### Organismal and Population Biology Laboratory

- **Fall, Spring, Summer. 2(1-3)**: Interdepartmental with Biological Science and Plant Biology. Administered by Biological Science.
  - P: BS 161 or BS 181H or LB 145 SA: BS 110, BS 145H Not open to students with credit in BS 192H or LB 144.

### Honors Organismal and Population Biology

- **Fall, 3(3-0)**: Interdepartmental with Biological Science and Lyman Briggs and Plant Biology. Administered by Biological Science.
  - P: BS 161 or concurrently or (BS 182H or concurrently) SA: BS 110, BS 155H Not open to students with credit in BS 192H or LB 144.
  - Nature and process of organismal biology including experimental design, statistical methods, hypothesis testing in genetics, ecology, and evolution.

### Honors Organismal and Population Biology Laboratory

- **Fall, 2(1-3)**: Interdepartmental with Biological Science and Lyman Briggs and Plant Biology. Administered by Biological Science.
  - P: BS 155H, BS 110 Not open to students with credit in BS 172 or LB 144.
  - Nature and process of organismal biology, including experimental design and statistical methods, hypothesis testing, genetics, ecology, and evolution.

### Oceanography

- **Fall, 4(4-0)**: Interdepartmental with Geological Sciences. Administered by Zoology.
  - P: (CEM 141 or CEM 181H or LB 171) and (PHY 231 or PHY 183 or PHY 193H or LB 273).
  - 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.

### Invertebrate Biology

- **Fall, 4(3-3)**: P: BS 162 or LB 144 or BS 182H Systematics, morphology, and natural history of invertebrate animals. Identification of live and preserved specimens. Recognition of selected groups.

### Psychology and Biology of Human Sexuality

- **Spring of odd years. 3(3-0)**: Interdepartmental with Psychology. Administered by Psychology.
  - P: (PSY 101 or concurrently) and (BS 161 or concurrently) or (BS 162 or concurrently) or (LB 145 or concurrently) or (BS 181H or concurrently) or (BS 182H or concurrently) Not open to students with credit in HDFS 145.

### General Parasitology

- **Spring, 3(3-0)**: P: LB 144 or BS 162 or BS 182H Identification, life history, host-parasite relationships, and epidemiology of protozoan, helminth, acanthocephalan, copepod, and arthropod parasites of animals and humans.

### Introduction to Earth System Science

- **Fall, 3(3-0)**: Interdepartmental with Entomology and Geological 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 spatio-temporal scales. Sustainability of the Earth system.

### Developmental Biology

- **Fall, 4(3-3)**: P: (BS 161 or LB 145 or BS 181H) and (BS 162 or LB 144 or BS 182H) SA: ZOL 220
  - Principles of development, emphasizing vertebrates. Illustrations from morphological and experimental investigations.

### Comparative Anatomy and Biology of Vertebrates (W)

- **Spring, 4(3-3)**: P: (BS 162 or LB 144 or BS 182H) and completion of Tier I writing requirement Not open to students with credit in ZOL 220.
  - Comparative morphology and natural history of vertebrates. Dissection of representatives of most vertebrate classes.

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### Other Courses

- **Fundamental Genetics**
  - Fall, Spring, Summer. 4(4-0)**: Interdepartmental with Plant Biology. Administered by Zoology. P: BS 161 or LB 145 or BS 181H
  - Principles of heredity in animals, plants and microorganisms. Classical and molecular methods in the study of gene structure, transmission, expression and evolution.

- **Genetics Laboratory**
  - Spring. 3(0-6)**: P: (ZOL 341 or concurrently) and completion of Tier I writing requirement Experiments involving genetics of Drosophila and other eucaryotic organisms.

- **Marine Biology (W)**
  - Fall. 4(4-0)**: P: (BS 162 or LB 144 or BS 182H) and completion of Tier I writing requirement

- **Ecology**
  - Fall, Spring. 3(3-0)**: Interdepartmental with Plant Biology. Administered by Zoology. P: BS 162 or LB 144 or BS 182H 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.

- **Ecology Laboratory (W)**
  - Spring. 1(1-0)**: P: ZOL 355 or concurrently or completion of Tier I writing requirement
  - sandy beach and dune communities. Principles of population, community, and ecosystem ecology, utilizing plant and animal examples to demonstrate general field principles.

- **Introduction to Zoology and Aquatic Science**
  - Spring. 3(3-0)**: Interdepartmental with Fisheries and Wildlife and Landscape Architecture and Veterinary Medicine. Administered by Zoology. P: BS 162 or LB 144 or BS 182H Fundamentals of zoo and aquarium operations including research, interpretation, design, nutrition, captive breeding, conservation, ethics and management.

- **Introduction to Zoogeography**
  - Fall. 3(3-0)**: Interdepartmental with Fisheries and Wildlife and Geography. Administered by Zoology. P: (ZOL 355 or concurrently) Patterns of geographical distribution of animals and the ecological and historical processes leading to these patterns.
Biology of Amphibians and Reptiles (W)  
Fall. 4(3-3) P: (BS 162 or LB 144 or BS 182H) and completion of Tier I writing requirement

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.

Practicum in Zoo/Aquarium Careers  
Summer. 4 credits.

Practical application of science, business and education methods through typical workdays with zoo professionals.

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.

Neurobiology  
Fall, Spring. 3(3-0) P: (BS 162 or LB 144 or BS 182H) and (BS 161 or LB 145 or BS 181H) R: Not open to freshmen or sophomores.

Structure and function of nerve cells and nervous systems.

Integrative Neurobiology  
Spring of odd years. 3(3-0) P: ZOL 402 or 404 or PSY 209 R: 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.

Histology  
Fall. 4(3-3) P: BS 161 or LB 145 or BS 181H SA: ZOL 350

Structure of cells and their interactions to form tissues.

Laboratory in Behavioral Neuroscience (W)  
Fall. 4(2-4) Interdepartmental with Psychology. Administered by Psychology. P: PSY 295 and PSY 299 (or ZOL 402) 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.

Ecological Aspects of Animal Behavior (W)  
Spring. 3(3-0) P: (ZOL 313) and completion of Tier I writing requirement

Advanced topics in the ecology and evolution of animal behavior.

Stream Ecology  
Fall. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. P: ZOL 355 or approval of department RB: CEM 141

Biological and environmental factors determining structure and function of stream ecosystems.

Aquatic Entomology  
Fall of odd years. 3(2-3) Interdepartmental with Entomology and Fisheries and Wildlife. Administered by Entomology. P: BS 162 SA: ENT 420

Biological, ecology and systematics of aquatic insects in streams, rivers and lakes. Field trips and aquatic insect collection required.

Algal Biology  
Fall of even years. Summer of odd years. 4(2-4) Interdepartmental with Plant Biology. Administered by Plant Biology. P: (BS 162 or LB 144 or BS 182H) and (BS 172 and completion of Tier I writing requirement) RB: ZOL 355 and ZOL 355L SA: BOT 424

Algal taxonomy, systematics, physiology, ecology, and environmental assessment. Lab focus on identification of freshwater alga genera collected from regional habitats.

Cells and Development (W)  
Spring. 4(3-3) P: (BS 161 and BS 171) or LB 145 or (BS 181H and BS 191H) and completion of Tier I writing requirement) SA: ZOL 222

The role of cells in growth, differentiation and development of animals from protozoa to mammals.

Neuroendocrine Aspects of Behavior  
Spring of odd years. 3(3-0) P: 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.

Vertebrate Paleontology  
Fall of even years. 4(3-2) Interdepartmental with Geological Sciences. Administered by Geological Sciences. P: ZOL 328 or GLG 304

Fossil vertebrates with emphasis on evolution and interrelationships of major groups. Modern techniques of identification and interpretation of fossils.

Evolutionary Paleobiology  
Fall. 4(3-2) Interdepartmental with Geological Sciences. Administered by Geological Sciences. RB: BS 162 or GLG 304 or LB 144 or BS 182H

Patterns and processes of evolution known from the fossil record including speciation, phylogeny, extinction, heterochrony and biogeography.

Field Ecology and Evolution  
Summer. 4 credits. Interdepartmental with Plant Biology. Administered by Zoology. P: ZOL 355

Solving conceptual and practical research problems in ecology and evolution under field conditions.

Restoration Ecology  
Spring. 3(2-2) Interdepartmental with Biological Sciences. Engineering and Fisheries and Wildlife and Plant Biology. Administered by 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.

Conservation Biology  
Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. P: (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.

Evolution (W)  
Fall. 3(3-0) Interdepartmental with Crop and Soil Sciences and Plant Biology. Administered by Zoology. P: (ZOL 341 or CSS 330) and completion of Tier I writing requirement R: Not open to freshmen. SA: ZOL 345


Evolution Laboratory  
Spring. 1(0-3) P: ZOL 445 or concurrently

Computer, laboratory and field based studies of evolution, utilizing plant, animal and microbiological examples to demonstrate general evolutionary principles.

Environmental Issues and Public Policy  
Fall. 3(3-0) Interdepartmental with Environmental Studies and Agriscience. Administered by Zoology. 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.

Cancer Biology (W)  
Spring. 3(3-0) P: (BMB 200 or BMB 401 or ZOL 425) or (BMB 461 and BMB 462) and completion of Tier I writing requirement


Ichthyology  
Spring. 4(3-3) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. P: ((BS 162 and BS 172) or (BS 182H and BS 192H) or LB 144) and Completion of Tier I Writing Requirement


Limnology  
Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. P: (CEM 141 or LB 171) and ZOL 355

Ecology of lakes with emphasis on interacting physical, chemical, and biological factors affecting their structure and function.

Field and Laboratory Techniques for Aquatic Studies  
Fall. 3(2-3) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. P: (FW 414 or concurrently) or (FW 420 or concurrently) or (FW 417 or concurrently) or (FW 416 or concurrently) or (FW 472 or concurrently) or (FW 479 or concurrently) SA: FW 470

Field and laboratory techniques for the investigation and analysis of lake and stream ecosystems and their biota. Field trips required.

Environmental Physiology (W)  
Spring. 4(4-0) Interdepartmental with Physiology. Administered by Zoology. P: ((BS 161 or LB 145 or BS 181H) and completion of Tier I writing requirement) and (BS 162 or LB 144 or BS 182H) and (CEM 141 or CEM 151 or CEM 181H or LB 171)

Aspects of physiology important to the environmental relations of vertebrates and invertebrates: energetics, thermal relations, osmotic-ionic relations, and exercise physiology.
495 Undergraduate Seminar
Fall, Spring. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.

496 Internship in Zoology
Fall, Spring. 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open to seniors.

497 International Internship in Zoology and Aquarium Science
Fall, Spring. Summer. 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open to seniors.

498 Internship in Zoology and Aquarium Science
Fall, Spring. 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open to seniors.

501 Professional Development
Fall. 1(2-0) R: Open only to graduate students in the Department of Zoology.

504 Molecular and Developmental Neurobiology
Fall. 3(3-0) Interdepartmental with Neuroscience and Pathobiology.

505 Animal Welfare Assessment
Fall. 3(3-0) Interdepartmental with Animal Science.

507 Stable Isotope Biogeochemistry
Fall. 3(3-0) Interdepartmental with Geological Sciences.

508 Tropical Biology: An Ecological Approach
Spring. 6 credits. R: Approval of department.

509 Physiology and Pharmacology of Excitable Cells
Fall. 3(3-0) Interdepartmental with Neuroscience and Pathobiology.

510 Conservation and Genetics
Fall. 3(3-0) Interdepartmental with Fisheries and Wildlife.

511 Current Topics in Evolutionary Development Biology
Spring. 3(3-0) R: ZOL 445 or ZOL 320 or ZOL 425 or ZOL 341.

514 Topical Problems in Zoology
Fall, Spring. 3 credits. R: Open to juniors.

515 Scientific Writing and Oral Presentations
Fall, Spring. 3 credits. R: Open to seniors.

517 Internship in Zoology
Fall, Spring. 3 to 6 credits. R: Open to seniors.

518 Tropical Biology
Spring. 3(3-0) Interdepartmental with Zoology.

805 Animal Welfare Assessment
Fall. 3(3-0) Interdepartmental with Animal Science.

808 Evolution of Nervous Systems
Spring. 3(0-6) Interdepartmental with Neuroscience.

812 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. R: Open to graduate students in the Department of Zoology.

815 Systems Neuroscience
Spring. 3(3-0) Interdepartmental with Human Anatomy and Neuroscience.

822 Principles of stable isotope chemistry applied to biogeochemical problems: climate change, ecology, contaminants, oceanography, limnology, and paleobiology.

828 Conservation and Genetics
Fall of even years. 3(2-2) Interdepartmental with Fisheries and Wildlife.

832 Evolution of Nervous Systems
Spring. 3(3-0) Interdepartmental with Neuroscience.

833 Systems Neuroscience
Spring. 4(4-0) Interdepartmental with Human Anatomy and Neuroscience.

839 Anatomy, pharmacology, and physiology of multicellular neural systems. Sensory, motor, autonomic, and chemo-regulatory systems in vertebrate brains.

845 Multi-disciplinary Research Methods for the Study of Evolution
Spring. 3(3-0) Interdepartmental with Computer Science and Engineering.

848 Current Topics in Evolutionary Development Biology
Spring. 3(3-0) R: ZOL 445 or ZOL 320 or ZOL 425 or ZOL 341.
849 Evolutionary Biology
Spring. 3(3-0) 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 Statistical Methods for Ecology and Evolution
Fall. 3(2-2) Interdepartmental with Plant Biology. Administered by Zoology. RB: (STT 814) or an equivalent course.
Statistical modeling and interpretation of biological data using computationally intensive methods for estimation and inference. General linear models, mixed and process models, and estimation strategies applied to students using their own data using the R language.

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.

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.

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.

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.

897 Ecosystem Ecology and Global Change
Spring of odd years. 4(4-0) Interdepartmental with Fisheries and Wildlife and Plant Biology. Administered by Zoology.
Structure and function of natural ecosystems and their responses to global environmental change. Biogeochemical cycles, food webs, energy flow, nutrient cycling, and ecosystem management and restoration.

898 Population and Community Ecology Theory Laboratory
Fall. 1(0-3) Interdepartmental with Plant Biology. Administered by Plant Biology. RB: 1 semester of calculus
Practical experience designing and analyzing mathematical models in ecology from single species to communities, food webs and ecosystems.

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.