602. Veterinary Practice Management

Spring. 2(2-0) Eighth-term Veterinary Medicine students.

Basic skills necessary to establish and effectively manage a practice of veterinary medicine.

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

Spring. 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. 4(4-0) B S 212, LBC 344 concurrently, not open to zoology majors. Students may not receive credit in 303 and 305 or 303 and 381.

A general survey of the animal kingdom. Topics include origin, evolution and diversity of invertebrate and vertebrate groups, their systematic and present status.

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.

305. Biology of Vertebrates

Fall. 4(3-3) B S 212. Students may not receive credit in both 305 and 303.

Primarily concerned with natural history of vertebrates. Topics include morphological characteristics, ecology, zoogeography, and taxonomy of vertebrate animal groups. Laboratory involves recognition of representative species within the various classes.

314. Comparative Anatomy of Vertebrates

Fall, Winter. 5(3-6) B S 212.

Comparative anatomy and evolution of vertebrates. The dogfish and a mammal dissected in the laboratory.

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) 317 or concurrently; B S 212.

Principles of development illustrated by analysis of the ontogeny of selected organisms.

341. Human Heredity

Fall, Winter, Spring, Summer. 4(3-3) Three terms of Natural Science; Sophomores; not open to zoology majors. Students may not receive credit in more than one of the following: 341, 441.

Inheritance of human, physical, physiological, and psychological traits, and forces that influence human evolution. Foundation is laid on which applications of heredity in fields of education, sociology, anthropology, psychology, dentistry, and medicine must rest. Course includes field trips to state institutions.

344. Introductory Animal Systematics Laboratory

Fall. 1(0-3) 303 concurrently. Interdepartmental with and administered by Lyman Briggs College.

Laboratory examination of form and function of representative vertebrate and invertebrate animals.

381. Fundamentals of Invertebrate Zoology

Winter. 4(3-3) B S 212. Students may not receive credit in both 381 and 303.

Form and function of representative invertebrates. Meets requirements for a course in Invertebrate Zoology. Students expecting to obtain advanced degrees in Zoology or those more interested in a systematic or ecological approach should elect Zoology 481.

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 re-enroll 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 and CEM 132. 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) 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.

405. Experiments in Zoology I

Fall. 3(0-9) Approval of instructor.

A laboratory for Zoology majors. An integrated series of selected experiments in the topics of behavior, ecology and physiology.

406. Experiments in Zoology II

Winter. 3(0-9) 405.

A laboratory for Zoology majors. An integrated series of selected experiments in topics of cell biology, embryology and genetics.

407. Experiments in Zoology III

Spring. 3(0-9) 406.

A laboratory for Zoology majors. A continuation of 406 and 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.

412. Principles of Animal Behavior

Summer. 4(4-0) For teachers of biology. Not applicable toward major in zoology.

Evolutionary, hormonal, and neurological bases of animal behavior.

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) 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) 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) 317.

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

420. Ecology 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 and administered by the Department of Microbiology and Public Health.

Parasitism of animals by protozoa, helminths and anthropods with emphasis on the interrelationships of host-parasite associations with the natural environments.

425. Marine Ecology

Winter. 3(3-0) 381, 303.

Relation of marine organisms to their environment. Food webs, productivity, diversity and adaptations. Estuarine, coral reef, open water and sea floor communities. Harvesting, aquaculture and marine food resources.

430. Vertebrate Paleontology

Winter. 4(3-3) 314, 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 381 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. Paleoecology

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) B S 212. Students may not receive credit in more than one of the following: 341, 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) or 5(2-9) 441; MTH 108 or 111 recommended.

Population genetics and the genetic analysis of evolution. Optional laboratory with individual research projects.

443. Developmental Genetics

Spring. 4(4-0) 441 and 317.

Mechanisms of gene action. Role of genes in the embryology, morphology, and physiology organisms.

456. Foundations of Developmental Biology

Winter of odd-numbered years. 3(3-0) 317; 417 recommended.

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

460. Field Ornithology

Summer. 3 credits. B S 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

Spring. 5(3-6) 305.

Principles of classification, structure, distribution, migration, life histories, and habits. Laboratory and field identification of birds by size, form, color, song and habitat.

471. Ichthyology

Spring. 3(2-3) F W 301 or ZOL 305 or 314. 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 161; BOT 450 or ZOL 389. Students may not receive credit for both 376 and 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) 481; F W 476 concurrently; ENT 301, 302 recommended. Interdepartmental with and administered by the Department of Fisheries and Wildlife.

Methods and instruments of limnological field investigation on lakes and streams.

479. Soil Zoology

Fall. 4(2-6) B S 212.

Ecology and biology of soil-dwelling animals, with emphasis placed on protozoa, annelids and arthropods.

480. Biology of Fresh-Water and Terrestrial Invertebrates

Summer. 6 credits. 381 or B S 212 and 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) 381 or B S 212 and 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) 305 or 314.

Classification and natural history of amphibians and reptiles, with emphasis on Michigan species.

486. Mammalogy

Fall. 4(2-6) 305 or 314.

Classification distribution, natural history of mammals, with emphasis on Michigan species. Field studies, preparation of study specimens.

489. Animal Distribution

Winter. 3(3-0) 441; 389 recommended.

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 re-enroll 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; 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 re-enroll for a maximum of 12 credits. Juniors, written approval of instructor.

Laboratory research culminating in the preparation and defense of an undergraduate thesis.

817. Ecology of Zooplankton

Summer of every third year. Given in 1975. 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) 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.

821. Ontogeny of Behavior

Winter of even-numbered years. 4(4-0) 317, 413.

Changing patterns of behavior during the development of individual animals; effects of experimental control of external environment, and neurological and chemical intervention upon behavior.

823. Neurological and Hormonal Correlates of Animal Behavior

Spring. 4(4-0) 414, 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.

830. Advanced Vertebrate Zoology

Winter. 4(4-0) May re-enroll for a maximum of 12 credits. 305; 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) 437 or 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. Paleoecology

Fall. 3(2-4) 437 or 438. Interdepartmental with and administered by the Department of Geology.

Advanced problems in the distribution and abundance of fossil invertebrates; morphological adaptations to environmental pressures.

D. Fossil Morphology

Fall. 3(2-4) 437 or 438. Interdepartmental with and administered by the Department of Geology.

Skeletal morphology of fossil invertebrates, emphasizing the multivariate morphometric approach and other modern methods of morphological analysis.

834. Advanced Vertebrate Paleontology

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

858. Neuroembryology

Spring. 4(4-0) 318 and approval of department.

Experimental analyses of morphogenesis of vertebrate nervous systems.

859. Analysis of Hormone Action

Spring. 4(4-0) 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. 3(3-0) BPY 825. Interdepartmental with the departments of Biophysics, Biomechanics, Physiology and Psychology and administered by the Department of Biomechanics.

Basic organization, structure and function of neural networks comprising sensory, motor, and autonomic systems including examples from invertebrates and vertebrates.

871. Ecology of Fishes

Summer. 3(1-6) Approval of instructor or 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) 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

Fall. 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

Fall. 2(0-6) Approval of department.

Laboratory work in cellular morphogenesis accompanying 882.

884. Invertebrate Neural Systems

Fall of odd-numbered years. 4(3-3) Biochemistry and neurophysiology recommended.

Nervous systems in the invertebrates, including sense organs, effector organs, central nervous systems and integrative mechanisms.

885. Vertebrate Neural Systems I

Fall of odd-numbered years. 5(3-4) Approval of department; ANT 815 and BPY 825 recommended. Interdepartmental with the departments of Biophysics, Physiology and Psychology and 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 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

Fall, Winter, Spring, Summer. 1 credit. May re-enroll 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.

Quantitative analyses of the dynamics, production, regulation, energetics and distribution of animal populations.

893. Fertilization and Early Embryogenesis

Fall. 3(3-0) Developmental biology, biochemistry and approval of department. 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 re-enroll for a maximum of 6 credits. Approval of department.

Graduate level seminars on current research topics in biology.

896. *Animal Community Ecology*

Winter of odd-numbered years. 4(4-0) 892, approval of instructor.

Patterns and processes in animal communities with emphasis on structure, species diversity and stability.

899. *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. *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.