

**453. Women and Work: Issues and Policy Analysis**

Spring. 3(3-0) Interdepartmental with Public Resource Management and Economics. Administered by Public Resource Management.

P: EC 201 or EC 202 or PRM 201 or concurrently. R: Not open to freshmen and sophomores.

Current and past quantity and quality of women's participation in the labor force. Gender differentials in earnings, and occupations. Employment discrimination. Laws, especially affirmative action laws. Social policy effects. International issues.

**482. Theory and Practice of Feminist Literary Criticism**

Spring. 3(3-0) Interdepartmental with English. Administered by English.

P: ENG 353 or WS 202. R: Not open to freshmen and sophomores. Open only to students in English and Women's Studies, and to students in English teaching minor.

Feminist literary critical theory and its implications for reading and studying literature.

**490. Independent Study**

Fall, Spring. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course.

P: WS 201; WS 202 or WS 203. R: Open only to juniors and seniors; approval of program.

Individual reading and research on women and gender.

**491. Special Topics**

Spring. 3 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. P: WS 201; WS 202 or 203. R: Not open to freshmen and sophomores.

In-depth study of special topic emphasizing women and gender.

**492. Women's Studies Senior Seminar**

Spring. 4(4-0) P: WS 201, WS 203; WS 301 or WS 302. R: Not open to freshmen and sophomores.

Synthesis and elaboration of ideas and perspectives central to Women's studies. Current areas of interest and research in feminist scholarship.

**493. Internship**

Fall, Spring, Summer. 2 to 4 credits. A student may earn a maximum of 4 credits in all enrollments for this course.

P: WS 201; WS 202 or WS 203. R: Not open to freshmen and sophomores. Approval of program.

Integration of feminist knowledge through work experience related to women's concerns. Experience in legislative, community, or educational settings.

**890. Individual Reading**

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course.

R: Approval of program. Faculty supervised graduate level reading in special topics.

ZOOLOGY

Department of Zoology  
College of Natural Science

**141. Introductory Human Genetics**

Spring. 3(3-0)

R: Not open to students in Biochemistry, Botany, Entomology, Medical Technology, Clinical Laboratory Sciences, Physiology, Zoology, Microbiology or Interdepartmental Biological Science or to students in the corresponding Lyman Briggs School coordinate majors or to students in the Lyman Briggs School Biology Field of concentration. Not open to students with credit in ZOL 341 or ZOL 344.

Inheritance of human traits. Impact of genetic technology on society. Ethical and legal issues. Risks and benefits of genetic technology.

**306. Invertebrate Biology**

Fall. 4(3-3)

P: BS 110.

Systematics, morphology, and natural history of invertebrate animals. Identification of live and preserved specimens. Recognition of selected groups.

**313. Animal Behavior**

Fall. 3(3-0)

P: BS 110, BS 111 or LBS 144, LBS 145. R: Not open to freshmen.

Mechanisms and evolution of behavior (ethology). SA: ZOL 213

**316. General Parasitology**

Spring. 2(2-0)

P: BS 110, BS 111 or LBS 145.

Identification, life history, host-parasite relationships, and epidemiology of protozoan, helminth, acanthocephalan, copepod, and arthropod parasites of animals and humans.

**316L. General Parasitology Laboratory**

Spring. 1(0-2)

P: BS 110, BS 111 or LBS 145. C: ZOL 316.

Laboratory diagnosis of protozoans, helminths, acanthocephalans, copepods, and arthropods that infect humans and animals. Animal necropsy.

**320. Developmental Biology**

Fall. 4(3-3)

P: BS 110, BS 111 or LBS 144, LBS 145.

Principles of development, emphasizing vertebrates. Illustrations from morphological and experimental investigations.

SA: ZOL 220

**328. Comparative Anatomy and Biology of Vertebrates**

Spring. 4(3-3)

P: BS 110 or LBS 144.

Comparative morphology and natural history of vertebrates. Dissection of representatives of most vertebrate classes.

SA: ZOL 228

**331. Vertebrate Life of the Past**

Spring. 3(3-0) Interdepartmental with Geological Sciences. Administered by Geological Sciences.

P: BS 110 or BS 111 or juniors and above. R: Not open Zoology majors. Not open to students with credit in GLG 433.

Evolution and diversity of fossil vertebrates from fish to humans with emphasis on dinosaurs and Pleistocene events.

ZOL

**341. Fundamental Genetics**

Fall, Spring, Summer. 4(4-0) Interdepartmental with Botany and Plant Pathology.

P: BS 110 or LBS 144.

Principles of heredity in animals, plants and microorganisms. Formal and molecular methods in the study of gene structure, transmission, expression and evolution.

**342. Advanced Genetics**

Spring. 3(3-0)

P: ZOL 341.

Advanced topics in classical and molecular genetics including various forms of genetic mapping.

**343. Genetics Laboratory**

Spring. 2(0-4)

P: ZOL 341 or concurrently.

Experiments involving genetics of *Drosophila* and other eucaryotic organisms.

**344. Human Genetics**

Spring. 3(3-0)

P: ZOL 341. R: Not open to freshmen.

Inheritance of human traits. Medical, physiological and forensic applications. Biochemical and molecular genetics of human disease. Chromosomal disorders and their consequences. Prenatal and pre-symptomatic diagnosis. Legal and ethnical considerations.

**350. Histology**

Fall. 4(3-3)

P: BS 111 or LBS 145.

The structure of cells and their interactions to form tissues.

**353. Marine Biology**

Fall of even-numbered years. 4(4-0)

P: BS 110; BOT 250 or ZOL 250 or ZOL 306.

Analysis of marine and estuarine systems. Integration of biology, chemistry, and physics. Life histories of marine organisms. Biology of special marine habitats. Physiological problems of marine life.

**355. Ecology**

Fall. 4(3-3) Summer. 4 credits. Given at W.K.

Kellogg Biological Station. Interdepartmental with Botany and Plant Pathology.

P: BS 110 or LBS 144. R: Completion of Tier I writing requirement.

Plant and animal ecology. Interrelationships of plants and animals with the environment. Principles of population, community, and ecosystem ecology. Application of ecological principles to global sustainability.

SA: ZOL 250

**360. Biology of Birds**

Spring. 4(3-3) Summer. 4 credits. Given at

W.K. Kellogg Biological Station.

P: BS 110 or LBS 144.

The behavior, ecology, evolution, and systematics of birds with emphasis on biodiversity. Laboratories emphasize diversity of form and function, life history patterns, and identification.

**365. Biology of Mammals**

Fall. 4(3-3)

P: BS 110 or LBS 144

Analysis of the behavior, ecology, evolution, and systematics of mammals. Laboratories emphasize diversity of form and function, life history patterns, and identification. Field trips required.

**384. Biology of Amphibians and Reptiles**

Fall of odd-numbered years. 3(2-3) Summer of

even-numbered years. 3 credits. Given at W.K. Kellogg Biological Station.

P: ZOL 228.

Biology of amphibians and reptiles. Laboratory emphasis on diversity and on Michigan species. Field trips required.

**Descriptions — Zoology  
of  
Courses**

**400H. Honors Work**

Fall, Spring. 1 to 5 credits. A student may earn a maximum of 5 credits in all enrollments for this course.  
R: Not open to freshmen and sophomores. Approval of department.  
Honors work on a topic in zoology.

**402. Neurobiology**

Fall. 3(3-0)  
P: BS 110, BS 111 or LBS 144, LBS 145. R: Not open to freshmen and sophomores.  
Structure and function of nerve cells and nervous systems.

**412. Invertebrate Ecology**

Summer of odd-numbered years. 4 credits.  
Given only at W.K. Kellogg Biological Station.  
P: BS 110.  
Ecology and systematics of selected invertebrate phyla with emphasis on the local fauna. Extensive field and laboratory work with living animals.

**415. Ecological Aspects of Animal Behavior**

Spring. 3(3-0)  
P: ZOL 313. R: Not open to freshmen.  
Advanced topics in the ecology and evolution of animal behavior.

**417. Advanced Developmental Biology**

Spring. 3(3-0)  
P: ZOL 220 or ZOL 221. R: Not open to freshmen and sophomores.  
Multidisciplinary approaches to major current concepts. Historic perspectives, analyses from molecular to organismal level, and practical applications.  
SA: ZOL 417H

**420. Stream and Aquatic Insect Ecology**

Fall. 4(3-3) Interdepartmental with Fisheries and Wildlife, and Entomology. Administered by Fisheries and Wildlife.  
P: BS 110, CEM 141.  
Biological and environmental factors determining structure and function of stream and aquatic insect communities. Aquatic insect systematics.

**421. Hormones and Development**

Spring. 3(3-0) Interdepartmental with Physiology.  
P: ZOL 220.  
Hormonal regulation of development, growth and cancer. Hormonal decline in aging.

**425. Cells and Development**

Spring. 4(3-3)  
P: BS 110, BS 111 or LBS 144, LBS 145.  
The role of cells in growth, differentiation and development of animals from protozoa to mammals.  
SA: ZOL 221

**426. Biogeochemistry**

Summer. 3 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Microbiology, Geological Sciences, and Crop and Soil Sciences. Administered by Microbiology.  
P: BS 110 or BS 111, CEM 143 or CEM 251.  
Integration of the principles of ecology, microbiology, geochemistry, and environmental chemistry. Societal applications of research in aquatic and terrestrial habitats.

**431. Comparative Limnology**

Summer. 4 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Botany and Plant Pathology, and Fisheries and Wildlife.  
P: CEM 141 or CEM 151; ZOL 250. R: Not open to students with credit in FW 472. Not open to students with credit in FW 472.  
Physical, chemical, and biological aspects of lakes and streams. Introduction to freshwater biology, and population and community ecology.

**433. Vertebrate Paleontology**

Fall of even-numbered years. 4(3-2) Interdepartmental with Geological Sciences. Administered by Geological Sciences.  
P: ZOL 228. R: Not open to students with credit in GLG 331.  
Fossil vertebrates with emphasis on evolution of major groups. Modern techniques of collection, identification and interpretation of fossils.

**434. Evolutionary Paleobiology**

Fall of odd-numbered years. 4(3-2) Interdepartmental with Geological Sciences. Administered by Geological Sciences.  
P: BS 110 or GLG 201.  
Patterns and processes of evolution known from the fossil record including speciation, phylogeny, extinction, heterochrony and biogeography.

**444. Conservation Biology**

Fall. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife.  
P: BS 110.  
Ecological theories and methodologies to manage species, communities and genetic diversity on a local and global scale.

**445. Evolution**

Fall. 3(3-0) Interdepartmental with Botany and Plant Pathology.  
P: ZOL 341. R: Not open to freshmen.  
Processes of evolutionary change in animals, plants. Microbes. Population genetics, microevolution, speciation, adaptive radiation, macroevolution. Origin of Homo sapiens.  
SA: ZOL 345

**446. Environmental Issues and Public Policy**

Spring. 3(3-0) Interdepartmental with Resource Development.  
R: Not open to freshmen and sophomores.  
The interrelationship of science and public policy in resolving environmental issues. Technical, social, economic, and legal influences. Case study approach.

**450. Cancer Biology**

Spring. 3(3-0) Interdepartmental with Medicine.  
P: BCH 200 or BCH 401; ZOL 221.  
Cancer biology: cellular and molecular aspects. Applications of modern biotechnology to cancer research. Causes, treatment and prevention of cancer. World distribution and risk factors of cancer.

**453. Field Studies in Marine and Estuarine Biology**

Summer. 2 to 3 credits. A student may earn a maximum of 5 credits in all enrollments for this course.  
R: Approval of instructor.  
Marine and estuarine communities emphasizing ecology, life histories, behavior, and resource ecology of the organisms present. Field trip to seacoast.

**457. Foundations of Evolutionary Biology**

Spring. 3(3-0)  
P: BS 110.  
Reading and discussion of original works in evolutionary biology which have shaped modern evolutionary thought.

**471. Ichthyology**

Fall. 3(2-3) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife.  
P: ZOL 228.  
Fish morphology, physiology. Development, behavior, evolution and ecology. World fishes with emphasis on freshwater fishes.

**472. Limnology**

Fall. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife.  
P: CEM 141, ZOL 250. R: Not open to students with credit in ZOL 431.  
Ecology of lakes with emphasis on interacting physical, chemical, and biological factors affecting their structure and function.

**474. Fishery and Limnological Techniques**

Fall. 3(1-6) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife.  
P: FW 472 or concurrently.  
Field and laboratory investigations of physical, chemical, and biological parameters of lakes and streams.

**482. Cytochemistry**

Spring. 4(3-3)  
P: ZOL 350.  
Principles of microscopy, microtomy. Cells and organelles. Localization of lipids, carbohydrates, proteins, nucleic acids and enzymes using cytochemical, immunological and autoradiographic methods.

**483. Environmental Physiology**

Spring. 4(4-0) Interdepartmental with Physiology.  
P: ZOL 228 or ZOL 250.  
Aspects of physiology important to the environmental relations of vertebrates and invertebrates: energetics, thermal relations, osmotic-ionic relations, and exercise physiology.

**485. Tropical Biology**

Spring. 3(3-0) Interdepartmental with Botany and Plant Pathology, and Entomology.  
P: ZOL 250. R: Open only to juniors and seniors.  
Tropical biota emphasizing evolutionary and ecological principles compared across tropical ecosystems.

**485L. Field Tropical Biology**

Spring, Summer. 2 credits. Interdepartmental with Botany and Plant Pathology, and Entomology.  
P: ZOL 485 or concurrently. R: Open only to juniors and seniors. Approval of department.  
Intensive field experience to study tropical ecosystems. Individual project required. Given at various sites in Costa Rica by the Organization for Tropical Studies.

**494. Capstone: Independent Study**

Fall. 1 to 6 credits. A student may earn a maximum of 8 credits in all enrollments for this course.  
R: Approval of department.  
Supervised research on a topic not normally covered in the classroom.

**495. Capstone: Undergraduate Seminar**

Fall, Spring. 1(1-0) A student may earn a maximum of 3 credits in all enrollments for this course.  
R: Open only to senior Zoology majors.  
Economic, social and environmental impact of current developments in Zoology.

**496. Capstone: Internship in Zoology**

Fall, Spring, Summer. 1 to 6 credits. Given only at various off-campus sites. A student may earn a maximum of 8 credits in all enrollments for this course.  
R: Open only to seniors. Approval of department.  
Practical experience applying Zoology training in a setting outside the University.

**499. Capstone: Undergraduate Thesis**

Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 8 credits in all enrollments for this course.  
R: Open only to seniors. Approval of department.  
Laboratory research culminating in the preparation and defense of an undergraduate thesis.

- 811. Cellular and Neurophysiology**  
Fall. 6(6-0) Interdepartmental with Physiology. Administered by Physiology.  
P: BCH 462, PSL 432.  
Advanced bioenergetics, transport, regulation of metabolic reactions, specialized cell functions, and neurophysiology.
- 817. Ecology and Evolution in Aquatic Systems**  
Summer. 4 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Botany and Plant Pathology, and Fisheries and Wildlife.  
P: ZOL 250 or ZOL 431.  
Experimental field studies of population and community ecology of freshwater lakes and streams. Emphasis on interactions among species and between biotic and abiotic factors.
- 822. Topics in Ethology and Behavioral Ecology**  
Spring of odd-numbered years. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course.  
P: ZOL 415. R: Open only to graduate students.  
Critical analysis through seminar-discussions of the primary research literature.
- 826. Tropical Biology: An Ecological Approach**  
Spring, Summer. 8 credits. Interdepartmental with Botany and Plant Pathology. Administered by Botany and Plant Pathology.  
R: Approval of department; application required.  
Principles of tropical ecology at the population, community, and ecosystem levels. Given at various sites in Costa Rica by the Organization for Tropical Studies.
- 827. Advanced Neurobiology**  
Fall. 4(4-0) Interdepartmental with Physiology, Pharmacology and Toxicology.  
R: Approval of department.  
Nervous system function at the cellular level: membrane biophysics and potentials, synaptic transmission.
- 830. Neuroendocrine Aspects of Behavior**  
Spring of even-numbered years. 3(3-0)  
P: ZOL 402.  
Neural mechanisms by which hormones influence the reproductive, parental, and aggressive behavior of vertebrates. Plasticity.
- 831. Quantitative Paleobiology**  
Spring of even-numbered years. 3(2-2) Interdepartmental with Geological Sciences. Administered by Geological Sciences.  
P: GLG 431 or ZOL 345.  
Analysis of paleobiological problems using quantitative techniques such as cladistics, morphometrics, ordination, and stereology.
- 841. Chromosome Structure and Genetics**  
Spring of even-numbered years. 3(3-0) Interdepartmental with Genetics.  
R: Approval of department.  
Classical and molecular genetics of chromosome structure and behavior in mitosis and meiosis. Synapsis and disjunction, exchange, centromeres, euchromatin, heterochromatin and transposable elements.
- 842. Application of Ecological Principles**  
Spring. 2 credits. Given only at W.K. Kellogg Biological Station. A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Botany and Plant Pathology. Administered by Botany and Plant Pathology.  
R: Approval of department.  
Workshops and discussions with experts from industry, regulatory agencies, conservation groups, and academe on application of basic ecology and evolutionary biology to real-world problems.
- 843. Selected Topics in Human Genetics**  
Fall. 3(3-0)  
P: ZOL 344. R: Open only to seniors and graduate students.  
Inheritance of human traits including medical, physiologic, forensic, biochemical, molecular and chromosomal areas.
- 844. Organelle Genetics**  
Spring of odd-numbered years. 3(3-0) Interdepartmental with Botany and Plant Pathology. Administered by Botany and Plant Pathology.  
P: BCH 811 or BOT 856, ZOL 341.  
Organization, structure, function, heredity, molecular biology and manipulation of chloroplasts and mitochondria. Biological interaction between nucleus and organelles.
- 845. Ecology and Evolution: the Interface**  
Fall. 3(3-0) Interdepartmental with Botany and Plant Pathology, and Entomology.  
Conceptual and methodological issues common to both ecology and evolutionary biology.
- 849. Evolutionary Biology**  
Spring. 3(3-0) Interdepartmental with Botany and Plant Pathology. Administered by Botany and Plant Pathology.  
P: ZOL 341, STT 422 or concurrently. C: STT 422.  
Major conceptual, theoretical and empirical questions in evolutionary biology. Readings and lectures are synthesized in student discussions and on paper.
- 851. Quantitative Methods in Ecology and Evolution**  
Fall. 3(3-0) Interdepartmental with Botany and Plant Pathology.  
P: STT 465.  
Interpretation and analysis of ecological and evolutionary biology data. Statistical computer software.
- 860. Ecology and Evolution in Terrestrial Systems**  
Summer. 4 credits. Given only at W.K. Kellogg Biological Station. Interdepartmental with Botany and Plant Pathology, and Crop and Soil Sciences. Administered by Botany and Plant Pathology.  
P: STT 422.  
Field experimental and quantitative approaches to ecological and evolutionary mechanisms.
- 881. Soil Zoology**  
Spring of even-numbered years. 4(2-6)  
P: ENT 404 or ZOL 306. R: Open only to seniors and graduate students in College of Natural Science or College of Agriculture and Natural Resources.  
Soil fauna and their ecology, biology, and systematics.
- 888. Molecular and Cellular Aspects of Development**  
Spring. 4(4-0)  
R: Approval of department.  
Current research topics in developmental biology. Cell interactions. Molecular regulation of cellular function in fertilization, morphogenesis, differentiation, oncogenesis, terato-genesis and regeneration.
- 890. Special Problems**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 10 credits in all enrollments for this course.  
R: Approval of department.  
Current problems in Zoology.
- 891. Current Topics in Ecology and Evolution**  
Summer. 1 credit. Given only at W.K. Kellogg Biological Station. A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Botany and Plant Pathology, and Crop and Soil Sciences.  
Presentation and critical evaluation of theoretical and empirical developments by visiting scientists.
- 892. Biodiversity**  
Spring. 2(2-0) A student may earn a maximum of 4 credits in all enrollments for this course. Interdepartmental with Fisheries and Wildlife.  
P: ZOL 250.  
Status of world biota and factors in the decline and extinction of major groups of plants and animals. Theory and design of natural reserves. Assessment and ecological meaning of diversity. Management for global and local diversity.
- 895. Seminar**  
Fall, Spring. 1(1-0) A student may earn a maximum of 6 credits in all enrollments for this course. Graduate seminar on current research topics in Zoology.
- 896. Population and Community Ecology**  
Fall. 4(4-0)  
Population dynamics of animals and plants utilizing life tables and projection matrices. Species interactions. Life history theory. Structure and dynamics of communities. Succession.
- 897. Community and Ecosystem Ecology**  
Spring. 4(4-0) Interdepartmental with Botany and Plant Pathology, and Fisheries and Wildlife.  
Structure and function of natural communities and ecosystems. Community analysis along environmental gradients. Succession, food web analysis, energy flow, nutrient cycling, and effects of human activities on ecosystems.
- 899. Master's Thesis Research**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 24 credits in all enrollments for this course.
- 999. Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course.