Biophysics.  
Neural structure and function at cellular and intercellular levels. Membrane and synaptic potentials, receptor transduction, and intracellular transport with an introduction to comparative and evolutionary aspects.

#### 830. Advanced Vertebrate Zoology

Winter. 4(4-0) May reenroll for a maximum of 12 credits. ZOL 303; two years of undergraduate zoology and approval of department.  
Advanced vertebrate biology including systematics, ecology, distribution, morphology.

#### 833. Advanced Invertebrate Paleontology

**B. Quantitative Paleontology**  
Fall. 3(2-4) GLG 437 or GLG 438. Interdepartmental with and administered by the Department of Geology.  
Application of mathematical tools to paleontological problems, including statistical applications and numerical taxonomy; computer applications.

#### **C. Paleocology**

Fall. 3(2-4) GLG 437 or GLG 438. Interdepartmental with and administered by the Department of Geology.  
Advanced problems in population, community, and province level paleocology, primarily of marine invertebrates, including study of taxonomy, diversity, and adaptation.

#### **D. Developmental Paleontology**

Fall. 3(2-4) GLG 437 or GLG 438, ZOL 317 or approval of department. Interdepartmental with and administered by the Department of Geology.  
Application of the principles of development to the ontogeny and phylogeny of fossil invertebrates as known from skeletal morphology.

#### **E. Evolutionary Paleontology**

Fall. 3(2-4) GLG 437 or GLG 438. Interdepartmental with and administered by the Department of Geology.  
Aspects of evolutionary biology that can be studied in the fossil record, with emphasis on marine invertebrates.

#### 834. Advanced Vertebrate Paleontology

Winter of even-numbered years. 3(3-0) GLG 430 or approval of department. Interdepartmental with and administered by the Department of Geology.  
Recent advances and controversial issues in vertebrate paleontology including origin, classification, phylogeny, and stratigraphic relationships of fossil vertebrates.

#### 839. Population Ecology

Summer. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the Department of Botany and Plant Pathology.  
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.

#### 843. Ecosystem Analysis, Design and Management

Spring. 3(3-0) SYS 442 or ZOL 404. Interdepartmental with and administered by Systems Science.  
Groups of students from various biological and non-biological disciplines will synthesize and analyze models of selected biological systems. Projects should yield information relevant to solution of contemporary ecological problems.

#### 844. Problems in Human Genetics

Spring. 5(5-0) ZOL 441 or approval of department.  
Methods used in the study of human genetics and their application to medical, physiological and social problems. Laboratory consists of field trips and independent study selected by the student in consultation with the instructor.

#### 845. Organic Evolution

Winter. 4(4-0) ZOL 441 and a course in comparative biology.  
A historical view of evolutionary thought, a presentation of the evolution of prebiological systems and a critical evaluation of the evolution of genetic systems.

#### 847. Analysis of Gene Organization and Transmission

Winter of odd-numbered years. 4(4-0) ZOL 441 and approval of department.  
Formal and molecular analysis of gene organization and transmission in higher eucaryotes. Intended for graduate students with background in genetics and/or cytogenetics.

#### 850. Ultrastructure

Fall. 4(2-6) BOT 427.  
New developments in instrumentation and techniques of electron microscopy and their practical application in studying morphological and physiological changes in various organ systems.

#### 857. Experimental Morphology

Spring. 4(3-1) ZOL 317.  
Analysis of mechanisms of morphogenesis, particularly as these occur in post-gastrular stages of development. The significance of tissue interactions in developing and regenerating systems will be emphasized.

#### 859. Analysis of Hormone Action

Spring. 4(4-0) ZOL 317 or approval of department. Interdepartmental with the Department of Physiology.  
Discussion of recent work on the molecular and developmental aspects of hormone action in vertebrates and invertebrates. Selected topics to vary from year to year.

#### 865. Advanced Neurobiology

Spring. 4(4-0) BPY 827. Interdepartmental with the departments of Anatomy, Biophysics, Physiology, and Psychology. Administered by the Department of Anatomy.  
Basic organization, structure and function of neural networks comprising sensory, motor, and autonomic systems including examples from invertebrates and vertebrates. Attendance at neuroscience seminar is required.

#### 871. Ecology of Fishes

Summer. 3(1-6) Approval of instructor or ZOL 389 or FW 473. Given at the W. K. Kellogg Biological Station. Interdepartmental with the Department of Fisheries and Wildlife.  
Exploration of ecological problems with particular emphasis on growth, food and habitat selection, population biology and niche relations. Field and experimental investigations of fish communities.

#### 878. Comparative Limnology

(478.) Summer. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the Department of Botany and Plant Pathology.  
Theoretical concepts and methods of analysis of environmental parameters influencing productivity of freshwaters. Comparative field investigations of lakes, streams, and other aquatic habitats.

#### 881. Biology of the Arthropoda

Winter. 5(3-6) ZOL 481 or approval of department. Interdepartmental with the Department of Entomology.  
Ecology, life cycles, morphology, taxonomy, and distribution of arthropoda other than insects.

#### 882. Cellular Morphogenesis

Winter. 2(2-0) One course in biochemistry, approval of department.  
Selected topics on the structure, biological processes and differentiation of living cells.

#### 883. Laboratory in Cellular Morphogenesis

Winter. 2(0-6) Approval of department.  
Laboratory work in cellular morphogenesis accompanying ZOL 882.

#### 885. Vertebrate Neural Systems I

Fall of odd-numbered years. 5(3-4) Approval of department; ANT 815 and BPY 827 recommended. Interdepartmental with the departments of Biophysics, Physiology, and Psychology. Administered by the Department of Psychology.  
Structure and function of major component systems of vertebrate brains, their evolution, ontogeny and comparative analysis in mammals, birds, reptiles, amphibians and fish. Interrelation of behavioral, anatomical and physiological studies.

**886. Vertebrate Neural Systems II**  
*Winter of even-numbered years. 5(3-4)*  
PSY 885. *Interdepartmental with the departments of Psychology, Biophysics, and Physiology.*  
Continuation of ZOL 885. Major component systems of vertebrate brains, their evolution, ontogeny, and comparative analysis in mammals, birds, reptiles, amphibians and fish. Interrelation of behavioral, anatomical, and physiological studies.

**890. Special Problems**  
*Fall, Winter, Spring, Summer. 1 to 15 credits. Two years of undergraduate zoology. Approval of department.*  
Consideration of current problems.

**891. Current Topics in Ecological Research**  
*Summer. 1 credit. May reenroll for a maximum of 4 credits. Approval of department. Given at W. K. Kellogg Biological Station.*  
Discussions and special problem work; current theoretical views and investigations; treatment of the dynamics of energy and biomass in terrestrial and aquatic ecosystems; methods of analysis.

**892. Dynamics of Biologic Populations**  
*Winter. 5(4-3) One statistics course, 1 ecology course or approval of department.*  
Growth, regulation, competition, predator-prey, life history strategies and spatial dynamics of animal populations.

**893. Fertilization and Early Embryogenesis**  
*Fall. 3(3-0) Developmental biology, biochemistry and approval of department. ZOL 894 recommended concurrently.*  
Developmental biology of early stages of animal life, emphasis on physiology and biochemistry of marine invertebrate eggs.

**894. Methods in Cellular and Developmental Biology**  
*Fall. 3(1-6) Cellular and developmental biology, biochemistry and approval of department.*  
Theory and practice of research methods in cellular and developmental biology, with emphasis on physicochemical approaches.

**895. Seminar Topics**  
*Fall, Winter, Spring. 1 credit per term. May reenroll for a maximum of 6 credits. Approval of department.*  
Graduate level seminars on current research topics in biology.

**896. Animal Community Ecology**  
*Winter. 4(4-0) ZOL 892, approval of instructor.*  
Patterns and processes in animal communities with emphasis on structure, species diversity and stability.

**897. Ecosystem Ecology**  
*Fall. 3(3-0) ZOL 389 or BOT 450.*  
Concepts of ecosystem structure, energy flow, and nutrient cycling in representative terrestrial and aquatic ecosystems.

**899. Master's Thesis Research**  
*Fall, Winter, Spring, Summer. Variable credit. Approval of department.*  
Research for the master's degree in genetics, morphology, mammalogy, wildlife management, ornithology, fisheries biology, limnology, quantitative biology, invertebrate, experimental embryology, animal behavior, herpetology.

**999. Doctoral Dissertation Research**  
*Fall, Winter, Spring. Variable credit.*  
*Fifteen graduate credits in organizational behavior courses and approval of instructor.*  
Research for the Ph.D. degree in genetics, morphology, mammalogy, wildlife management, ornithology, fisheries biology, limnology.