ECOLOGY & EVOLUTIONARY BIOLOGY (E&EB)

*** 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 freshmen and sophomores. Prerequisite: high school biology. SC

*** E&EB 125b / EPS 125b, History of Life** Derek Briggs, Pincelli Hull, and Bhart-Anjan Bhullar
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 210a / S&DS 101a, Introduction to Statistics: Life Sciences Jonathan Reuning-Scherer
Statistical and probabilistic analysis of biological problems, presented with a unified foundation in basic statistical theory. Problems are drawn from genetics, ecology, epidemiology, and bioinformatics. QR

E&EB 220a / EVST 223a, General Ecology David Vasseur
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 223Lb, Laboratory for Principles of Ecology, Evolutionary Biology, and the Tree of Life Marta Wells
Study of evolutionary novelties, their functional morphology, and their role in the diversity of life. Introduction to techniques used for studying the diversity of animal body plans. Evolutionary innovations that have allowed groups of organisms to increase their diversity. SC 0 Course cr

E&EB 225b, Evolutionary Biology Paul Turner
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

E&EB 250a, Biology of Terrestrial Arthropods Marta Wells
Evolutionary history and diversity of terrestrial arthropods (body plan, phylogenetic relationships, fossil record); physiology and functional morphology (water relations, thermoregulation, energetics of flying and singing); reproduction (biology of reproduction, life cycles, metamorphosis, parental care); behavior (migration, communication, mating systems, evolution of sociality); ecology (parasitism, mutualism, predator-prey interactions, competition, plant-insect interactions). To be taken concurrently with E&EB 251L. SC

E&EB 251La, Laboratory for Biology of Terrestrial Arthropods Marta Wells
Comparative anatomy, dissections, identification, and classification of terrestrial arthropods; specimen collection; field trips. Concurrently with or after E&EB 250. SC 0 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 273b, Laboratory for Ornithology** Richard Prum
Laboratory and field studies of avian morphology, diversity, phylogeny, classification, identification, and behavior. *Concurrently with* E&EB 272b. SC ½ Course cr

* **E&EB 275b / EVST 400b, Biological Oceanography** Mary Beth Decker
Exploration of a range of coastal and pelagic ecosystems. Relationships between biological systems and the physical processes that control the movements of water and productivity of marine systems. Anthropogenic impacts on oceans, such as the effects of fishing and climate change. Includes three Friday field trips. Enrollment limited to 15. SC

E&EB 290b, Comparative Developmental Anatomy of Vertebrates Joshua Moyer
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 Joshua Moyer
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 322a, Evolutionary Genetics Jennifer Coughlan
Genetic variation is the currency by which natural selection is translated into evolutionary change. In this course we dissect patterns of genetic variation using an evolutionary mindset to ultimately understand what shapes genetic variation in nature and the potential for species to adapt to new and changing environments. This class unites two foundational fields of evolutionary genetics; quantitative genetics (the study of the genetic basis of complex traits) and population genetics (the study of gene variant frequencies across time and space), with an ultimate goal of understanding evolutionary change in nature. Although this course is lecture based, there is much opportunity for hands-on learning. Students use real-life and simulated genetic data to map the genetic basis of traits and investigate the evolutionary forces responsible for shaping genetic variation in nature. We also discuss how quantitative and population genetics theory are applied to the modern genomic era, particularly in the context of detecting genomic signatures of adaptation. Lastly, we discuss the application of evolutionary genetics to human populations, including the usefulness and missteps of these applications for science and society. Prerequisite: E&EB 225, Evolutionary Biology. SC

* **E&EB 336a / HSHM 453a / HUMS 336a, Culture and Human Evolution** Gary Tomlinson
Examination of the origins of human modernity in the light of evolutionary and archaeological evidence. Understanding, through a merger of evolutionary reasoning with humanistic theory, the impact of human culture on natural selection across the last 250,000 years. HU, SC

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 428a / AMTH 428a / EPS 428a / PHYS 428a, Science of Complex Systems Jun Korenaga
Introduction to the quantitative analysis of systems with many degrees of freedom. Fundamental components in the science of complex systems, including how to simulate complex systems, how to analyze model behaviors, and how to validate models using observations. Topics include cellular automata, bifurcation theory, deterministic chaos, self-organized criticality, renormalization, and inverse theory. Prerequisite: PHYS 301, MATH 247, or equivalent. QR, SC

E&EB 464b / ANTH 464b / ARCG 464b, Human Osteology Eric Sargis
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 0 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