101 Preview of Zoology
Fall, Spring. 1(1-0) R: Open 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 in the Biological Science Major or in the Clinical Laboratory Sciences Major or in the Entomology Major or in the Genetics Major or in the Human Biology Major or in the Microbiology Major or in the Physiology Major or in the Plant Biology Major or in the Zoology Major. Not open to students with credit in ZOL 341.

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. 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 Geological Sciences. Administered by Zoology. P: (CEM 141 or CEM 181H) or LB 171 or CEM 151) and (PHY 231 or PHY 183 or PHY 236H or PHY 238) or (PHY 231 or PHY 236H or PHY 238 or PHY 231C).
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 even years. 3(3-0) Interdepartmental with Neuroscience and Psychology. Administered by Neuroscience. P: (PSY 101 or concurrently) and (BS 161 or concurrently) or (BS 162 or concurrently) or (LB 144 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 445.

313 Animal Behavior
Fall, Spring, Summer. 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 protozoa, helminths, arthropods, and other 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 spatio-temporal 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) SA: 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 SA: ZOL 220.
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 eucaryotic 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. Analysis of marine and estuarine systems. Integration of biology, chemistry, and physics. Life histories of marine organisms. Biological role of major marine habitats including rocky intertidal zones, upwellings, coral reefs and deep sea.

355 Ecology Laboratory (W)
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.
Interrelationships of plants and animals with each other and the environment. Principles of individual, population, community, and ecosystem ecology. Application of ecological principles to global change and other anthropogenic stressors.

355L Ecology Laboratory (W)
Fall, Spring, Summer. 3(3-0) Interdepartmental with Plant Biology. Administered by Zoology. P: ZOL 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.

357 Global Change Biology (W)
Spring. 3(3-0) P: (ZOL 355) and completion of Tier I writing requirement RB: Intended for science or engineering majors. R: Not open to freshmen.
Causes and consequences of modes of contemporary global change that are caused by biological systems or impact biological systems. Theories, evidence, and predictions in global warming, ocean acidification, desertification, eutrophication, food security, and mass extinction.

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.
390 Practicum in Zoo/Aquarium Careers
Spring. 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.
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 and not open to students in the Programs in Neuroscience and not open to students in the Program in Zoology and Wildlife and not open to students in the Program in Animal Behavior.
Structure and function of nerve cells and nervous systems.

403 Integrative Neurobiology
Spring. 3(3-0) P: 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.

408 History
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.

413 Laboratory in Behavioral Neuroscience (W)
Fall. 4(2-4) Interdepartmental with Psychology, Administered by Psychology. P: (PSY 209 or ZOL 402) and (PSY 209 or ZOL 402) and (PSY 209 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)
Fall. 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 RB: 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
Biological, 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) 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 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 225
The role of cells in growth, differentiation and development of animals from protozoa to mammals.

433 Vertebrate Paleontology
Fall of even years. 4(3-2) Interdepartmental with Geological Sciences. Administered by Geological Sciences. P: ZOL 328 or GLG 304 or ZOL 360 or ZOL 365 or ZOL 384 or ZOL 445 or GLG 434 or FW 471
Fossil vertebrates with emphasis on evolution and interrelationships of major groups. Modern techniques of identification and interpretation of fossils.

434 Evolutionary Paleobiology
Fall of odd years. 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

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.

444 Conservation Biology
Spring. 3(3-0) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. P: (ZOL 355 or FOR 404 or PLB 441) 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, Spring, Summer. 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.

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.

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(3-3) 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

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.

474 Field and Laboratory Techniques for Aquatic Studies
Fall. 3(2-3) Interdepartmental with Fisheries and Wildlife. Administered by Fisheries and Wildlife. P: (FW 101L or FW 238) and completion of Tier I writing requirement SA: FW 470
Field and laboratory techniques for the investigation and analysis of lake and stream ecosystems and their biota. Field trips required.
Aspects of physiology important to the environmental principles compared across tropical ecosystems. Tropical biota emphasizing evolutionary and ecological principles compared across tropical ecosystems.

Aquatic transmission, sensory nervous system function. Membrane biophysics and potentials, synaptic transmission. Maturation, degeneration, plasticity, and repair in the nervous system.

Transcription, translation. Maturation, degeneration, plasticity, and repair in the nervous system.

Conservation and Genetics Fall of even years. 3(2-2) Interdepartmental with Fisheries and Wildlife and Plant Biology. Administered by Fisheries and Wildlife. R: 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.

Evolution of Nervous Systems Fall of odd years. 3(3-0) Interdepartmental with Neuroscience. Administered by Zoology. R: Background in neurobiology or evolutionary biology recommended. R: Open to graduate students in the Department of Computer Science and Engineering or in the Program in Neuroscience or in the Department of Psychology or in the Department of Zoology or approval of department.

Evolutionary origins, mechanisms, and consequences of evolutionary change in nervous systems.

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

Multi-disciplinary Research Methods for the Study of Evolution Spring. 3(3-0) Interdepartmental with Computer Science and Engineering and Microbiology and Molecular Genetics. Administered by Computer Science and Engineering. Techniques for engaging in multi-disciplinary research collaborations, including biology, computer science, and engineering. Students engage in group projects to answer fundamental questions about the dynamics of actively evolving systems including both natural and computational. Multi-disciplinary teams will learn to overcome discipline-specific language and conceptual issues. Experimental design, statistical analysis, data visualization, and paper and grant writing for multi-disciplinary audiences.

Current Topics in Evolutionary Development Biology Spring. 3(3-0) RB: (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. 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.

863  Wildlife Disease Ecology
Spring of even years. 3(3-0) Interdepartmental with Fisheries and Wildlife and Large Animal Clinical Sciences. Administered by Fisheries and Wildlife. RB: Additional course work in ecology, zoology, microbiology and environmental sciences. R: Open to graduate students. Not open to students with credit in FW 463.
Role of wildlife disease in ecological interactions, factors underlying pathogen emergence, mathematical modeling of infectious diseases, conservation medicine.

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 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.

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 36 credits in all enrollments for this course.
Doctoral dissertation research.