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.

141 Introductory Human Genetics
Fall, Spring. 3(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 major or to students in the Lyman Briggs School Biology field of concentration. Not open to students with credit in ZOL 341 or ZOL 344.

162 Organismal and Population Biology
Fall, Spring, Summer. 3(3-0) Interdepartmental with Biological Science and Plant Biology. Administered by Biological Science. P: BS 161 or BS 181H or LB 145 SA; BS 110, BS 148H Not open to students with credit in BS 182H or LB 144.

172 Organismal and Population Biology Laboratory
Fall, Spring, Summer. 2(1-3) Interdepartmental with Biological Science and Plant Biology. Administered by Biological Science. P: BS 162 or concurrently) or (BS 182H or concurrently) SA: BS 110, BS 158H 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.

182H 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 181H SA; BS 148H, BS 110 Not open to students with credit in BS 162 or LB 144.
Diversity and basic properties of organisms, with emphasis on genetic principles, ecological interactions, and the evolutionary process. Historical approach to knowledge discovery.

192H 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 182H or concurrently SA: BS 158H, 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.

303 Oceanography
Fall, 4(4-0) Interdepartmental with Geolocial 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.

306 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.

310 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 182H or concurrently) or (BS 182H or concurrently) or (BS 182H or concurrently) or (BS 182H or concurrently) Not open to students with credit in HDFS 145.

313 Animal Behavior
Fall, Spring, 3(3-0) P: BS 162 or LB 144 or BS 182H 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: 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.

319 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 spatiotemporal scales. Sustainability of the Earth system.

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

328 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 or Zoology. P: (ZOL 355 or concurrently)
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: 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.

343 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 eukaryotic organisms.

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

355 Ecology
Fall, Spring, Summer. 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.

355L Ecology Laboratory (W)
Fall, Spring, Summer. 1(0-3) Interdepartmental with Plant Biology. Administered by Zoology. P: (ZOL 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: BS 162 or LB 144 or BS 182H
Behavior, ecology, evolution, and systematics of birds; biodiversity. Laboratories emphasize diversity of form and function, life history patterns, and identification.

365 Biology of Mammals
Spring. 4(3-3) P: BS 162 or LB 144 or BS 182H
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: 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.

370 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.
Zoology—ZOL

384 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, systematic, ecology, and behavior of amphibians and reptiles. Laboratory emphasizes diversity and identification of families and Great Lakes species. Field trips may be required.

390 Practicum in Zoo/Aquarium Careers
Summer. 4 credits.
Practical application of science, business and education methods through typical workdays with zoo professionals.

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: (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.

403 Integrative Neurobiology
Spring of odd years. 3(3-0) P: ZOL 402 or PSY 209. R: Junior or Senior level students. 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.

408 Histology
Fall. 4(3-3) P: BS 161 or LB 145 or BS 181H
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: PSY 295 or PSY 309 (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.

415 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.

420 Stream Ecology
Fall. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. P: ZOL 355 or approval of department R: CEM 141
Biological and environmental factors determining structure and function of stream ecosystems.

422 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
Biology, ecology and systematics of aquatic insects in streams, rivers and lakes. Field trips and aquatic insect collection required.

424 Algal Biology
Fall of every 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 161 or LB 145 or BS 181H) and completion of Tier I writing requirement) R: ZOL 355 and ZOL 355L SA: BOT 424
Algal taxonomy, systematics, physiology, ecology, and environmental assessment. Lab focus on identification of freshwater algal genera collected from regional habitats.

425 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 221
The role of cells in growth, differentiation and development of animals from protozoa to mammals.

426 Biogeochemistry
Summer. 3 credits. Interdepartmental with Crop and Soil Sciences and Geological Sciences. 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.

433 Vertebrate Paleontology
Fall of every 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.

434 Evolutionary Paleobiology
Fall. 4(4) Interdepartmental with Geological Sciences. R: 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.

440 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.

443 Restoration Ecology
Spring. 3(2-2) Interdepartmental with BioSystems Engineering and Fisheries and Wildlife. Administered by Fisheries and Wildlife. R: (BS 210 or BE 230) and (FOR 446 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
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.

445 Evolution (W)
Fall. 3(3-0) Interdepartmental with Crop and Soil Sciences and Plant Biology. Administered by Zoology. P: (ZOL 341 or CSS 350) and completion of Tier I writing requirement. R: Not open to freshmen. SA: ZOL 345

455L 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.

446 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.

448 Evolutionary Developmental Biology
Spring. 2(2-0) P: ZOL 445 RB: ZOL 320 or ZOL 425 or ZOL 341
Genetic and developmental basis for evolutionary change. Synthesis of molecular and developmental genetics with evolutionary biology.

450 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.

471 Ichthyology
Spring. 4(3-0) 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.
Fish morphology and physiology. Development, behavior, evolution, and ecology. Fish species with emphasis on freshwater fishes. Field trips required.

472 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. Pr. (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. Pr: (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.

Tropical Biology
Spring. 3(3-0) Interdepartmental with Entomology and Plant Biology. Administered by Zoology. Pr: ZOL 355 R: Open only to juniors or seniors.
Tropical biota emphasizing evolutionary and ecological principles compared across tropical ecosystems.

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.

Overseas Study in Zoology
Fall, Spring. 3 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department. Supervised research on a topic not normally covered in the classroom.

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.

Internship in Zoology
Fall, Spring, Summer. 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open to seniors. Approval of department. Practical experience applying zoology training in a setting outside the University.

International Internship in Zoo and Aquarium Science
Fall, Spring, Summer. 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. A student may earn a maximum of 8 credits ZOL 496, ZOL 497, ZOL 498 RB: Biological Sciences R: Open to juniors or seniors or graduate students. Approval of department; application required. Application of zoological experience in a zoo or aquarium setting outside the United States.

Internship in Zoo and Aquarium Science
Fall, Spring, Summer. 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 to juniors or seniors. Approval of department. Application of zoological experience in a zoo or aquarium setting outside the university.

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

Molecular and Developmental Neurobiology
Fall, 3(3-0) Interdepartmental with Neuroscience and Pathobiology and Diagnostic Investigation and Pharmacology and Toxicology and Psychology. Administered by Neuroscience. Pr: 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.

Animal Welfare Assessment
Fall, Spring. 3(3-0) Interdepartmental with Animal Science. Administered by Animal Sciences. Pr: (ANS 305 or ZOL 313) or background in animal science or zoology including exposure to topics such as animal behavior, physiology, psychology, 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.

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: ZOL 415 R: Open only to graduate students. Critical analysis through seminar-discussions of the primary research literature.

Stable Isotope Biogeochemistry
Spring of even years. 3(3-0) R: Open only to graduate students. Principles of stable isotope chemistry applied to biogeochemical problems: climate change, ecology, contaminants, oceanography, limnology, and paleobiology.

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.

Physiology and Pharmacology of Excitable Cells
Fall. 3(3-2) Interdepartmental with Fisheries and Wildlife and Plant Biology. Administered by Fisheries and Wildlife. Pr: 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.

Quantitative Paleobiology
Fall, Spring. 3(3-2) Interdepartmental with Geological Sciences. Administered by Geological Sciences. Pr: GLG 431 Analysis of paleobiological problems using quantitative techniques such as cladistics, morphometrics, ordination, and stereology.

Systems Neuroscience
Spring. 4(4-0) Interdepartmental with Human Anatomy and Neuroscience and Pharmacology and Toxicology and Psychology. Administered by 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. Pr: ANT 839 Anatomy, pharmacology, and physiology of multicellular neural systems. Sensory, motor, autonomic, and chemo-regulatory systems in vertebrate brains.

Current Topics in Evolutionary Development Biology
Spring. 3(3-0) R: (ZOL 445 or ZOL 320 or ZOL 425 or ZOL 341) or background in evolutionary biology or developmental biology. Genetic and developmental basis for evolutionary change. Synthesis of molecular and developmental genetics with evolutionary biology. Discussion of primary literature in evolutionary development.

Evolutionary Biology
Spring. 3(3-0) Interdepartmental with Plant Biology. Administered by Plant Biology. Pr: 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.