

## Descriptions - Veterinary Medicine

of

### Courses

#### 566. Nervous System

(512.) Spring. 3(3-0) Sixth-term Veterinary Medicine students.

Normal and abnormal neural structure and function in animals with emphasis on clinical neurology and neuropathology.

#### 568. Integumentary System

(524.) Spring. 3(3-0) Sixth-term Veterinary Medicine students.

Diseases of the integumentary system of animals with emphasis on laboratory examinations, interpretations of pathological features, diagnosis and treatment.

#### 570. Principles of Anesthesia

Fall. 2(2-0) Seventh-term Veterinary Medicine students.

Principles and techniques of administering anesthetic agents. Supportive care including fluid therapy. Emergency procedures. Euthanasia agents.

#### 571. Core of Medicine Laboratories II

Fall. 1(0-3) Seventh-term Veterinary Medicine students.

Classification, diagnosis and treatment of diseases of the cardiovascular, respiratory and digestive systems of animals. Preanesthetic and anesthetic procedures and skills.

#### 572. Cardiovascular System

(513.) Fall. 3(3-0) Seventh-term Veterinary Medicine students.

Pathogenesis, diagnosis, and management of cardiovascular diseases of animals. Anatomical, physiological, pathological and pharmacological principles providing basis for medical and surgical treatment. Diagnostic and surgical procedures and radiologic interpretation.

#### 574. Respiratory System

(515.) Winter. 4(4-0) Eighth-term Veterinary Medicine students.

Pathogenesis, diagnosis, and management of respiratory diseases of animals; anatomical, physiological and surgical treatments. Diagnostic and surgical procedures and radiologic interpretation.

#### 576. Digestive System I

(522.) Fall. 4(4-0) Seventh-term Veterinary Medicine students.

Pathogenesis, diagnosis, and treatment of diseases of the alimentary tract and digestive organs of small animals.

#### 578. Principles of Surgery I

Fall. 3(2-3) Seventh-term Veterinary Medicine students.

Fundamentals of surgery. Common procedures used in soft tissue surgery with small animals.

#### 580. Theriogenology

(516.) Fall. 6(5-3) Seventh-term Veterinary Medicine students.

Reproductive function and diseases of animals' genital structure and function and endocrine controls. Examination, diagnosis and treatment of the mammary gland and reproductive tract.

#### 581. Core of Medicine Laboratories III

Winter. 3(0-9) Eighth-term Veterinary Medicine students.

Diagnosis and treatment of diseases of the reproductive, digestive and musculoskeletal systems.

#### 582. Musculoskeletal System I

(526.) Winter. 3(3-0) Eighth-term Veterinary Medicine students.

Diagnosis and treatment of musculoskeletal diseases of animals with emphasis on pathological changes, radiological techniques, and interpretation of radiographs.

#### 586. Digestive System II

Winter. 4(4-0) Eighth-term Veterinary Medicine students.

Pathogenesis, diagnosis and treatment of diseases of the alimentary tract and digestive organs of food animals and horses.

#### 588. Principles of Surgery II

Winter. 3(2-3) Eighth-term Veterinary Medicine students.

Fundamental large animal surgery. Surgical techniques and management of animals before, during and after surgery.

#### 590. Client Communication and Jurisprudence

(501.) Spring. 2(2-0) Ninth-term Veterinary Medicine students.

Communication and interviewing skills for effective client relations. Communication aspects of medical records and their use in medical problem solving. Legal responsibilities of the veterinary medical profession.

#### 591. Core of Medicine Laboratories IV

Spring. 2(0-6) Ninth-term Veterinary Medicine students.

Diagnosis and treatment of common toxicologic conditions, musculoskeletal disorders and orthopedic conditions in animals.

#### 592. Musculoskeletal System II

(534.) Spring. 4(4-0) Eighth-term Veterinary Medicine students.

Diagnosis, prognosis and management of musculoskeletal diseases of large animals. Anatomical relationships of normal to abnormal function. Surgical procedures applicable to the equine and ruminant. Radiographic diagnosis and interpretation of various lameness conditions.

#### 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 VM 610 and LSM 674.

Clinical or research experience in an off-campus setting.

## ZOOLOGY

## ZOL

### College of Human Medicine College of Natural Science

#### 203. Resource Ecology

(IDC 200.) Fall, Winter, Spring, Summer. 3(3-0) Interdepartmental with the departments of Fisheries and Wildlife, Forestry, Geography, and Resource Development. Administered by the Department of Fisheries and Wildlife.

Basic concepts of ecology which are the unifying basis for resource management, conservation policy and the analysis of environmental quality. Extensive use of guest lecturers.

#### 301. Nature and Homo Sapiens

Spring. 4(2-6) Three terms of natural science; not open to zoology majors.

Relates humans to their natural environment. Chief emphasis on identifying characteristic animal life in broad areas of nature and how humans fit or misfit 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 Geology.

Fossil vertebrates from fish to humans.

#### 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 Humans

Winter. 3(3-0) Juniors; not open to zoology majors.

Examines philosophical and biological issues which make the study of animal behavior relevant to humans. Emphasizes history of animal behavior, current theories, and experiments relating biological and environmental determinants of adaptive and non-adaptive behavior patterns.

#### 313. Animal Behavior

(413.) Spring. 4(4-0) B S 211.

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.

#### 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 Geology.

The direct evidence for organic evolution in the fossil record. Evolution of life from prebiological systems to humans. Impact of fossil discoveries on human thought.

**341. Human Heredity**

Fall, Winter, Summer. 4(4-0) 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 School.

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. 1 to 5 credits. May reenroll for a maximum of 15 credits. Juniors; approval of department.

**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. 4(0-12) 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. Administered by Biological Science.

Extensive field investigations of several types of terrestrial communities. Interrelationship of plants, animals, and environment. Factors determining distribution and abundance.

**414. Biological Mechanisms of Animal Behavior**

Winter. 3(3-0) or 5(3-6) ZOL 313 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**

Fall. 3(3-0) or 5(3-6) ZOL 317.

Molecular and cellular biology of development. Complementary laboratory exercises with emphasis on experiments.

**420. Biology of Animal Parasites**

Summer. 6 credits. B S 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. 5(3-6) B S 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 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 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) B S 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 organisms.

**445. Evolution**

Fall. 4(4-0) B S 211.

Processes of evolutionary change including the origin of species and homo sapiens, fossils and the geological record, and applications in genetic engineering, agriculture, and medicine.

**450. Comparative Histology**

Fall. 4(4-0) B S 212.

The comparative structure of cells of selected invertebrate and vertebrate organisms and their interactions to form tissues.

**Descriptions – Zoology  
of  
Courses**

**456. Foundations of Developmental Biology**

Winter of even-numbered years. 3(3-0) ZOL 317; ZOL 417 recommended. Interdepartmental with the Department of Natural Science.

Reading and discussion of original research which posed significant problems of modern developmental biology.

**460. Ornithology for Teachers**

Summer. 3 credits. A course in biology or approval of department. Not open to Zoology majors. Given at W. K. Kellogg Biological Station. Interdepartmental with Biological Science.

Distribution, breeding cycles, migration, food and feeding habits, voice and other important areas of avian biology. Emphasis on field identification and natural history.

**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.

**465. Field Evolutionary Ecology**

Summer. 3 credits. May reenroll for a maximum of 6 credits. ZOL 389. Given at W. K. Kellogg Biological Station.

Major questions of evolutionary ecology, along with field projects designed to explore these questions. Course concludes with individual field project.

**468. Behavioral Ecology**

Summer. 3 credits. May reenroll for a maximum of 6 credits if different topic is taken. ZOL 413 or ZOL 415, ZOL 389. Given at Kellogg Biological Station.

Current theoretical issues in behavioral ecology with illustrative field problems and an individual field project.

**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.

**478. Stream Ecology**

Spring. 3(3-0) ENT 420, ZOL 389 or BOT 450 or FW 302 or approval of department. Students may not receive credit in both FW 478 and ENT 421. Interdepartmental with the departments of Entomology and Fisheries and Wildlife. Administered by the Department of Fisheries and Wildlife.

Biological, chemical, physical, and geological processes which determine the structure and function of stream ecosystems.

**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. Extensive field and laboratory work with living animals.

**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) B S 212.

Structures and functions of animal-like, eukaryotic microorganisms.

**483. Physiological Ecology**

Winter. 4(3-2) B S 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) B S 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 Biophysics and the departments of 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.

**804B. Neuroscience Laboratory II**

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

**815. Current Trends in Primatology**

Winter of odd-numbered years. 4(4-0) Approval of instructor.

Lectures and discussion of current concepts in primate research. Emphasis will be upon the nonhuman primate as a model for research into biomedical and zoological problems.

**817. Ecology of Zooplankton**

Summer of odd-numbered years. 3 credits. Approval of department. 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 relationships and species diversity.

**820. Behavior of Animal Populations**

Spring. 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**

(BY 827.) Fall. 4(4-0) Approval of department.

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 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 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 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 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 Geology.

Recent advances and controversial issues in vertebrate paleontology including origin, classification, phylogeny, and stratigraphic relationships of fossil vertebrates.

**839. Population Ecology**

Summer of even-numbered years. 3 credits. May reenroll for a maximum of 6 credits. Approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the Department of Botany and Plant Pathology.

A field-experimental approach to the study of adaptations. Selected topics will deal with population growth, competition, predation, mutation, community structure and species abundance.

**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.

**846. Advanced Topics in Evolution**

Winter. 4(4-0) May reenroll for a maximum of 12 credits if different topics are taken. ZOL 445 or approval of instructor.

Mechanistic and theoretical aspects of the evolutionary process. Topics will be drawn from the current literature and will deal with one of the following areas: microevolution, macroevolution, and speciation.

**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.

**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.

**862. Avian Behavioral Ecology**

Fall. 4(4-0) ZOL 389, ZOL 413, ZOL 461.

Theory of habitat selection. Optimal foraging theory dealing with breadth of diet, patch utilization and sampling theory. Coloniality, cooperation and optimal group size, and refuging systems as they apply to avian populations.

**865. Advanced Neurobiology**

(BIM 865.) Spring. 4(4-0) BPY 827. Interdepartmental with Biophysics and the departments of Anatomy, 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 of even-numbered years. 3 credits. Approval of department. 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 of odd-numbered years. 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**

(PSY 885.) Winter of even-numbered years. 5(3-4) ANT 815, ANT 865 recommended. Interdepartmental with the departments of Anatomy, Physiology and Psychology. Administered by the Department of Anatomy.

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**

Spring of even-numbered years. 5(3-4) ANT 885. Interdepartmental with the departments of Anatomy, Physiology, and Psychology. Administered by the Department of Anatomy.

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 or 2 credits. 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 of odd-numbered years. 3(3-0) Developmental biology, biochemistry, approval of department.

Developmental biology of early stages of animal life, emphasis on physiology and biochemistry of marine invertebrate eggs.

**Descriptions – Zoology**

**of**

**Courses**

**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 of even-numbered years. 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. Interdepartmental with the Department of Fisheries and Wildlife.*

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, Summer. Variable credit. Approval of department.*

Research for the Ph.D. degree in genetics, morphology, mammalogy, wildlife management, ornithology, fisheries biology, limnology, quantitative biology, invertebrate, experimental embryology, animal behavior, herpetology.