

- 370 Editing and Style in Professional Writing**  
Spring. 3(3-0) P:M: (WRA 202) and completion of Tier I writing requirement. SA: AL 370  
Theories, practice, and processes of editing in professional writing contexts. Rhetoric and style.
- 410 Advanced Web Authoring**  
Spring. 3(3-0) P:M: (WRA 210) and completion of Tier I writing requirement. SA: AL 410  
Developing and maintaining large-scale, interactive Web sites. Visual design, usability, audio and video integration, ongoing site management, and web accessibility.
- 415 Digital Rhetoric**  
Fall. 3(3-0) P:M: Completion of Tier I writing requirement. SA: AL 415  
Rhetorical, social, political, economic, and ethical dimensions of electronic writing and publishing. Rhetorical dynamics of computer-mediated writing spaces such as the Internet, World Wide Web, e-mail, and synchronous chat.
- 417 Multimedia Writing**  
Fall. 4(4-0) P:M: (WRA 210) and completion of Tier I writing requirement. RB: Prior experience with graphical computer applications. SA: AL 417  
Visual rhetoric and design theories applied to digital short subjects. Write, direct, critique, and produce motion-based digital compositions that include multiple media.
- 420 Advanced Technical Writing**  
Spring. 3(3-0) P:M: (WRA 320) and completion of Tier I writing requirement. SA: AL 420  
Applied theory and specialized practices. User-centered design, project and document management, information and interface design. Issues in digital writing, technical editing, and writing for scientific and technical journals.
- 444 Writing In American Cultures**  
Fall, Spring. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. P:M: (WRA 260) and completion of Tier I writing requirement. SA: AL 444  
Analysis of rhetorical practices in selected academic and professional disciplines, communities, and public cultures.
- 445 Writing in American Cultures: Rhetoric and Music**  
Spring of even years. 3(3-0) P:M: (IAH 201 or IAH 202 or IAH 203 or IAH 204 or IAH 206 or IAH 207 or IAH 208) and completion of Tier I writing requirement. RB: (AL 260) R: Open only to juniors and seniors. SA: AL 445  
Exploration of forms of writing about music. Links between music and oral cultures. Practice in modes of writing about and evaluating critiques of music.
- 446 American Indian Rhetorics (N)**  
Spring. 3(3-0) P:M: (WRA 260) Completion of Tier I writing requirement. RB: 3 credits in other ethnic studies coursework. SA: AL 446  
Theoretical approaches to Native rhetorics. Historical and contemporary debates about the production and reception of visual and written Native texts.
- 451 Managing Large-Scale Publication Projects**  
Spring of even years. 3(3-0) P:M: (WRA 202 or WRA 320) and completion of Tier I writing requirement. SA: AL 451  
Design theory, task management research, collaborative problem-solving approaches, and team processes involved in designing and creating large-scale publications.
- 453 Grant and Proposal Writing**  
Fall. 3(3-0) P:M: (WRA 202) and completion of Tier I writing requirement. SA: AL 453  
Researching and writing grants and proposals for corporations, nonprofit organizations, businesses, and government agencies.
- 455 Portfolio Seminar**  
Fall, Spring. 3(3-0) P:M: Completion of Tier I writing requirement. SA: AL 455  
Workshop for students preparing professional document portfolios in print and digital formats, including application materials for career, graduate study, and professional positions.
- 490 Independent Study**  
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 8 credits in all enrollments for this course. P:M: Completion of Tier I writing requirement. R: Open only to students in the College of Arts and Letters.  
Special project, directed reading and research.
- 491 Special Topics**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. P:M: Completion of Tier I writing requirement.  
Writing and reading intensive course on special topics in professional writing. Topics vary.
- 493D Internship in Professional Editing and Publishing**  
Spring of odd years. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P:M: Completion of Tier I writing requirement. RB: (WRA 370 and WRA 355) R: Approval of college. SA: AL 493D  
Supervised work in editing and publishing.
- 493E Internship in Professional Writing**  
Spring. 3 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. P:M: (WRA 202) and completion of Tier I writing requirement. RB: Web-authoring course or experience. R: Approval of college. SA: AL 493E  
Supervised work as writers and editors in a corporate or organizational setting. Required workshop component.
- 141 Introductory Human Genetics**  
Fall, Spring. 3(3-0) R: Not open to students in the Biochemistry and Molecular Biology, Plant Biology, Entomology, Medical Technology, Clinical Laboratory Science, Physiology, Zoology, Microbiology and Molecular Genetics, Biological Science-Interdepartmental, or Human Biology majors. Not open 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:M: (BS 110 or LBS 144 or LBS 148H)  
Systematics, morphology, and natural history of invertebrate animals. Identification of live and preserved specimens. Recognition of selected groups.
- 310 Psychology and Biology of Human Sexuality**  
Spring of odd years. 3(3-0) Interdepartmental with Psychology. Administered by Department of Psychology. P:M: (PSY 101 or concurrently) and (BS 110 or concurrently or BS 111 or concurrently or LBS 144 or concurrently or LBS 145 or concurrently or LBS 148H or concurrently or LBS 149H or concurrently) Not open to students with credit in FCE 445.  
Sexual behavior from biological, psychological and neuroscience perspectives. Sexual differentiation of the body. Role of hormones in development and reproduction in humans and other animals. Human sexual orientation. Fertility and contraception. Sexual disorders. Sexually transmitted diseases.
- 313 Animal Behavior**  
Fall, Spring. 3(3-0) P:M: (BS 110 or LBS 144 or LBS 148H) R: Not open to freshmen. SA: ZOL 213  
Development, physiological mediation, adaptive significance and evolution of behavior.
- 316 General Parasitology**  
Spring. 3(3-0) P:M: (LBS 144 or LBS 145 or LBS 148H or LBS 149H or BS 110) or (BS 111 and BS 111L)  
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:M: (ZOL 316 or concurrently) R: Not Open to freshman  
Laboratory diagnosis of protozoans, helminths, acanthocephalans, copepods, and arthropods that infect humans and animals. Animal necropsy.
- 319 Introduction to Earth System Science**  
Fall. 3(3-0) Interdepartmental with Entomology; Plant Biology; Geological Sciences; Sociology. Administered by Department of Entomology. RB: Completion of one course in biological or physical science.  
Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.

## ZOOLOGY

## ZOL

Department of Zoology  
College of Natural Science

- 101 Preview of Zoology**  
Fall, Spring. 1(1-0) R: Open only to freshmen in the Zoology major.  
Zoology as a discipline. Availability of diverse career options. Integration of human and technical skills in scientific problem solving.
- 111L Cell and Molecular Biology Laboratory**  
Fall, Spring, Summer. 2(1-3) Interdepartmental with Biological Science; Microbiology and Molecular Genetics; Plant Biology. Administered by College of Natural Science. P:M: (BS111 or concurrently) Not open to students with credit in LBS 159H.  
Principles and applications of common techniques used in cell and molecular biology.

## Zoology—ZOL

- 320 Developmental Biology**  
Fall. 4(3-3) P:M: (BS 110 or LBS 144 or LBS 148H) and (BS 111 or LBS 145 or LBS 149H) SA: ZOL 220  
Principles of development, emphasizing vertebrates. Illustrations from morphological and experimental investigations.
- 328 Comparative Anatomy and Biology of Vertebrates**  
Spring. 4(3-3) P:M: (BS 110 or LBS 144 or LBS 148H) and completion of Tier I writing requirement. SA: ZOL 228  
Comparative morphology and natural history of vertebrates. Dissection of representatives of most vertebrate classes.
- 341 Fundamental Genetics**  
Fall, Spring, Summer. 4(4-0) Interdepartmental with Plant Biology. P:M: (BS 111 or LBS 145 or LBS 149H)  
Principles of heredity in animals, plants and microorganisms. Classical and molecular methods in the study of gene structure, transmission, expression and evolution.
- 343 Genetics Laboratory**  
Spring. 2(0-4) P:M: (ZOL 341 or concurrently) and completion of Tier I writing requirement.  
Experiments involving genetics of *Drosophila* and other eucaryotic organisms.
- 353 Marine Biology**  
Fall. 4(4-0) P:M: (BS 110 or LBS 144 or LBS 148H) and completion of Tier I writing requirement.  
Analysis of marine and estuarine systems. Integration of biology, chemistry, and physics. Life histories of marine organisms. Biology of special marine habitats including rocky intertidal zones, upwellings, coral reefs and deep sea.
- 355 Ecology**  
Fall, Spring, Summer. 3(3-0) Interdepartmental with Plant Biology. P:M: (BS 110 or LBS 144 or LBS 148H) SA: ZOL 250  
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.
- 355L Ecology Laboratory**  
Fall, Spring, Summer. 1(0-3) Interdepartmental with Plant Biology. P:M: (ZOL 355 or concurrently or PLB 355 or concurrently) and completion of Tier I writing requirement.  
Population, community, and ecosystem ecology, utilizing plant and animal examples to demonstrate general field principles.
- 360 Biology of Birds**  
Fall. 4(3-3) P:M: (BS 110 or LBS 144 or LBS 148H)  
Behavior, ecology, evolution, and systematics of birds; biodiversity. Laboratories emphasize diversity of form and function, life history patterns, and identification.
- 361 Michigan Birds**  
Summer. 4(3-3) Summer: Given only at W.K. Kellogg Biological Station. P:M: (BS 110 or LBS 144 or LBS 148H) Not open to students with credit in ZOL 360.  
Field study of avian diversity, ecology, and behavior using current systematics and habitat identification techniques.
- 365 Biology of Mammals**  
Spring. 4(3-3) P:M: (BS 110 or LBS 144 or LBS 148H)  
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.
- 369 Introduction to Zoo and Aquarium Science**  
Spring. 3(3-0) Interdepartmental with Landscape Architecture; Fisheries and Wildlife; Veterinary Medicine. P:M: (BS 110 or LBS 144 or LBS 148H)  
Fundamentals of zoo and aquarium operations including research, interpretation, design, nutrition, captive breeding, conservation, ethics and management.
- 370 Introduction to Zoogeography**  
Fall. 3(3-0) Interdepartmental with Fisheries and Wildlife; Geography. P:M: (ZOL 355)  
Patterns of geographical distribution of animals and the ecological and historical processes leading to these patterns.
- 384 Biology of Amphibians and Reptiles**  
Fall. 4(3-3) P:M: (BS 110 or LBS 144 or LBS 148H)  
The evolution, systematics, ecology, and behavior of amphibians and reptiles. Laboratory emphasizes diversity and identification of families and Great Lakes species. Field trips may be required.
- 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 or sophomores. Approval of the department.  
Honors work on a topic in zoology.
- 402 Neurobiology**  
Fall, Spring. 3(3-0) P:M: (BS 110 or LBS 144 or LBS 148H) and (BS 111 or LBS 145 or LBS 149H) R: Not open to freshmen or sophomores.  
Structure and function of nerve cells and nervous systems.
- 404 Human Genetics**  
Spring. 3(3-0) P:M: (ZOL 341) and (BMB 401 or concurrently or BMB 461 or concurrently) and completion of Tier I writing requirement. SA: ZOL 344  
Inheritance of human traits. Medical, molecular, physiological and forensic applications. Biochemical, clinical, and molecular genetics of human disease. Prenatal, pre-symptomatic, and clinical diagnosis. Ethical, legal and social considerations.
- 408 Histology**  
Fall. 4(3-3) P:M: (BS 111 or LBS 145 or LBS 149H) SA: ZOL 350  
Structure of cells and their interactions to form tissues.
- 413 Laboratory in Behavioral Neuroscience (W)**  
Fall. 4(2-4) Interdepartmental with Psychology. Administered by Department of Psychology. P:M: (PSY 209 or ZOL 402) and (PSY 295 or concurrently or STT 201) and completion of Tier I writing requirement. SA: PSY 309  
Theory and laboratory experience in the study of behavioral neuroscience. Relationship among hormones, brain, and behavior.
- 415 Ecological Aspects of Animal Behavior**  
Spring. 3(3-0) P:M: (ZOL 313) and completion of Tier I writing requirement.  
Advanced topics in the ecology and evolution of animal behavior.
- 419 Advanced Earth System Science**  
Spring. 3(2-2) Interdepartmental with Entomology; Plant Biology; Geological Sciences; Sociology. Administered by Department of Entomology. P:M: (ENT 319)  
Systems science theory applied to analysis of the biological, geological, physical, and social causes and consequences of global changes. Issues of sustaining the Earth system.
- 420 Stream Ecology**  
Fall. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:M: (BS 110 or LBS 144 or LBS 148H) RB: (CEM 141 and ZOL 355)  
Biological and environmental factors determining structure and function of stream ecosystems.
- 422 Aquatic Entomology**  
Fall of odd years. 3(2-3) Interdepartmental with Entomology; Fisheries and Wildlife. Administered by Department of Entomology. P:M: (BS 110) SA: ENT 420  
Biology, ecology and systematics of aquatic insects in streams, rivers and lakes. Field trips and aquatic insect collection required.
- 424 Algal Biology**  
Fall of even years. Summer of odd years. 4(2-4) Summer: KBS. Interdepartmental with Plant Biology. Administered by Department of Plant Biology. P:M: (BS 110 or LBS 144 or LBS 148H) and completion of Tier I writing requirement. RB: (ZOL 355 and ZOL 355L) or (PLB 441) SA: BOT 424  
Algal taxonomy, systematics, physiology, ecology, and environmental assessment. Lab focus on identification of freshwater algal genera collected from regional habitats. Field trips required.
- 425 Cells and Development**  
Spring. 4(3-3) P:M: (BS 111 and BS 111L) or (LBS 145) or (LBS 149H) and completion of Tier I writing requirement. SA: ZOL 221  
The role of cells in growth, differentiation and development of animals from protozoa to mammals.
- 426 Biogeochemistry**  
Summer. 3 credits. Summer: Given only at W.K. Kellogg Biological Station. Interdepartmental with Microbiology and Molecular Genetics; Crop and Soil Sciences; Geological Sciences. Administered by Department of Microbiology and Molecular Genetics. RB: (BS 110 or LBS 144 or LBS 148H or BS 111 or LBS 145 or LBS 149H) and (CEM 143 or CEM 251) SA: MPH 426  
Integration of the principles of ecology, microbiology, geochemistry, and environmental chemistry. Societal applications of research in aquatic and terrestrial habitats.
- 428 Frontiers in Developmental and Tissue Biology**  
Fall. 3(3-0) RB: (BS 111 or ZOL 320) or (ZOL 408 and BMB 401) and completion of Tier I writing requirement.  
Integrated approach to common cellular mechanisms in normal and abnormal development, tissue regeneration, stem cell biology and differentiation. Tissue engineering, tissue and organ replacement and chronic diseases, such as arthritis, cancer, diabetes and Parkinson's disease.

- 430 Neuroendocrine Aspects of Behavior**  
Spring of odd years. 3(3-0) P:M: (ZOL 313 and ZOL 402) R: Open only to juniors or seniors in the Psychology or Zoology major. SA: ZOL 830  
Neural mechanisms by which hormones influence the reproductive, parental, aggressive and social behavior of vertebrates. Plasticity.
- 431 Comparative Limnology**  
Summer. 4(2-6) Summer: Given only at W.K. Kellogg Biological Station. Interdepartmental with Plant Biology; Fisheries and Wildlife. P:M: (CEM 141 or CEM 151) and (ZOL 355) 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 years. 4(3-2) Interdepartmental with Geological Sciences. Administered by Department of Geological Sciences. P:M: (ZOL 328)  
Fossil vertebrates with emphasis on evolution and interrelationships of major groups. Modern techniques of identification and interpretation of fossils.
- 434 Evolutionary Paleobiology**  
Fall. 4(3-2) Interdepartmental with Geological Sciences. Administered by Department of Geological Sciences. RB: (BS 110 or GLG 304 or LBS 144 or LBS 148H)  
Patterns and processes of evolution known from the fossil record including speciation, phylogeny, extinction, heterochrony and biogeography.
- 440 Field Ecology and Evolution**  
Summer. 4 credits. Summer: Given only at W.K. Kellogg Biological Station. Interdepartmental with Plant Biology. P:M: (ZOL 355)  
Solving conceptual and practical research problems in ecology and evolution under field conditions.
- 443 Restoration Ecology**  
Spring. 3(2-2) Interdepartmental with Fisheries and Wildlife; Biosystems Engineering. Administered by Department of Fisheries and Wildlife. RB: (CSS 210 or BE 230) and (FOR 404 or FW 364 or ZOL 355)  
Principles of ecological restoration of disturbed or damaged ecosystems. Design, implementation, and presentation of restoration plans. Field trips required.
- 444 Conservation Biology**  
Fall. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:M: (ZOL 355 or FOR 404) and completion of Tier I writing requirement.  
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 Plant Biology. P:M: (ZOL 341) and completion of Tier I writing requirement. R: Not open to freshmen. SA: ZOL 345  
Processes of evolutionary change in animals, plants. Microbes. Population genetics, microevolution, speciation, adaptive radiation, macroevolution. Origin of Homo sapiens.
- 446 Environmental Issues and Public Policy**  
Fall, Spring. 3(3-0) Interdepartmental with Resource Development. R: Not open to freshmen or sophomores.  
Interrelationship of science and public policy in resolving environmental issues. Technical, social, economic, and legal influences. Case study approach.
- 447 Practical Applications of Landscape Ecology**  
Fall. 3(1-4) P:M: (BS 110) RB: (CSE 101) and (ZOL 355)  
Concepts and techniques of landscape ecology. Issues and resource management. Simulation of changes in landscape metrics, disturbance, and connectivity and metapopulations.
- 450 Cancer Biology**  
Spring. 3(3-0) P:M: (BMB 200 or BMB 401 or ZOL 425) or (BMB 461 and BMB 462) and completion of Tier I writing requirement.  
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**  
Spring. 2 to 3 credits. A student may earn a maximum of 5 credits in all enrollments for this course. R: Approval of department.  
Marine and estuarine communities emphasizing ecology, life histories, behavior, identification, morphology, and resource ecology of the organisms present. Field trip to sea coast.
- 457 Foundations of Evolutionary Biology**  
Spring. 3(3-0) P:M: (BS 110 or LBS 144 or LBS 148H) and completion of Tier I writing requirement.  
Reading and discussion of original works in evolutionary biology which have shaped modern evolutionary thought.
- 460 The Biology of Molluscs**  
Spring of even years. 3(3-0) P:M: (ZOL 306)  
Biology, economic importance, and role of molluscs in biological research.
- 471 Ichthyology**  
Fall. 4(3-3) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:M: (BS 110 or LBS 144 or LBS 148H) and completion of Tier I writing requirement.  
Fish morphology and physiology. Development, behavior, evolution, and ecology. World fishes with emphasis on freshwater fishes.
- 472 Limnology**  
Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:M: (CEM 141 or LBS 171) and (ZOL 355) Not open to students with credit in BOT 431 or FW 431 or ZOL 431.  
Ecology of lakes with emphasis on interacting physical, chemical, and biological factors affecting their structure and function.
- 474 Limnological and Fisheries Techniques**  
Fall. 3(1-6) Interdepartmental with Fisheries and Wildlife. Administered by Department of Fisheries and Wildlife. P:M: (FW 472 or FW 414 or concurrently)  
Field and laboratory investigations of physical, chemical, and biological parameters of lakes and streams. Field trips required.
- 482 Cytochemistry**  
Spring. 4(3-3) P:M: (BS 111) and completion of Tier I writing requirement.  
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:M: (BS 110 or LBS 144 or LBS 148H) and (BS 111 or LBS 145 or LBS 149H) and (CEM 141 or CEM 151 or CEM 181H or LBS 171) and completion of Tier I writing requirement.  
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 Plant Biology; Entomology. P:M: (ZOL 355) R: Open only to juniors or seniors.  
Tropical biota emphasizing evolutionary and ecological principles compared across tropical ecosystems.
- 489 Seminar in Zoo and Aquarium Science**  
Fall, Spring. 1(1-0) A student may earn a maximum of 3 credits in all enrollments for this course. Interdepartmental with Park, Recreation and Tourism Resources; Fisheries and Wildlife; Landscape Architecture. R: Approval of department.  
Scientific writing and oral presentations related to zoo and aquarium studies.
- 490 Overseas Study in Zoology**  
Fall, Spring, Summer. 3 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. RB: (BS 110 and BS 111) R: Open only to juniors or seniors or graduate students. Approval of department.  
Topical problems course in Zoology or coordinated by Zoology faculty in foreign countries.
- 491 Seminar in Marine Biology**  
Fall, Spring. 1(1-0) RB: (ZOL 355 or ZOL 353 or GLG 303) R: Open only to seniors in the Department of Zoology.  
Reading and discussion of articles relating to current developments in marine biology and the economic, social and environmental impact of these discoveries.
- 494 Independent Study**  
Fall, Spring, Summer. 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 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.

## Zoology—ZOL

- 496 Internship in Zoology**  
Fall, Spring, Summer. 1 to 6 credits. Summer: 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.
- 498 Internship in Zoo and Aquarium Science**  
Fall, Spring, Summer. 3 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Fisheries and Wildlife; Landscape Architecture. R: Open only to juniors or seniors. Approval of department.  
Application of zoological experience in a zoo or aquarium setting outside the university.
- 499 Undergraduate Thesis**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 8 credits in all enrollments for this course. P:M: Completion of Tier I writing requirement. R: Open only to seniors. Approval of department.  
Laboratory research culminating in the preparation and defense of an undergraduate thesis.
- 804 Molecular and Developmental Neurobiology**  
Fall. 3(3-0) Interdepartmental with Neuroscience; Pharmacology and Toxicology; Psychology; Pathology. Administered by Program in Neuroscience. RB: Bachelor's degree in a Biological Science or Psychology. R: Open only to graduate students in the Neuroscience major.  
Nervous system specific gene transcription and translation. Maturation, degeneration, plasticity and repair in the nervous system.
- 814 Environmental Chemodynamics**  
Spring of even years. 4(4-0) R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering or College of Human Medicine or College of Natural Science or College of Osteopathic Medicine or College of Veterinary Medicine. SA: FW 814  
Chemical and environmental factors controlling the distribution of organic and inorganic chemicals in air, water, and soil. Environmental monitoring.
- 822 Topics in Ethology and Behavioral Ecology**  
Spring of odd years. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. RB: (ZOL 415) R: Open only to graduate students.  
Critical analysis through seminar-discussions of the primary research literature.
- 825 Molecular and Biochemical Bases of Human Disease**  
Spring. 3(3-0) Interdepartmental with Genetics. RB: (ZOL 341) or equivalent general genetics course.  
Medical genetics. Molecular, biochemical, and diagnostic issues related to human disease. Disease pathophysiology. Ethical, legal, and social issues related to human genetics research.
- 826 Tropical Biology: An Ecological Approach**  
Spring, Summer. 8 credits. Spring: Costa Rica. Summer: Costa Rica. Interdepartmental with Plant Biology. Administered by Department of Plant Biology. R: Approval of department; application required. SA: BOT 826  
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 Physiology and Pharmacology of Excitable Cells**  
Fall. 4(4-0) Interdepartmental with Pharmacology and Toxicology; Physiology; Neuroscience. Administered by Department of Pharmacology and Toxicology. RB: (PSL 431 or PSL 432 or BMB 401 or BMB 461 or ZOL 402)  
Function of neurons and muscle at the cellular level: membrane biophysics and potentials, synaptic transmission, sensory nervous system function.
- 828 Conservation and Genetics**  
Fall of even years. 3(2-2) Interdepartmental with Fisheries and Wildlife; Plant Biology. Administered by Department of Fisheries and Wildlife. RB: (ZOL 341 or CSS 350 or ANS 314)  
Population and evolutionary genetic principles applied to ecology, conservation, and management of fish and wildlife at the individual, population, and species level.
- 831 Quantitative Paleobiology**  
Spring of odd years. 3(2-2) Interdepartmental with Geological Sciences. Administered by Department of Geological Sciences. RB: (GLG 431)  
Analysis of paleobiological problems using quantitative techniques such as cladistics, morphometrics, ordination, and stereology.
- 835 Biogeography**  
Spring of odd years. 3(3-0) Interdepartmental with Fisheries and Wildlife; Geography; Plant Biology. Administered by Department of Fisheries and Wildlife. RB: Courses in evolution and ecology at undergraduate level.  
Geographical distributions of plants and animals; biogeographic realms. Ecological and evolutionary mechanisms determining distributional patterns. Application of biogeography to conservation problems.
- 839 Systems Neuroscience**  
Spring. 4(4-0) Interdepartmental with Neuroscience; Human Anatomy; Pharmacology and Toxicology; Physiology; Psychology. Administered by Program in Neuroscience. R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Agriculture and Natural Resources, Natural Science, Social Science, and Veterinary Medicine. SA: ANT 839  
Anatomy, pharmacology, and physiology of multicellular neural systems. Sensory, motor, autonomic, and chemo-regulatory systems in vertebrate brains.
- 842 Application of Ecological Principles**  
Spring. 2 credits. A student may earn a maximum of 8 credits in all enrollments for this course. Interdepartmental with Plant Biology. Administered by Department of Plant Biology. SA: BOT 842  
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.
- 849 Evolutionary Biology**  
Spring. 3(3-0) Interdepartmental with Plant Biology. Administered by Department of Plant Biology. RB: (ZOL 341 and STT 422 or concurrently) SA: BOT 849  
Major conceptual, theoretical and empirical questions in evolutionary biology. Readings and lectures are synthesized in student discussions and papers.
- 851 Quantitative Methods in Ecology and Evolution**  
Fall. 3(3-0) Interdepartmental with Plant Biology. RB: (STT 465)  
Interpretation and analysis of ecological and evolutionary biology data. Statistical computer software.
- 853 Applied Systems Modeling and Simulation for Natural Resource Management**  
Spring of odd years. 3(2-2) Interdepartmental with Fisheries and Wildlife; Biosystems Engineering; Forestry; Resource Development. Administered by Department of Fisheries and Wildlife. RB: (FW 820 or BE 486 or ZOL 851) approval of department. R: Open only to seniors and graduate students  
Mathematical models for evaluating resource management strategies. Stochastic and deterministic simulation for optimization. System control structures. Team modelling approach.
- 855 Molecular Evolution: Principles and Techniques**  
Fall of odd years. 3(3-0) Interdepartmental with Plant Biology; Microbiology and Molecular Genetics. RB: (ZOL 341 or ZOL 445)  
Current techniques used to characterize and compare genes and genomes. Genetic variation, assays of variation. Data analysis and computer use to conduct a phylogenetic analysis to compare organisms and infer relationships.
- 857 Theoretical Ecology**  
Spring of even years. 3(2-2) Interdepartmental with Fisheries and Wildlife; Plant Biology. Administered by Department of Fisheries and Wildlife. RB: One course in ecology and calculus. Programming experience helpful.  
Theoretical ecology of animal behavior, population dynamics, and multispecies communities. Basic mathematical approaches and use of modeling software to perform mathematical functions and develop models.
- 867 Nature and Practice of Cognitive Science**  
Spring. 3(3-0) Interdepartmental with Psychology; Linguistics; Philosophy; Computer Science and Engineering. RB: Undergraduate course work in behavioral biology, cognitive psychology, philosophy, linguistics, or artificial intelligence.  
Survey of how different disciplines explore the cognitive processes underlying intelligent behavior.

- 868 Aquatic Toxicology**  
Spring of odd years. 4(3-2) R: Open only to graduate students in the College of Agriculture and Natural Resources or College of Engineering or College of Human Medicine or College of Natural Science or College of Osteopathic Medicine or College of Veterinary Medicine. SA: FW 831  
Techniques for assessing acute and chronic effects of toxicants on biochemical, physiological, organismal, population, community, and ecosystem levels of organization.
- 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. Summer: 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 Plant Biology; 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. RB: (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) Interdepartmental with Plant Biology.  
Population dynamics of animals and plants utilizing life tables and projection matrices. Species interaction. Life history theory. Structure and dynamics of communities. Succession.
- 897 Ecosystem Ecology**  
Spring. 4(4-0) Interdepartmental with Plant Biology; Fisheries and Wildlife.  
Structure and function of natural ecosystems. Succession, food web analysis, energy flow, nutrient cycling, and effects of human activities on ecosystems. Global environmental change. Ecosystem management and restoration.
- 899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 36 credits in all enrollments for this course.  
Master's thesis research.
- 999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 120 credits in all enrollments for this course.  
Doctoral dissertation research.