ZOOLOGY

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 and Microbiology. P:M: BS 111 or concurrently. Not open to students with credit in LBS 159H. Principles and applications of common techniques used in cell and molecular biology.

141  Introductory Human Genetics
   Fall, Spring. (3-0) R: Not open to students in the Biochemistry and Molecular Biology major or Plant Biology major or Entomology major or Medical Technology major or Clinical Laboratory Sciences major or Physiology major or Zoology major or Microbiology and Molecular Genetics major or Biological Science-Interdepartmental major or Human Biology major. 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.

303  Oceanography
   Fall. (4-0) Interdepartmental with Geological Sciences. Administered by Zoology. P:M: (CEM 141 or CEM 142 or CEM 151 or CEM 152 or CEM 181H or CEM 182H or LBS 171) and (PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C or LBS 271). Physical, chemical, biological, and geological aspects of oceanography: ocean circulation, waves, tides, air-sea interactions, chemical properties of ocean water, ocean productivity, shoreline processes, and sediments.

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. (3-0) Interdepartmental with Psychology. Administered by 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. (3-0) P:M: BS 110 or LBS 144 or LBS 148H. Not open to freshmen. SA: ZOL 213. Development, physiological mediation, adaptive significance and evolution of behavior.

316  General Parasitology
   Spring. (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 freshmen. 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 and Geology and Sciences and Plant Biology and Sociology. Administered by 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 spatiotemporal scales. Sustainability of the Earth system.

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) or 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. Administered by Zoology. 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), 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, upwelling, coral reefs and deep sea.

355  Ecology
   Fall, Spring, Summer. 3(3-0) Interdepartmental with Plant Biology. Administered by Zoology. P:M: BS 110 or LBS 144 or LBS 148H. 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. Administered by Zoology. P:M: ((ZOL 355 or concurrently) or (PLB 355 or concurrently)) or 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) 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.

369  Introduction to Zoo and Aquarium Science
   Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife and Landscape Architecture and Veterinary Medicine. Administered by Zoology. 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 and Geography. Administered by Zoology. 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 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.

403 Integrative Neurobiology
Spring of even years. 3(3-0) P:M: ZOL 402 or PSY 209 RB: Junior or Senior level
How the nervous system has evolved mechanisms to determine the location and significance of physical and social sensory information. Epigenetic factors that guide nervous system development.

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

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 Psychology. P:M: (PSY 209 or ZOL 402) and completion of Tier I writing requirement) and (PSY 295 or concurrently) or STT 201) 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 and Geological Sciences and Plant Biology and Sociology. Administered by Entomology. P:M: ENT 319
Systems science theory applied to analysis of the biological, geophysical, physical, and social causes and consequences of global changes. Issues of sustaining the Earth system.
460 The Biology of Molluscs  
Spring of even years. 3(3-0) P:M: ZOL 306.  
Biochemistry, economic importance, and role of molluscs in biological research.

471 Ichthyology  
Fall. 4(3-3) Interdepartmental with Fisheries and Wildlife.  
Administered by 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 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.

473 Limnological and Fisheries Techniques  
Fall. 3(1-6) Interdepartmental with Fisheries and Wildlife.  
Administered by 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.

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.  
Administered by Zoology. P:M: (BS 110 or LBS 144 or LBS 148H) or completion of Tier I writing requirement and (BS 111 or LBS 145 or LBS 149H) and (CEM 141 or CEM 151 or CEM 181H or LBS 171).  
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 Entomology and Plant Biology. Administered by Zoology. P:M: ZOL 355: 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 Fisheries and Wildlife and Landscape Architecture and Park, Recreation and Tourism Resources. Administered by Zoology. 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. 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.

496 Internship in Zoology  
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.  
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 and Landscape Architecture. Administered by Zoology. 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. R: 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.

801 Professional Development  
Fall. 1(2-0) R: Open only to graduate students in the Department of Zoology.  
Ethical conduct in research. Selecting research topics and approaches. Scientific writing, grantsmanship, and publication. Career paths inside and outside academia.

804 Molecular and Developmental Neurobiology  
Fall. 3(0) Interdepartmental with Neuroscience and Pathobiology and Diagnostic Investigation and Pharmacology and Toxicology and Psychology. Administered by Neuroscience. RB: Bachelor's degree in a Biological Science or Psychology. R: Open to graduate students in Neuroscience major.  
Nervous system specific gene transcription and translation. Maturation, degeneration, plasticity, and repair in the nervous system.

805 Animal Welfare Assessment  
Fall, Spring. 3(3-0) Interdepartmental with Animal Science. Administered by Animal Science. RB: (ANS 305 or ZOL 313) or background in animal science or zoology including exposure to topics such as animal behavior, physiology, management, and husbandry.  
Multidisciplinary online computer-based instruction in animal welfare science and related issues including physiology, behavior, human-animal interactions, suffering and pain, ethics, health, assessment and standards, and economics.

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.

824 Stable Isotope Biogeochemistry  
Spring. 2(1-2) Interdepartmental with Geobiological Sciences. Administered by Zoology. RB: CEM 142 or CEM 152 or CEM 182H or LBS 171.  
Principles of stable isotope chemistry applied to biogeochemical problems: climate change, ecology, contaminants, oceanography, limnology, and paleobiology.
825 Molecular and Biochemical Bases of Human Disease
Spring, 3(3-0) Interdepartmental with Genetics. Administered by Zoology. 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. Interdepartmental with Plant Biology. Administered by 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 Neuroscience and Pharmacology and Toxicology and Physiology. Administered by Pharmacology and Toxicology. RB: PSL 431 or PSL 432 or MMB 401 or MMB 461 or ZOL 402
Function of neurons and muscle at the cellular level; membrane biophysics, molecular, synaptic transmission, sensory nervous system function.

828 Conservation and Genetics
Fall of even years. 3(2-2) Interdepartmental with Fisheries and Wildlife and Plant Biology. Administered by 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 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 and Geography and Plant Biology. Administered by 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 Human Anatomy and Neuroscience and Pharmacology and Toxicology and Physiology and Psychology. Administered by Neurosciences. R: Open only to graduate students in the Colleges of Human Medicine, Osteopathic Medicine, Agricultural 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.

849 Evolutionary Biology
Spring. 3(3-5) Interdepartmental with Plant Biology. Administered by 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. Administered by Zoology. 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 Biosystems Engineering and Forestry and Fisheries and Wildlife and Resource Development. Administered by Fisheries and Wildlife. RB: (FW 820 or BE 486 or ZOL 851) or approval of department. R: Open only to seniors and graduate students

855 Molecular Evolution: Principles and Techniques
Fall of odd years. 3(3-0) Interdepartmental with Microbiology and Molecular Genetics and Plant Biology. Administered by Zoology. 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 and Plant Biology. Administered by 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 Computer Science and Engineering and Linguistics and Philosophy and Psychology. Administered by Zoology. 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, organ, 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 to 2 credits. A student may earn a maximum of 10 credits in all enrollments for this course. Interdepartmental with Crop and Soil Sciences and Plant Biology. Administered by Zoology.
Presentation and critical evaluation of theoretical and empirical developments in ecology and evolutionary biology 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. Administered by Zoology. 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. Administered by Zoology. RB: ZOL 341

897 Ecosystem Ecology
Fall. 4(4-0) Interdepartmental with Fisheries and Wildlife and Plant Biology. Administered by Zoology.
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.