331. Design Implementation: Theory and Application II
Winter. (4-6) 330.
Continuation of grading and introduction to surface drainage, quantity estimates, and horizontal and vertical road alignments.

332. Design Implementation: Theory and Application III
(433) Spring. 3(1-4) 331, 345.
Problems of immediate complexity in site engineering and an introduction to contract documents including working drawings and specifications.

343. Intermediate Landscape Design
Fall. (4-6) 243, 330; HRT 212.
Continuation of 243, with concentration on investigation, analysis and synthesis in the design of moderately complex landscape projects.

344. Intermediate Landscape Design
Winter. (4-6) 344.
Continuation of 343 with emphasis on more complex land design projects.

345. Intermediate Landscape Design
Spring. (4-6) 344.
Continuation of 344, with concentration on the design of broad scale land architectural projects.

421. Selected Topics
Fall. (4-6) 400. Senior majors.
Critical examination of theories and applications of landscape architecture through lectures, discussions, oral presentations and written reports.

430. Advanced Landscape Design
(490.) Fall, Winter, Spring, Summer.
4(1-6) May re-enroll for a maximum of 16 credits. 234, 318, 331, 345.
Lectures and studio projects involving investigation, analysis, solution and presentation relative to the physical aspects of environmental design.

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

450. Architectural Design
Winter. (4-0) 400. 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.

480. 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.

485. 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 profession.

490. Special Problems
Fall, Winter, Spring. 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. 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. 5 to 12 credits.
Continuation of 801.

803. Graduate Landscape Architecture III
Fall, Winter, Spring. 5 to 12 credits.
Continuation of 802.

804. Comprehensive Problems
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.

ZOOLOGY

College of Human Medicine
College of Natural Science

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

204. Natural History of Birds
Fall. (4-3) N S 193; 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 values.

301. Nature and Man
Spring. (4-2-6) N S 193; 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 finds his place in 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.

305. Biology of Vertebrates
Fall. 4(4-6). B S 212.
Primarily concerned with natural history of vertebrates. Topics include morphological characteristics and relationships, ecology, zoogeography and behavior of higher animals. Laboratory involves recognition of representative species within various groups.

315. Comparative Anatomy of Vertebrates
Fall. 4(4-6). B S 212.
Comparative anatomy and evolution of vertebrates. The dogfish and a mammal dissected in the laboratory.

316. Comparative Anatomy Laboratory
Winter. 2(0-6) 315 or concurrently.

317. Principles of Development
Fall, Spring. 3(3-3). 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(0-8) 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) N S 193; 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(3-2) 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 6 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.

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. Invertebrate Behavior
Spring. 3(3-0) or 5(3-8) 413.
Concerned with evolutionary, hormonal, and neurological bases of invertebrate behavior. Behavioral topics studied include sensory processes, instincts, learning, periodicity, and social organization.

415. Vertebrate Behavior
Fall. 4(4-0) 413.
Concerned with evolutionary, hormonal, and neurological bases of vertebrate behavior. Topics studied include sensory processes, instincts, learning, periodicity, complex processes, motivation, individual differences, and social organization.

420. Vertebrate Paleontology
Winter. 4(3-3) 305 or 315 or GLG 302 of approval of department. Interdepartmental with the Geology Department.
Fossils 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. 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 microbes. Serves as a 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 microbes. Breeding experiments with Drosophila and Neurospora.

453. Animal Histology
Spring. 5(3-8) B S 212.
Study of vertebrate tissues.

455. Experimental Ecology
Spring. 5(3-9) 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(3-5) 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(3-8) 305 or 318.
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(3-2) 305 or 315. Interdepartmental with the Fisheries and Wildlife Department.
Classification and natural history of fishes. Emphasis on food, game, and forage fishes.

473. Field Ichthyology
Summer of odd-numbered years. 3 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station.
Taxonomy, life history and ecological relationships of fishes of the Great Lakes region.

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(3-0) 481; F W 476 concurrently; ENT 301, 302 recommended. Interdepartmental with and administered by the Fisheries and Wildlife Department.
Methods and instrumentation 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 freshwater. Comparative field investigations of lakes, streams, and other aquatic habitats.

480. Biology of Fresh-water and Terrestrial Invertebrates
Summer. 6 credits. B S 212 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) 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. 4(3-3) 381 or 451.
Morphology, physiology and natural habitats of protozoa.

483. Physiological Ecology
Fall. 4(3-3) 381 or 461.
Physiological aspects of basic ecological principles and concepts.

484. Herpetology
Spring. 5(3-6) 305 or 315.
Classification and natural history of amphibians and reptiles, with emphasis on Michigan species.

485. Field Herpetology
Summer of even-numbered years. 3 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station.
Study of the amphibians and reptiles of the regional area, with special reference to classification and natural history.

486. Mammalogy
Fall. 4(3-6) 305 or 315.
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 origin, and concepts relating to the distribution of modern vertebrates.
491. Quantitative Biology
Fall. 4(3-3) 577 421 or approval of department.
Application of biometrical techniques to biological problems.

492. Cytochemistry
Fall. 4(3-3) B 8 215.
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.

810. Malacology
Summer of even-numbered years. 3 credits. 461 or approval of department. Given at W. K. Kellogg Biological Station.
Biology of the mollusks; morphology, size identification and biology of the local enzymes.

817. Ecology of Zooplankton
Summer of every third year; given in 1986. 3 credits. 481 or approval of department. Given at W. K. Kellogg Biological Station.
Factors affecting distribution and abundance of planktonic animals. Physiological ecology, secondary production, nutrition, and behavior.

820. Behavior of Animal Populations
Spring. 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 neurochemical and other intervention upon behavior.

822. Behavior of Aquatic Animals
Fall. 4(3-3) 413; PW 478 recommended.
Emphasis will be upon vertebrates. Approach will be primarily ecological on adaptation to special aquatic environments.

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 to the field of the principles of ecology as they operate in the tropics, especially concerning the tropical environment and biota, ecological 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.