

331. Design Implementation II

Winter. 4(1-6) 330, 343.

Continuation of 330 with the further study of contract documents including bidding procedures, the preparation of a set of construction drawings for the development of a small site, specifications and the construction process.

332. Design Implementation III

(432.) Spring. 3(3-2) 331, 344.

Construction materials, their proper use, job supervision and office practice.

343. Environmental Design Concepts

Fall. 4(1-6) 242, 255, HRT 212.

Basic concepts in landscape design emphasizing the design process and conceptual thinking toward improving the quality of man's physical environment.

344. Site Design for Housing

Winter. 4(1-6) 343.

Low, medium and high-density developments for human shelter including the design of subdivisions and related facilities, and developments for apartments, townhouses, condominiums, and mass-produced units.

345. Site Planning for Recreational Facilities

Spring. 4(1-6) 331, 344.

Techniques of analysis and design for outdoor recreational facilities such as playgrounds, parks and parkways, golf courses, marinas and facilities for athletics. Field trips required.

402. History of Environmental Development

(202.) Winter, Spring. 4(3-0)

Analysis of man's attempts to organize and design outdoor space. Emphasis on major influences, people and historical landscape styles and movements.

421. Bibliographic Research and Methods in Environmental Design

Fall. 4(2-2) Senior majors.

Research into published information in environmental design; abstraction of data; synthesis into oral and written presentations.

430. Special Projects in Environmental Design

Summer. 5(2-6) 318, 332, 345.

The improvement of man's physical environment as taught by a sequence of highly regarded professional practitioners and educators in the environmental design professions.

440. Graphic Communication

Fall. 3(0-6) Bachelor of Science in Landscape Architecture.

Development and perfection of individual delineation techniques as applied to landscape design projects.

445. Design Theory and Implementation—Natural Materials

Fall. 3(0-6) Bachelor of Science in Landscape Architecture.

Designs, working drawings and specifications related to the use of vegetation and other natural materials on various projects in a wide range of scales.

446. Site Planning for Urban Areas

Fall. 5(2-6) 318, 332, 345.

Lectures, readings, and laboratory projects concerning site planning for public and quasi-public urban buildings and spaces, including central business districts, malls, plazas, and college and university campuses. Field trips required.

447. Advanced Landscape Design

Winter. 5(2-6) 446.

Lectures, readings and laboratory assignments on a variety of landscape design projects. A personal biographical dossier and portfolio, based on previous landscape architectural courses, is required from each student as collateral.

448. Terminal Project in Design

Spring. 5(2-6) 332, 447.

Completion of a design project, selected by the student and approved by the School, with report, simulating professional office procedures and demonstrating proficiency in beginning levels of professional landscape architecture. This involves the preparation of a set of drawings including site design, planting design, construction, rendering and sketching.

450. Architectural Design

Winter. 4(0-6) Bachelor of Science in Landscape Architecture.

Lectures, discussions, assigned readings, written reports, and studio projects in architectural design, emphasizing complex architectural planning, form structure and site relationships.

455. History of Landscape Design

Winter. 3(3-0) Bachelor of Science in Landscape Architecture.

Significant movements, personalities, and projects in landscape design, from ancient to contemporary times, with emphasis on the development of the current practice of landscape architecture.

460. Research Methods

Winter. 3(3-0) Bachelor of Science in Landscape Architecture.

Review of traditional and proven research methods in the physical and social sciences utilizing representative case studies as applied to environmental considerations.

465. Seminar

Spring. 3(3-0) Bachelor of Science in Landscape Architecture.

Professional philosophy of landscape architecture; the social responsibility of the landscape architect; administrative processes and methods essential for effective professional practice.

470. Design Theory and Implementation—Construction

Spring. 3(3-0) Bachelor of Science in Landscape Architecture.

Comprehensive site projects involving construction plans, working drawings, contract documents, cost estimates and office practice.

475. Comprehensive Design

Fall, Winter, Spring. 4(0-8) Must be repeated for a total of twelve credits. Bachelor of Science in Landscape Architecture.

Studio projects and discussions emphasizing the synthesis of landscape architectural principles and related disciplines as applied to a wide range of design scales and sites in both urban and regional contexts.

485. Professional Contact

Summer. 4(0-8) Bachelor of Science in Landscape Architecture.

Similar to 475, but taught by a sequence of highly regarded professional practitioners and educators in the environmental design professions.

490. Special Problems

Fall, Winter, Spring, Summer. 2 to 5 credits. May re-enroll for a maximum of 8 credits. Approval of school.

Investigation, for advanced undergraduate students in landscape architecture, developed from special interest areas.

801. Graduate Landscape Architecture I

Fall, Winter, Spring, Summer. 5 to 12 credits.

A series of complex problems of variable subject matter adjusted to the interests and needs of each individual student and designed to emphasize the various phases of landscape architecture such as plant materials and planting design, drafting and delineation, surveying and construction, contracts, specifications and reports, architecture and city planning and landscape design.

802. Graduate Landscape Architecture II

Fall, Winter, Spring, Summer. 5 to 12 credits. 801.

Continuation of 801.

803. Graduate Landscape Architecture III

Fall, Winter, Spring, Summer. 5 to 12 credits. 802.

Continuation of 802.

804. Comprehensive Problem

Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 15 credits. 803.

Development of a terminal, creative project of subject matter selected by the student and approved by the department, involving the various phases of landscape architecture and submitted to the faculty as evidence of his mastery of the principles of his profession.

**VETERINARY MEDICINE V M
(College of)**

500. Veterinary Medical Communication

Fall, Spring. 1(1-0) Admission to the professional veterinary program.

Seminars on professional speaking and writing research design and data interpretation, and client relations.

600. Veterinary Medical History, Ethics, and Jurisprudence

Fall, Spring. 1(1-0) Admission to the veterinary professional program.

Seminars on historical background, ethical principles, and legal responsibilities of the veterinary medical profession.

ZOOLOGY ZOL

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

200. Resource Ecology and Man

For course description, see Interdisciplinary Courses.

204. Natural History of Birds

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

Identification of Michigan birds in field and laboratory, including life histories, habits, and consideration of their economics, aesthetic and recreational value.

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) Not open to zoology majors. Interdepartmental with and administered by the Geology Department.

Fossil vertebrates from fish to man.

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. Not suggested for students having previous experience in vertebrate taxonomy or morphology.

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

(315.) 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, 459.

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.

381. Fundamentals of Invertebrate Zoology

Winter. 4(3-3) B S 212.

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

Spring. 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.

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.

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. 3(3-0) or 5(3-6) 413.

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.

430. Vertebrate Paleontology

Winter. 4(3-3) 314, or approval of department. Interdepartmental with and administered by the Geology Department.

Fossil vertebrates with emphasis on the evolution of major groups. Laboratories on modern techniques and on the identification and interpretation of fossils.

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, 459.

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.

Thorough discussion of quantitative inheritance, linkage and crossing-over, genetic consequences of chromosome aberrations, results of differences in life cycles of animals, plants and microorganisms. Breeding experiments with *Drosophila* and *Neurospora*.

443. Developmental Genetics

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

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

455. Experimental Ecology

Spring. 5(2-9) Approval of department. Interdepartmental with the Botany and Plant Pathology Department.

Dynamics, regulation and production of biological populations, structure composition and stability of biotic communities; biogeochemical and energetic characteristics of ecosystems.

456. Experimental Analysis of Development

Winter. 3(3-0) or 5(3-6) 317 and 318.

Analysis of developmental biology of selected forms, emphasis on cellular and sub-cellular basis of differentiation, stressing modern experimental techniques. Individual laboratory problems as introduction to research methods.

457. Vertebrate Morphology for Teachers

Summer. 4(3-4) B S 212.

A comprehensive survey of developmental processes, with special emphasis on results of experimental analysis as they explain the morphogenesis of cells, tissues and organs.

459. Genetics for Teachers of Biology

Summer. 5(5-0) B S 212. Students may not receive credit in more than one of the following: 341, 441, 459.

Principles of heredity in animals, plants and microorganisms.

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. 4(2-6) 305 or 314.

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) 305 or 314. Interdepartmental with and administered by Fisheries and Wildlife Department.

Classification and natural history of fishes. Emphasis on food, game, and forage fishes.

476. Limnology

Winter. 3(3-0) B S 212. Interdepartmental with and administered by the Fisheries and Wildlife Department.

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 Fisheries and Wildlife Department.

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

478. Comparative Limnology

Summer. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station.

Theoretical concepts and methods of analysis of environmental parameters influencing productivity of freshwaters. Comparative field investigations of lakes, streams, and other aquatic habitats.

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. Morphology, physiology and natural habitats of protozoa.

483. Physiological Ecology

Fall. 4(3-3) 381 or 481. Physiological aspects of basic ecological principles and concepts.

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.

491. Quantitative Biology

Fall. 4(4-0) STT 423 or approval of department. Application of biometrical techniques to biological problems.

492. Cytochemistry

Fall. 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.

497. Principles of Endocrinology

Winter. 4(4-0) 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.

816. Malacology

Summer of even-numbered years. 3 credits. 481 or approval of department. Given at W. K. Kellogg Biological Station.

Biology of the mollusks; morphology, classification, distribution, evolution, ecology, and economics. Laboratory and field work will emphasize identification and biology of the local land and fresh-water colluscan fauna.

817. Ecology of Zooplankton

Summer of every third year. Given in 1968. 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. 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. 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.

822. Behavior of Aquatic Animals

Fall. 4(3-3) 413; F W 476 recommended. Emphasis will be upon vertebrates. Approach will be primarily ecological on adaptation to special aquatic environments.

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 Botany and Plant Pathology Department.

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.

826. Advanced Tropical Zoology

Summer. 12 credits. Approval of department and acceptance by Organization for Tropical Studies.

A field course concerning the adaptation, evolution and physiological characteristics of tropical animal life. The subject of the course might vary from term to term and will be given in the field in Latin America.

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.

839. Population Ecology

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

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.

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.

850. Ultrastructure

Spring. 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.

854. Histochemistry

Winter. 4(3-4) Two years of undergraduate zoology.

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 Physiology Department.

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. Advanced Ornithology: Systematics

Winter of odd-numbered years. 5(3-6)

461. Courses 862 and 863 constitute an advanced series preferably to be taken in sequence. The first term deals primarily with systematics, including a brief survey of the birds of the world.

863. Advanced Ornithology: Anatomy and Physiology

Winter of even-numbered years. 4(2-6)

461. Feathers, plumages, and the internal anatomy of birds, including dissection of a pigeon and comparisons with other birds.

881. Biology of the Arthropoda

Winter. 5(3-6) 481 or approval of department. Interdepartmental with the Entomology Department.

Ecology, life cycles, morphology, taxonomy, and distribution of arthropods 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 as related to development.

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.

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) 491; one course in ecology 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) 317, one year of basic biochemistry and approval of department.

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

894. Laboratory in Fertilization and Early Embryogenesis

Fall. 2(0-6) 893 or concurrently and approval of department.

Special emphasis on handling of echinoderm eggs and analytic methods used in embryology.

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.

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