550. Veterinary Public Health and Epidemiology

(520.) Winter. 5(5-0) Fifth-term Veterinary Medicine students.

Public health aspects of veterinary medicine. Principles of epidemiology and their application to the study of diseases of animal populations.

560. Urinary System

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

Normal and abnormal structure and function, diagnostic methods, and the medical and surgical manipulation of the urinary system.

561. Core of Medicine Laboratories I

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

Classification diagnosis and treatment of diseases of the urinary, hematopoietic, nervous, integumetary and visual systems of animals.

562. Hematopoietic System

(509.) Spring. 2(2-0) Sixth-term Veterinary Medicine students.

Normal structure and function of the hematopoietic system and pathophysiologic effects of hematopoletic diseases. Clinical manifestations, laboratory evaluation and medical management.

563. Visual Systems

(532.) Spring. 2(2-0) Sixth-term Veterinary Medicine students.

Methods of examination, diagnosis, and treatment of ocular diseases.

564. Survey of Infectious Agents

(510.) Spring. 4(4-0) Sixth-term Veterinary Medicine students.

Host-microorganism relationship in diseases of animals; laboratory diagnosis, treatment, control, and public health significance.

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. 2(0-6) 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.) Fall. 4(4-0) Seventh-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.) Winter. 5(5-0) Eighth-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 musculosketal 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 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, Spring, 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. 1(0-3) 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 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) 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.

405. *Experiments in Zoology I*

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 ecosytems, 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. 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.

428. *Morphology of the Chordates*

(314.) Winter, Spring. 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 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: 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.

450. *Comparative Histology*

Fall. 4(3-3) B S 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. 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*

Winter. 4(4-0) 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) F W 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 F W 376 and F W 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; F W 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.

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. 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) 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 the departments of Biophysics, Physiology, and Psychology and administered by the Department of Psychology.

Development of skills in the methods, techniques and instrumentation necessary for reseach in a variety of areas concerned with neuroscience.

804B. *Neuroscience Laboratory II*

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

821. *Ontogeny of Behavior*

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

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 paleoecology, 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.

858. *Neuroembryology*

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

Experimental analyses of morphogenesis of vertebrate nervous 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.

865. *Advanced Neurobiology*

Spring. 4(4-0) BPY 827. Interdepartmental with the departments of Anatomy, Biophysics, Physiology and Psychology and 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 Biophsyics, 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 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 of odd-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.

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.