

# ECOLOGY & EVOLUTIONARY BIOLOGY (E&EB)

**\* E&EB 035a, The Ecology of Food** Linda Puth

Food and ecology are inextricably linked, both in producing domesticated food through agriculture and livestock and in harvesting wild plants and animals. Furthermore, the production and consumption of food have downstream consequences through energy consumption, food waste, trophic interactions, and the transportation of food around the globe. These topics link to many of the fundamental concepts of ecology, including population biology, the niche, trophic interactions, nitrogen cycling, and the effects on biodiversity. In this class, we explore these topics intensively through a combination of lectures, readings, and interactive field trips to on/near campus ecosystems, including the Marsh Botanical Gardens, the Yale Sustainable Farm, a nearby forest and salt marsh, and an orchard. Each week, we meet twice for 50 minutes for a combination of lecture and discussion and for 110 minutes for field trips, discussions, and guest lectures. SC

**\* E&EB 106a / HLTH 155a / MCDB 106a, Biology of Malaria, Lyme, and Other Vector-Borne Diseases** Alexia Belperron

Introduction to the biology of pathogen transmission from one organism to another by insects; special focus on malaria, dengue, and Lyme disease. Biology of the pathogens including modes of transmission, establishment of infection, and immune responses; the challenges associated with vector control, prevention, development of vaccines, and treatments. Intended for non-science majors; preference to first-years and sophomores. Prerequisite: high school biology. SC

**E&EB 115a, Conservation Biology** Linda Puth

An introduction to ecological and evolutionary principles underpinning efforts to conserve Earth's biodiversity. Efforts to halt the rapid increase in disappearance of both plants and animals. Discussion of sociological and economic issues. SC

**\* E&EB 125b / EPS 125b, History of Life** Derek Briggs

Examination of fossil and geologic evidence pertaining to the origin, evolution, and history of life on Earth. Emphasis on major events in the history of life, on what the fossil record reveals about the evolutionary process, on the diversity of ancient and living organisms, and on the evolutionary impact of Earth's changing environment. SC

**E&EB 145b, Plants and People** Linda Puth

The interaction of plants and people throughout history explored from biological, historical, anthropological, and artistic perspectives. Basic botany; plants in the context of agriculture; plants as instruments of trade and societal change; plants as inspiration; plants in the environment. Includes field trips to the greenhouses at Yale Marsh Botanical Garden, the Yale Peabody Museum and Herbarium, the Yale Farm, and the Yale Art Gallery. SC

**E&EB 220a / EVST 223a, General Ecology** Staff

The theory and practice of ecology, including the ecology of individuals, population dynamics and regulation, community structure, ecosystem function, and ecological interactions at broad spatial and temporal scales. Topics such as climate change,

fisheries management, and infectious diseases are placed in an ecological context.

Prerequisite: MATH 112 or equivalent. SC 0 Course cr

**E&EB 225b, Evolutionary Biology** Paul Turner and Jennifer Coughlan

An overview of evolutionary biology as the discipline uniting all of the life sciences.

Reading and discussion of scientific papers to explore the dynamic aspects of evolutionary biology. Principles of population genetics, paleontology, and systematics; application of evolutionary thinking in disciplines such as developmental biology, ecology, microbiology, molecular biology, and human medicine. SC 0 Course cr

**E&EB 242b, Behavioral Ecology** Vanessa Ezenwa

An introduction to the study of animal behavior from an evolutionary and ecological perspective. Topics include decision-making, group living and cooperation, sexual selection and mating behavior, signaling and communication. In addition to lectures, in-class discussions and activities, students engage in the material by design and implement their own research projects. Prerequisite: BIOL 104, or permission of instructor. SC 0 Course cr

**E&EB 246a, Plant Diversity and Evolution** Erika Edwards

This course has several, interrelated objectives. First, it serves as an introduction to the science of phylogenetics, providing an overview of both the theory and methodology involved in constructing phylogenetic trees, and how to use trees to study character and organismal evolution. For our second objective, we put this new framework to immediate use by using phylogeny to explore and illustrate 400 million years of land plant evolution, with emphasis on the diversity of flowering plants. The course examines major trends in plant evolution from functional, ecological, and biogeographical perspectives. Students acquire a basic understanding of 1) phylogenetic approaches to comparative biology, 2) plant anatomy and morphology, 3) evolutionary relationships among the major land plant clades (with emphasis on the flowering plants), and 4) major evolutionary trends that have significantly shaped the diversity of plant life that we see today. The third and most important objective is to instill in students the ability to look at any biological problem through the lens of "phylogeny-colored glasses"- a powerful way to examine the complexity of life that surrounds (and includes!) us. SC

**E&EB 247La, Laboratory for Plant Diversity and Evolution** Erika Edwards

Hands-on experience with the plant groups examined in the accompanying lectures.

Local field trips. To be taken concurrently with E&EB 246. BIOL 104 SC ½ Course cr

**E&EB 262a, The Biology of Sharks and Their Relatives** Joshua Moyer

An integrative course that examines the biology of sharks and other cartilaginous fishes (Class Chondrichthyes) from a variety of perspectives. Students learn about the taxonomy and systematics, paleontology, functional anatomy, behavior, physiology, ecology, and cultural significance of sharks. Coursework includes answers to discussion prompts, guided review of scientific literature, and in-class exams that allow students to demonstrate their understanding of chondrichthyan biology and sharks' unique place in the vertebrate tree of life. To be taken with E&EB 263L. SC

**E&EB 263La, The Biology of Sharks and Their Relatives Laboratory** Joshua Moyer

This is a hands-on, specimen-based overview of the fossil record, comparative anatomy, functional morphology, and biodiversity of sharks and their relatives, the skates, rays, and ratfish. Students examine and dissect fresh and preserved specimens and use the

fossil remains of extinct sharks to investigate the evolution of cartilaginous fishes. This course should be taken concurrently with E&EB 262, The Biology of Sharks and Their Relatives. SC ½ Course cr

\* **E&EB 272b, Ornithology** Richard Prum

An overview of avian biology and evolution, including the structure, function, behavior, and diversity of birds. The evolutionary origin of birds, avian phylogeny, anatomy, physiology, neurobiology, breeding systems, and biogeography. Enrollment limited to 50. SC

\* **E&EB 273Lb, Laboratory for Ornithology** Richard Prum

Laboratory and field studies of avian morphology, diversity, phylogeny, classification, identification, and behavior. Enrollment limited to 12. SC ½ Course cr

\* **E&EB 275b / EVST 400b, Biological Oceanography** Mary Beth Decker

Exploration of oceanic ecosystems and how these environments function as coupled physical/biological systems. Ocean currents and other physical processes determine where nutrients are available to support primary production and where organisms from plankton to top predators occur. Includes discussion of anthropogenic impacts, such as the effects of fishing and climate change on marine ecosystems. Enrollment limited to 35. SC

**E&EB 290b, Comparative Developmental Anatomy of Vertebrates** Staff

A survey of the development, structure, and evolution of major vertebrate groups. Topics include the micro-anatomy of major organ systems, the developmental underpinnings of the vertebrate body plan, and the development, structure, and evolution of the major organ systems such as the locomotory system, sensory organs, digestive tract, reproductive tract, and nervous system. SC

**E&EB 291Lb, Comparative Anatomy of Vertebrates Laboratory** Staff

Microscopic examination of histological and embryological preparations. Dissection of selected vertebrate species including shark, bony fish, frog, lizard, and rat. To be taken with E&EB 290. SC ½ Course cr

**E&EB 295a, Life in Motion: Ecological and Evolutionary Physiology** Martha Munoz

Physiology is the study of the functions that organisms perform and how they use those functions to interact with the environment. To survive, grow, and reproduce, all organisms must acquire energy and avoid conditions that exceed their physiological limits. These interactions all involve motion—ions traveling across membranes, muscle fibers twitching, respiration, and locomotion, to name a few. In this course, we tackle physiological processes from both “bottom up” and “top down” approaches, with integration among these dimensions, to extract general physiological rules of life. Then, we link our discoveries to the broader context of ongoing global change, and consider whether and how organisms can physiologically respond to contemporary selective pressures. While the course focuses heavily on animal physiology, plants, fungi, and microbes are also featured. Prerequisites: BIOL 101, 102, 103, 104, and CHEM 161, or permission of the instructor. SC

\* **E&EB 335a / HLTH 250a, Evolution and Medicine** Brandon Ogbunu

Introduction to the ways in which evolutionary science informs medical research and clinical practice. Diseases of civilization and their relation to humans' evolutionary past; the evolution of human defense mechanisms; antibiotic resistance and virulence in pathogens; cancer as an evolutionary process. Students view course lectures on line;

class time focuses on discussion of lecture topics and research papers. Prerequisite: BIOL 101–104. WR, SC

**E&EB 340a, Microbial Ecology** Martina Dal Bello

When thinking about microbes what comes to mind are usually diseases and unpleasant smells from the fridge or the basement. Nevertheless, microbes and the communities they form are key contributors to our wellbeing and the functioning of the planet. This course provides an introduction to microbial ecology, with an emphasis on how microbial systems differ from their macroscopic counterparts, including defining a microbial species; sampling/experimenting with microbes; principles of microbial growth, metabolism, and death; species interactions and community assembly in different environments; microbial community functions; elements of microbial evolution. BIOL 101, BIOL 102, BIOL 103, & BIOL 104. General Ecology E&EB 220 and MCDB 290 are encouraged but not required.

**E&EB 354a, Phylogenetic Biology** Casey Dunn

Phylogenetic Biology is the study of the evolutionary relationships between organisms, and the use of evolutionary relationships to understand other aspects of organism biology. This course surveys phylogenetic methods, providing a detailed picture of the statistical, mathematical, and computational tools for building phylogenies and using them to study evolution. We also examine the application of these tools to particular problems in the literature and emerging areas of study. Prerequisites: E&EB 225 and an organismal course. SC

**\* E&EB 362b, Tropical Field Biology** Linda Puth

Firsthand experience of a region can inspire great insights and understanding of ecology and evolutionary biology. This course immerses students in the communities and ecosystems of a single tropical region each year, but locations rotate among a small group of sites. We spend the first half of the semester learning about the geology, history, biomes and organisms of the region. The spring 2021 class will travel to 1–2 tropical forest research stations in Costa Rica. Prerequisites: E&EB 220, E&EB 225, and permission of the instructor. SC

**E&EB 464b / ANTH 464b / ARCG 464b, Human Osteology** Staff

A lecture and laboratory course focusing on the characteristics of the human skeleton and its use in studies of functional morphology, paleodemography, and paleopathology. Laboratories familiarize students with skeletal parts; lectures focus on the nature of bone tissue, its biomechanical modification, sexing, aging, and interpretation of lesions. SC, SO o Course cr

**\* E&EB 469a or b, Tutorial** Marta Wells

Individual or small-group study for qualified students who wish to investigate an area of ecology or evolutionary biology not presently covered by regular courses. A student must be sponsored by a faculty member who sets requirements and meets weekly with the student. One or more written examinations and/or a term paper are required. To register, the student must submit a written plan of study approved by the faculty instructor to the director of undergraduate studies. Students are encouraged to apply during the term preceding the tutorial. Proposals must be submitted no later than the first day of the second week of the term in which the student enrolls in the tutorial. The final paper is due in the hands of the director of undergraduate studies by the last day of reading period in the term of enrollment. In special cases, with approval of the

director of undergraduate studies, this course may be elected for more than one term, but only one term may be counted as an elective toward the requirements of the major. Normally, faculty sponsors must be members of the EEB department.

\* **E&EB 470a or b, Senior Tutorial** Marta Wells

Tutorial for seniors in the B.A. degree program who elect a term of independent study to complete the senior requirement. A thesis, fifteen to twenty pages in length, is required. A student must be sponsored by a faculty member who sets requirements and meets weekly with the student. To register, the student must submit a written plan of study approved by the faculty instructor to the director of undergraduate studies. Students are encouraged to apply during the term preceding the tutorial. Proposals must be submitted no later than the first day of the second week of the term in which the student enrolls in the tutorial. The final paper is due in the hands of the director of undergraduate studies by the last day of reading period in the term of enrollment. Normally, faculty sponsors must be members of the EEB department. Enrollment limited to seniors. Fulfills the senior requirement for the B.A. degree.

\* **E&EB 474a or b, Research** Marta Wells

One term of original research in an area relevant to ecology or evolutionary biology. This may involve, for example, laboratory work, fieldwork, or mathematical or computer modeling. Students may also work in areas related to environmental biology such as policy, economics, or ethics. The research project may not be a review of relevant literature but must be original. In all cases students must have a faculty sponsor who oversees the research and is responsible for the rigor of the project. Students are expected to spend ten hours per week on their research projects. Using the form available from the office of undergraduate studies or from the Canvas, students must submit a research proposal that has been approved by the faculty sponsor to the director of undergraduate studies, preferably during the term preceding the research. Proposals are due no later than the first day of the second week of the term in which the student enrolls in the course. The final research paper is due in the hands of the director of undergraduate studies by the last day of reading period in the term of enrollment.

\* **E&EB 475a and E&EB 476b, Senior Research** Marta Wells

One term of original research in an area relevant to ecology or evolutionary biology. This may involve, for example, laboratory work, fieldwork, or mathematical or computer modeling. Students may also work in areas related to environmental biology such as policy, economics, or ethics. The research project may not be a review of relevant literature but must be original. In all cases students must have a faculty sponsor who oversees the research and is responsible for the rigor of the project. Students are expected to spend ten hours per week on their research projects. Using the form available from the office of undergraduate studies or from the Canvas, students must submit a research proposal that has been approved by the faculty sponsor to the director of undergraduate studies, preferably during the term preceding the research. Proposals are due no later than the first day of the second week of the term in which the student enrolls in the course. The final research paper is due in the hands of the director of undergraduate studies by the last day of classes in the term of enrollment. Fulfills the senior requirement for the B.S. degree. Enrollment limited to seniors.

\* **E&EB 495a and E&EB 496b, Intensive Senior Research** Marta Wells

One term of intensive original research during the senior year under the sponsorship of a Yale faculty member. Similar to other research courses except that a more substantial

portion of a student's time and effort should be spent on the research project (a minimum average of twenty hours per week). A research proposal approved by the sponsoring faculty member must be submitted to the director of undergraduate studies; forms are available from the office of undergraduate studies. For research in the fall term, approval is encouraged during the spring term of the junior year. Proposals are due no later than the first day of the second week of the term in which the student enrolls in the course. The final research paper is due in the hands of the director of undergraduate studies by the last day of reading period in the term of enrollment. One term of intensive research fulfills a portion of the senior requirement for the B.S. degree. 2 Course cr per term