BIOLOGY, HOPKINS MARINE STATION

Courses offered by the Hopkins Marine Station are listed under the subject code BIOHOPK on the (http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=BIOHOPK&filter-catalognumber-BIOHOPK=on) Stanford Bulletin's (http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=BIO&filter-catalognumber-BIO=on) ExploreCourses web site (http://explorecourses.stanford.edu/CourseSearch/search/?view=catalog&catalog=&page=0&q=BIO&filter-catalognumber-BIO=on).

The Hopkins Marine Station, located 90 miles from the main University campus in Pacific Grove, was founded in 1892 as the first marine laboratory on the west coast of North America. The modern laboratory facilities on the 11-acre campus on Cabrillo Point house nine faculty, all members of the Department of Biology. The Miller Library has a collection of literature in marine science. The Hopkins faculty offers undergraduate and graduate courses in biology which focus on the marine realm and involve topics including oceanography, environmental and comparative physiology, molecular evolution, biomechanics, cellular biology, conservation biology, and neurobiology and behavior. Most courses have laboratory sections that exploit the potential of working with readily available marine plants and animals. Small class sizes encourage close student-faculty interactions. Undergraduates have opportunities to carry out research projects with Hopkins faculty during the academic year or summer months.

Courses at Hopkins Marine Station can satisfy many requirements, from Ways to major and minor requirements in departments housed in the Schools of Engineering, Humanities and Sciences, and Earth, Evergy, and Environmental Sciences. Students are encouraged to check with their department's student services office to see which courses at Hopkins may be used to fulfill major or minor requirements.

Summer Program at Hopkins Marine Station

The summer program is open to advanced undergraduate, graduate students, and postdoctoral students, and to teachers whose biological backgrounds, teaching, or research activities can benefit from a summer's study of marine life. Applications, deadlines, and further information are available at the Hopkins Marine Station (http://hopkins.stanford.edu) web site.

Emeriti Professors: David Epel, George N. Somero

Director: Mark W. Denny

Professors: Barbara A. Block, Larry Crowder, Giulio De Leo, Mark W. Denny, William F. Gilly, Fiorenza Micheli, Stephen R. Palumbi, Stuart H. Thompson

Associate Professor: Christopher Lowe

Assistant Professor: Jeremy A. Goldbogen

Lecturer: Robin Elahi

Courses

BIOHOPK 14. Bio-logging and Bio-telemetry. 3 Units.
Bio-logging is a rapidly growing discipline that includes diverse fields such as consumer electronics, medicine, and marine biology. The use of animal-attached digital tags is a powerful approach to study the movement and ecology of individuals over a wide range of temporal and spatial scales. This course is an introduction to bio-logging methods and analysis. Using whales as a model system, students will learn how use multi-sensor tags to study behavioral biomechanics.

BIOHOPK 43. Plant Biology, Evolution, and Ecology. 5 Units.
Introduction to biology in a marine context. Principles of plant biology: physiology, structure, diversity. Principles of evolution: macro and microevolution, population genetics. Ecology: the principles governing the distribution and abundance of organisms; population, community, and ecosystem ecology. Equivalent to BIO 43. Corequisite: BIOHOPK 47.

BIOHOPK 47. Introduction to Research in Ecology and Ecological Physiology. 5 Units.
This course is a field-based inquiry into rocky intertidal shores that introducesnstudents to ecology and environmental physiology and the research methods used to study them. Students will learn how to detect patterns quantitatively in nature through appropriate sampling methods & statistical analysis. Following exploration of appropriate background material in class and through exploration of the scientific literature, students will learn how to formulate testable hypotheses regarding the underlying causes of the patterns they discern. A variety of different aspects of ecology and physiology will be investigated cooperatively by the students during the quarter, culminating in development of an individual final paper in the form of a research proposal based on data collected during the course. The course will provide a broad conceptual introduction to the underlying biological principles that influence adaptation to the planet¿s dynamic habitats, as well as inquiry-based experience in how to explore and understand complex systems in nature. nThis course fulfills the same laboratory requirement as BIO 47. Satisfies WIM in Biology.

BIOHOPK 81. Introduction to Ecology. 4 Units.
The course is designed to provide background on key concepts in ecology, familiarize students with key ecological processes and ecosystems, and the methods used in ecological studies. The course will further build students' skills in critical scientific thinking, reading the literature, and scientific communication. A major goal of the course is to train students to ask questions in ecology, and to design, conduct and report studies addressing these questions. Thus, emphasis is also placed, in additional to general ecological concepts, on field observations, experimental design, and the analysis, interpretation and presentation of ecological data (through computer laboratories, written assignments and presentations). Written assignments, presentations and discussions are designed to provide experience in organizing and presenting information and to expose students to multiple perspectives on ecological processes and their applications.nThis course fulfills the same requirement as BIO 81.
Same as: BIOHOPK 183H

BIOHOPK 84. Physiology. 4 Units.
This course will examine basic physiological systems of vertebrate and invertebrate animals, including nerve and muscle, heart and circulation, kidney and osmoregulation, metabolism, and thermoregulation. nThis course fulfills the same requirement as BIO 84.

BIOHOPK 85. Evolution. 4 Units.
Principles of micro- and macro-evolution from molecular genetics to the development of biological diversity. Adaptation, divergence and natural selection in the past and in contemporary ecological settings. Evolution of humans and human-caused evolution. Emphasis on major body plans in the sea and ocean examples of major evolutionary processes.nThis course fulfills the same requirements as BIO 85.

BIOHOPK 140H. Statistical Modeling. 3 Units.
(Graduate students register for 240H.) Introduction to applied statistical modeling in a Bayesian framework. Topics will include probability, regression, model comparison, and hierarchical modeling. We will take a hands-on, computational approach (R, Stan) to gain intuition so that students can later design their own inferential models. Prerequisites for this course include introductory statistics and some calculus or linear algebra, as well as previous exposure to scientific computing. Open to graduate students; undergraduate students may enroll with consent of instructor.
Same as: BIOHOPK 240H

BIOHOPK 142H. Historical Ecology of Marine Invertebrates. 5 Units.
This course is an exploration of the local invertebrate fauna at Hopkins Marine Station, through the lens of a long-term monitoring study initiated by Hewatt in 1931. During week 1, lectures will provide an overview of the major phyla represented on rocky intertidal shores. In the laboratory, students will focus on species identification. These skills will be put to use in week 2, when we will quantify patterns of invertebrate biodiversity along the Hewatt transect. During week 3, students will investigate a relevant taxonomic or quantitative problem. This course will meet 12-5pm, Monday-Friday. January 13-31, 2020. Open to graduate students; undergraduate students may enroll with consent of instructor.
Same as: BIOHOPK 242H

BIOHOPK 143H. Quantitative methods for marine ecology and conservation. 4 Units.
The goal of this course is to learn the foundations of ecological modelling with a specific (but not exclusive) focus on marine conservation and sustainable exploitation of renewable resources. Students will be introduced to a range of methods ¿ from basic to advanced ¿to characterize population structure, conduct demographic analyses, estimate extinction risk, identify temporal trends and spatial patterns, quantify the effect of environmental determinants and anthropogenic pressures on the dynamics of marine populations, describe the potential for adaptation to climate change. This course will emphasize learning by doing, and will rely heavily on practical computer laboratories, in R and/or Phyton, based on data from our own research activities or peer reviewed publications. Students with a background knowledge of statistics, programming and calculus will be most welcome.
Same as: BIOHOPK 243H, CEE 164H, CEE 264H, EARTHSYS 143H, EARTHSYS 243H

BIOHOPK 150H. Ecological Mechanics. 3 Units.
(Graduate students register for 250H.) The principles of life's physical interactions. We will explore basic physics. fluid mechanics, thermal dynamics, and materials science to see how the principles of these fields can be used to investigate ecology at levels from the individual to the community. Topics include: diffusion, boundary layers, fluid-dynamic forces, locomotion, heat-budget models, fracture mechanics, adhesion, beam theory, the statistics of extremes, and the theory of self-organization. Open to students from all backgrounds. Some familiarity with basic physics and calculus advantageous but not necessary.
Same as: BIOHOPK 250H

BIOHOPK 152H. Physiology of Global Change. 2 Units.
(Graduate students register for 252H.) Global change is leading to significant alterations in several environmental factors, including temperature, ocean acidity and oxygen availability. This course focuses on: (i) how these environmental changes lead to physiological stress and (ii) how, and to what extent, are organisms able to adapt through short-term acclimatization and evolutionary adaptation to cope with these stresses. A major focus of the class is to link changes in species' distribution patterns with underlying physiological mechanics that establish environmental optima and tolerance limits.
Same as: BIOHOPK 252H

BIOHOPK 153H. Current Topics and Concepts in Quantitative Fish Dynamics and Fisheries Management. 1 Unit.
(Graduate students register for 253H) The course will focus on extensive reading of seminal and reference papers published in the literature in the last decade on modeling population biology, community dynamics and fishery management in the marine environment. Basic knowledge of population dynamics is welcome. The goal is to develop an appreciation on both traditional and cutting-edge modeling approaches to study the dynamics and management of marine populations subjected to natural or anthropogenic shocks and pressures.
Same as: BIOHOPK 253H

BIOHOPK 154H. Animal Diversity: An Introduction to Evolution of Animal Form and Function from Larvae to Adults. 7 Units.
Survey of invertebrate diversity, emphasizing form and function of both adult and larval life history stages. Focuses on how morphology, life histories, and development contribute to current views of the evolutionary diversification of multicellular animals. Labs are a hands-on exploration of animal diversity using local marine species as examples, as well as techniques of obtaining, handling, and maintaining larvae from early development through settlement. Lectures, labs, plus field trips. Satisfies Central Menu Area 3 for Bio majors. Prerequisite: Biology core or consent of instructors.
Same as: BIOHOPK 254H

BIOHOPK 155H. Developmental Biology and Evolution. 4 Units.
(Graduate students register for 255) This course focusses on how animals form their basic body plans; from the formation of their germ layers; ectoderm, endoderm and mesoderm, to how they are organized along the main developmental axes; the anteroposterior and dorsoventral axes. The course will focus in part on the molecular mechanisms that underlie these developmental decisions from work carried out in established developmental model species. However, we will also explore the current understanding of how these mechanisms evolved from new insights from emerging models representing a broad range of animal phyla. The setting at Hopkins Marine Station will allow us to carry out experiments from animals collected in the field, and the course will involve a substantial lab component to complement concepts and approaches presented in lecture. nPre-requisites : Biocore or by permission of instructor.
Same as: BIOHOPK 255H

BIOHOPK 156H. Hands-On Neurobiology: Structure, Function and Development. 6 Units.
This laboratory course will examine neural and neuromuscular systems at a cellular level in selected vertebrate and invertebrate taxa using anatomical, physiological and molecular approaches. Intracellular dye injections and confocal microscopy will be used to visualize neuronal structure. Ca-imaging will permit functional analysis of living neurons. Electrical recording methods will be used to explore principles of excitability, synaptic transmission, sensory pathways and neural integration. Development of neural systems will be studied using molecular visualization methods. Work in the lab will be supplemented with informal lectures and discussions, and results of the labs will be reviewed weekly. Two 4-hour afternoon lab sessions per week.
Same as: BIOHOPK 256H

BIOHOPK 157H. Creative Writing & Science: The Artful Interpreter. 5 Units.
What role does creativity play in the life of a scientist? How has science inspired great literature? How do you write accessibly and expressively about things like whales, DNA or cancer? This course usually begins with a field trip to Hopkins Marine Station where Stanford labs buzz with activity alongside barking seals and crashing waves. While we won't be able to visit Monterey Bay this quarter, the spirit of interdisciplinary exchange will not be lost, and students will be encouraged to get outside and engage with their local environments. As historian Jill Lepore writes of Rachel Carson: ¿She could not have written Silent Spring if she hadn't, for decades, scrambled down rocks, rolled up her pant legs, and waded into tide pools, thinking about how one thing can change another...¿n nAs a small workshop course writing process and the study of literary craft form the foundation of our work together. For inspiration we will read nonfiction by scientists who write for wide audiences and literary giants who draw from science. Students will explore the intersection between creative expression and scientific curiosity, completing three short essays and offering supportive peer feedback throughout the quarter. This course is open to all undergraduates. Note: Students must attend the first class meeting to retain their roster spot.
Same as: BIOHOPK 257H, ENGLISH 157H

BIOHOPK 158H. Science Meets Literature on the Monterey Peninsula. 5 Units.
(Graduate students register for 258H.) This course will consider the remarkable nexus of scientific research and literature that developed on the Monterey Peninsula in the first half of the 20th century and how the two areas of creativity influenced each other. The period of focus begins with the 1932 association of John and Carol Steinbeck, Ed Ricketts, and Joseph Campbell, all of whom were highly influenced by the Carmel poet, Robinson Jeffers ¿ and ends with the novels Cannery Row (1945) and Sweet Thursday (1954). An indisputable high-tide mark, Sea of Cortez: A Leisurely of Travel and Research (1941) will be considered in detail. Weekend field trips will include intertidal exploration, a tour of the Jeffers Tor House in Carmel, and whale watching on Monterey Bay.
Same as: BIOHOPK 258H, ENGLISH 158H

BIOHOPK 159H. Molecular Ecology Lab. 1 Unit.
Graduate students register for 259H. This course will allow students to learn lab approaches to analyzing DNA to answer questions in parentage, population biology, and species identification. Students will spend 2-3 hours each week in the lab extracting DNA, analyzing sequences, and testing hypotheses. Molecular projects will interface with local research projects and course content.
Same as: BIOHOPK 259H

BIOHOPK 160H. Developmental Biology in the Ocean: Diverse Embryonic & Larval Strategies of marine invertebrates. 5-8 Units.
(Graduate students register for 261H). Lab course is designed to introduce students to the diversity in the early developmental strategies of marine invertebrates and how an understanding of these microscopic life histories is key to understanding the evolutionary diversification of phyla and the distribution of their more familiar adults. Emphasis is on hands-on collection, spawning, observation and manipulation of embryos and their larvae.
Same as: BIOHOPK 260H

BIOHOPK 161H. Invertebrate Zoology. 5 Units.
(Graduate students register for 261H.) Survey of invertebrate diversity emphasizing form and function in a phylogenetic framework. Morphological diversity, life histories, physiology, and ecology of the major invertebrate groups, concentrating on local marine forms as examples. Current views on the phylogenetic relationships and evolution of the invertebrates. Lectures, lab, plus field trips.
Same as: BIOHOPK 261H

BIOHOPK 162H. Comparative Animal Physiology. 5 Units.
(Graduate students register for 262H.) How animals work. Topics: physiology of respiration, circulation, energy metabolism, thermal regulation, osmotic regulation, muscle physiology, and locomotion. Evolutionary and ecological physiology. Lectures, lab, and field research. An option to combine the course work with a more intensive research focus, with more units, is available. Satisfies Central Menu Area 3 for Bio majors. Prerequisite: Consent of instructor.
Same as: BIOHOPK 262H

BIOHOPK 163H. Oceanic Biology. 4 Units.
(Graduate students register for 263H.) How the physics and chemistry of the oceanic environment affect marine plants and animals. Topics: seawater and ocean circulation, separation of light and nutrients in the two-layered ocean, oceanic food webs and trophic interactions, oceanic environments, biogeography, and global change. Lectures, discussion, and field trips. Satisfies Central Menu Area 4 for Bio majors. Recommended: PHYSICS 21 or 51, CHEM 31, or consent of instructor.
Same as: BIOHOPK 263H

BIOHOPK 165H. The Extreme Life of the Sea. 3 Units.
(Graduate students register for 265H). Lecture course that explores the way marine species live in extreme ocean habitats. We will cover the deepest, hottest, coldest, and shallowest habitats and the biggest, fastest, most fecund, oldest and smallest species. We will focus on the molecular, physiological and ecological adaptations that allow species to thrive in these unusual environments.
Same as: BIOHOPK 265H

BIOHOPK 166H. Molecular Ecology. 5 Units.
(Graduate students register for 266H.) How modern technologies in gene sequencing, detection of nuclear nucleotide polymorphisms, and other approaches are used to gather data on genetic variation that allow measurement of population structure, infer demographic histories, inform conservation efforts, and advance understanding of the ecology of diverse types of organisms.
Same as: BIOHOPK 266H

BIOHOPK 167H. Nerve, Muscle, and Synapse. 5 Units.
(Graduate students register for 267H.) Fundamental aspects of membrane excitability, nerve conduction, synaptic transmission, and excitation-contraction coupling. Emphasis is on biophysical, molecular, and cellular level analyses of these processes in vertebrate and invertebrate systems. Labs on intra- and extracellular recording and patch clamp techniques. Lectures, discussions, and labs. Satisfies Central Menu Area 3 for Bio majors Prerequisites: PHYSICS 23, 28, 43, or equivalent; CHEM 31, calculus; or consent of instructor.
Same as: BIOHOPK 267H

BIOHOPK 168H. Disease Ecology: from parasites evolution to the socio-economic impacts of pathogens on nations. 3 Units.
(Graduate students register for 268H.) Course will lead participants on a journey through the dynamics of infectious diseases that will start at the smallest level from within-host parasite dynamics and will progressively scale up to parasite evolution, disease ecology, public health policies, disease driven poverty traps and the socio-economic impact of infectious diseases on nations. The course will be organized around case studies, including among the others, schistosomiasis, malaria, cholera and sleeping sickness. Participants will have the opportunity to develop a capstone project.
Same as: BIOHOPK 268H

BIOHOPK 173H. Marine Conservation Biology. 4 Units.
(Graduate students register for 273H.). Introduction to the key concepts of ecology and policy relevant to marine conservation issues at the population to ecosystems level. Focus on the origin and maintenance of biodiversity and conservation applications from both the biology and policy perspectives (for example, endangered species, captive breeding, reserve design, habitat fragmentation, ecosystem restoration/rehabilitation). Also includes emerging approaches such as ecosystem based management, ocean planning, and coupled social-ecological systems. The course will include lectures, readings and discussions of primary literature, and attendance at seminars with visiting scholars. Prerequisite: introductory biology; suggested: a policy and/or introductory ecology course.
Same as: BIOHOPK 273H

BIOHOPK 173HA. Marine Conservation Biology - Seminar and Discussion Only. 1-2 Unit.
(Graduate students register for 273HA.). Introduction to the key concepts of ecology and policy relevant to marine conservation issues at the population to ecosystems level. Focus on the origin and maintenance of biodiversity and conservation applications from both the biology and policy perspectives (for example, endangered species, captive breeding, reserve design, habitat fragmentation, ecosystem restoration/rehabilitation). Also includes emerging approaches such as ecosystem based management, ocean planning, and coupled social-ecological systems. The course will include lectures, readings and discussions of primary literature, and attendance at seminars with visiting scholars. Prerequisite: introductory biology; suggested: a policy and/or introductory ecology course.nStudents should enroll in this course if they are only joining the seminar and discussion. Students who will engage in the full course should enroll in BIOHOPK 173H/273H.
Same as: BIOHOPK 273HA

BIOHOPK 174H. Experimental Design and Probability. 3 Units.
(Graduate students register for 274H.) Variability is an integral part of biology. Introduction to probability and its use in designing experiments to address biological problems. Focus is on experimental design and the use of linear models in testing hypotheses (e.g., analysis of variance, regression). Students will use R to explore and analyze locally relevant biological datasets. No programming or statistical background is assumed. Prerequisite: consent of instructor.
Same as: BIOHOPK 274H

BIOHOPK 175H. Marine Science and Conservation in a Changing World. 16 Units.
Graduate students register for 275H. This hands-on, experiential course provides a broad foundation in marine science, and explores emerging opportunities for innovation in the study of life in the sea. Students are resident at Stanfords Hopkins Marine Station in Pacific Grove (90 miles south of main campus) where the diverse organisms and environments of Monterey Bay provide the focus for the course. Class meets daily with lectures, discussions, labs, and field work throughout the day. Three linked concentrations¿each 3 weeks long¿are taught sequentially to address (1) the extraordinary diversity of marine organisms and habitats, (2) the physiology and behavior of marine animals, and (3) the principles of marine ecology. Connecting these concentrations is a weekly seminar-based discussion of topics in marine conservation. This design permits deep concentration on each subject, and places emphasis on discussion, group dialog, individual exploration, and experiential learning. In the final week of the quarter, students complete an individual capstone project of their choosing. For the Biology major, this course fulfills the same requirements as BIO 47 and BIO 81. Satisfies WIM in Biology.
Same as: BIOHOPK 275H

BIOHOPK 177H. Dynamics and Management of Marine Populations. 4 Units.
(Graduate students register for 277H.) Course examines the ecological factors and processes that control natural and harvested marine populations. Course emphasizes mathematical models as tools to assess the dynamics of populations and to derive projections of their demographic fate under different management scenarios. Course objectives will be met by a combination of theoretical lectures, assigned readings and class discussions, case study analysis and interactive computer sessions.
Same as: BIOHOPK 277H

BIOHOPK 179H. Physiological Ecology of Marine Megafauna. 3 Units.
(Graduate students register for 279H.) The ocean is home to the largest animals of all-time. How, when, and why did gigantism evolve in different taxa? What are the consequences of large body size? This course will focus on how biological processes scale with body size, with an emphasis on oceanic megafauna including marine mammals, birds, fishes, and reptiles. In particular, the course will explore the functional mechanisms that generate the scaling relationships for physiological and ecological traits, such as metabolism, ecosystem function and body size evolution. Students will also be introduced to state-of-the-art technologies used to student marine megafauna in some of the most logistically challenging habitats on earth.
Same as: BIOHOPK 279H

BIOHOPK 181H. Physiology of Global Change. 2 Units.
(Graduate students register for 281H.) Global change is leading to significant alterations in several environmental factors, including temperature, ocean acidity and oxygen availability. This course focuses on: (i) how these environmental changes lead to physiological stress and (ii) how, and to what extent, are organisms able to adapt through short-term acclimatization and evolutionary adaptation to cope with these stresses. A major focus of the class is to link changes in species' distribution patterns with underlying physiological mechanics that establish environmental optima and tolerance limits.
Same as: BIOHOPK 281H

BIOHOPK 182H. Stanford at Sea. 16 Units.
(Graduate students register for 323H.) Five weeks of marine science including oceanography, marine physiology, policy, maritime studies, conservation, and nautical science at Hopkins Marine Station, followed by five weeks at sea aboard a sailing research vessel in the Pacific Ocean. Shore component comprised of three multidisciplinary courses meeting daily and continuing aboard ship. Students develop an independent research project plan while ashore, and carry out the research at sea. In collaboration with the Sea Education Association of Woods Hole, MA. Only 6 units may count towards the Biology major. 2020-21 academic year offering of this course is dependent on COVID-19 regulations.
Same as: BIOHOPK 323H, EARTHSYS 323, ESS 323

BIOHOPK 183H. Introduction to Ecology. 4 Units.
The course is designed to provide background on key concepts in ecology, familiarize students with key ecological processes and ecosystems, and the methods used in ecological studies. The course will further build students' skills in critical scientific thinking, reading the literature, and scientific communication. A major goal of the course is to train students to ask questions in ecology, and to design, conduct and report studies addressing these questions. Thus, emphasis is also placed, in additional to general ecological concepts, on field observations, experimental design, and the analysis, interpretation and presentation of ecological data (through computer laboratories, written assignments and presentations). Written assignments, presentations and discussions are designed to provide experience in organizing and presenting information and to expose students to multiple perspectives on ecological processes and their applications.nThis course fulfills the same requirement as BIO 81.
Same as: BIOHOPK 81

BIOHOPK 184H. Holistic Biology. 16 Units.
(Graduate students register for 284H.) For majors and non-majors. Complexity in natural systems is examined from complementary points of view, including scientific, historical, philosophical and literary. Lectures and discussions will focus on the writings of Ed Ricketts and John Steinbeck, poetry of Robinson Jeffers and on historical and contemporary works concerning marine and fresh-water systems, resource management and climate change. A group project with individual contributions will be carried out and presented at a symposium. This course will involve a significant amount of creative writing, and it satisfies the Writing in Major requirement for Biology. It is open to all majors and classes. Only 6 units may count towards the Biology major.
Same as: BIOHOPK 284H

BIOHOPK 185H. Ecology and Conservation of Kelp Forest Communities. 5 Units.
(Graduate students register for 285H.) Five week course. Daily lectures, labs, and scuba dives focused on scientific diving and quantitative ecological methods in kelp forests.. Topics include identification and natural history of resident organisms, ecological processes, and subtidal field techniques. Class projects contribute to long-term monitoring at Hopkins Marine Station. It is recommended (but not required) that students complete the Stanford Scientific Diver Training session, typically offered prior to the start of the course. Prerequisites: consent of instructor; rescue scuba certification and scuba equipment.
Same as: BIOHOPK 285H

BIOHOPK 187H. Sensory Ecology. 4 Units.
(Graduate students register for 287H.) Topics: the ways animals receive, filter, and process information gleaned from the environment, sensory receptor mechanisms, neural processing, specialization to life underwater, communication within and between species, importance of behavior to ecosystem structure and dynamics, impact of acoustic and light pollution on marine animals. Emphasis is on the current scientific literature. The laboratory portion of the class explores sensory mechanisms using neurobiological methods and methods of experimental animal behavior.
Same as: BIOHOPK 287H

BIOHOPK 198H. Directed Instruction or Reading. 1-15 Unit.
May be taken as a prelude to research and may also involve participation in a lab or research group seminar and/or library research. Credit for work arranged with out-of-department instructors restricted to Biology majors and requires department approval. May be repeated for credit. (Staff).

BIOHOPK 199H. Undergraduate Research. 1-15 Unit.
Qualified undergraduates undertake individual work in the fields listed under 300H. Arrangements must be made by consultation or correspondence.

BIOHOPK 234H. Topics in Comparative and Environmental Physiology. 1 Unit.
Seminar and discussion focused on current topics and research at the interface of physiology and ecology.

BIOHOPK 240H. Statistical Modeling. 3 Units.
(Graduate students register for 240H.) Introduction to applied statistical modeling in a Bayesian framework. Topics will include probability, regression, model comparison, and hierarchical modeling. We will take a hands-on, computational approach (R, Stan) to gain intuition so that students can later design their own inferential models. Prerequisites for this course include introductory statistics and some calculus or linear algebra, as well as previous exposure to scientific computing. Open to graduate students; undergraduate students may enroll with consent of instructor.
Same as: BIOHOPK 140H

BIOHOPK 242H. Historical Ecology of Marine Invertebrates. 5 Units.
This course is an exploration of the local invertebrate fauna at Hopkins Marine Station, through the lens of a long-term monitoring study initiated by Hewatt in 1931. During week 1, lectures will provide an overview of the major phyla represented on rocky intertidal shores. In the laboratory, students will focus on species identification. These skills will be put to use in week 2, when we will quantify patterns of invertebrate biodiversity along the Hewatt transect. During week 3, students will investigate a relevant taxonomic or quantitative problem. This course will meet 12-5pm, Monday-Friday. January 13-31, 2020. Open to graduate students; undergraduate students may enroll with consent of instructor.
Same as: BIOHOPK 142H

BIOHOPK 243H. Quantitative methods for marine ecology and conservation. 4 Units.
The goal of this course is to learn the foundations of ecological modelling with a specific (but not exclusive) focus on marine conservation and sustainable exploitation of renewable resources. Students will be introduced to a range of methods ¿ from basic to advanced ¿to characterize population structure, conduct demographic analyses, estimate extinction risk, identify temporal trends and spatial patterns, quantify the effect of environmental determinants and anthropogenic pressures on the dynamics of marine populations, describe the potential for adaptation to climate change. This course will emphasize learning by doing, and will rely heavily on practical computer laboratories, in R and/or Phyton, based on data from our own research activities or peer reviewed publications. Students with a background knowledge of statistics, programming and calculus will be most welcome.
Same as: BIOHOPK 143H, CEE 164H, CEE 264H, EARTHSYS 143H, EARTHSYS 243H

BIOHOPK 250H. Ecological Mechanics. 3 Units.
(Graduate students register for 250H.) The principles of life's physical interactions. We will explore basic physics. fluid mechanics, thermal dynamics, and materials science to see how the principles of these fields can be used to investigate ecology at levels from the individual to the community. Topics include: diffusion, boundary layers, fluid-dynamic forces, locomotion, heat-budget models, fracture mechanics, adhesion, beam theory, the statistics of extremes, and the theory of self-organization. Open to students from all backgrounds. Some familiarity with basic physics and calculus advantageous but not necessary.
Same as: BIOHOPK 150H

BIOHOPK 252H. Physiology of Global Change. 2 Units.
(Graduate students register for 252H.) Global change is leading to significant alterations in several environmental factors, including temperature, ocean acidity and oxygen availability. This course focuses on: (i) how these environmental changes lead to physiological stress and (ii) how, and to what extent, are organisms able to adapt through short-term acclimatization and evolutionary adaptation to cope with these stresses. A major focus of the class is to link changes in species' distribution patterns with underlying physiological mechanics that establish environmental optima and tolerance limits.
Same as: BIOHOPK 152H

BIOHOPK 253H. Current Topics and Concepts in Quantitative Fish Dynamics and Fisheries Management. 1 Unit.
(Graduate students register for 253H) The course will focus on extensive reading of seminal and reference papers published in the literature in the last decade on modeling population biology, community dynamics and fishery management in the marine environment. Basic knowledge of population dynamics is welcome. The goal is to develop an appreciation on both traditional and cutting-edge modeling approaches to study the dynamics and management of marine populations subjected to natural or anthropogenic shocks and pressures.
Same as: BIOHOPK 153H

BIOHOPK 254H. Animal Diversity: An Introduction to Evolution of Animal Form and Function from Larvae to Adults. 7 Units.
Survey of invertebrate diversity, emphasizing form and function of both adult and larval life history stages. Focuses on how morphology, life histories, and development contribute to current views of the evolutionary diversification of multicellular animals. Labs are a hands-on exploration of animal diversity using local marine species as examples, as well as techniques of obtaining, handling, and maintaining larvae from early development through settlement. Lectures, labs, plus field trips. Satisfies Central Menu Area 3 for Bio majors. Prerequisite: Biology core or consent of instructors.
Same as: BIOHOPK 154H

BIOHOPK 255H. Developmental Biology and Evolution. 4 Units.
(Graduate students register for 255) This course focusses on how animals form their basic body plans; from the formation of their germ layers; ectoderm, endoderm and mesoderm, to how they are organized along the main developmental axes; the anteroposterior and dorsoventral axes. The course will focus in part on the molecular mechanisms that underlie these developmental decisions from work carried out in established developmental model species. However, we will also explore the current understanding of how these mechanisms evolved from new insights from emerging models representing a broad range of animal phyla. The setting at Hopkins Marine Station will allow us to carry out experiments from animals collected in the field, and the course will involve a substantial lab component to complement concepts and approaches presented in lecture. nPre-requisites : Biocore or by permission of instructor.
Same as: BIOHOPK 155H

BIOHOPK 256H. Hands-On Neurobiology: Structure, Function and Development. 6 Units.
This laboratory course will examine neural and neuromuscular systems at a cellular level in selected vertebrate and invertebrate taxa using anatomical, physiological and molecular approaches. Intracellular dye injections and confocal microscopy will be used to visualize neuronal structure. Ca-imaging will permit functional analysis of living neurons. Electrical recording methods will be used to explore principles of excitability, synaptic transmission, sensory pathways and neural integration. Development of neural systems will be studied using molecular visualization methods. Work in the lab will be supplemented with informal lectures and discussions, and results of the labs will be reviewed weekly. Two 4-hour afternoon lab sessions per week.
Same as: BIOHOPK 156H

BIOHOPK 257H. Creative Writing & Science: The Artful Interpreter. 5 Units.
What role does creativity play in the life of a scientist? How has science inspired great literature? How do you write accessibly and expressively about things like whales, DNA or cancer? This course usually begins with a field trip to Hopkins Marine Station where Stanford labs buzz with activity alongside barking seals and crashing waves. While we won't be able to visit Monterey Bay this quarter, the spirit of interdisciplinary exchange will not be lost, and students will be encouraged to get outside and engage with their local environments. As historian Jill Lepore writes of Rachel Carson: ¿She could not have written Silent Spring if she hadn't, for decades, scrambled down rocks, rolled up her pant legs, and waded into tide pools, thinking about how one thing can change another...¿n nAs a small workshop course writing process and the study of literary craft form the foundation of our work together. For inspiration we will read nonfiction by scientists who write for wide audiences and literary giants who draw from science. Students will explore the intersection between creative expression and scientific curiosity, completing three short essays and offering supportive peer feedback throughout the quarter. This course is open to all undergraduates. Note: Students must attend the first class meeting to retain their roster spot.
Same as: BIOHOPK 157H, ENGLISH 157H

BIOHOPK 258H. Science Meets Literature on the Monterey Peninsula. 5 Units.
(Graduate students register for 258H.) This course will consider the remarkable nexus of scientific research and literature that developed on the Monterey Peninsula in the first half of the 20th century and how the two areas of creativity influenced each other. The period of focus begins with the 1932 association of John and Carol Steinbeck, Ed Ricketts, and Joseph Campbell, all of whom were highly influenced by the Carmel poet, Robinson Jeffers ¿ and ends with the novels Cannery Row (1945) and Sweet Thursday (1954). An indisputable high-tide mark, Sea of Cortez: A Leisurely of Travel and Research (1941) will be considered in detail. Weekend field trips will include intertidal exploration, a tour of the Jeffers Tor House in Carmel, and whale watching on Monterey Bay.
Same as: BIOHOPK 158H, ENGLISH 158H

BIOHOPK 259H. Molecular Ecology Lab. 1 Unit.
Graduate students register for 259H. This course will allow students to learn lab approaches to analyzing DNA to answer questions in parentage, population biology, and species identification. Students will spend 2-3 hours each week in the lab extracting DNA, analyzing sequences, and testing hypotheses. Molecular projects will interface with local research projects and course content.
Same as: BIOHOPK 159H

BIOHOPK 260H. Developmental Biology in the Ocean: Diverse Embryonic & Larval Strategies of marine invertebrates. 5-8 Units.
(Graduate students register for 261H). Lab course is designed to introduce students to the diversity in the early developmental strategies of marine invertebrates and how an understanding of these microscopic life histories is key to understanding the evolutionary diversification of phyla and the distribution of their more familiar adults. Emphasis is on hands-on collection, spawning, observation and manipulation of embryos and their larvae.
Same as: BIOHOPK 160H

BIOHOPK 261H. Invertebrate Zoology. 5 Units.
(Graduate students register for 261H.) Survey of invertebrate diversity emphasizing form and function in a phylogenetic framework. Morphological diversity, life histories, physiology, and ecology of the major invertebrate groups, concentrating on local marine forms as examples. Current views on the phylogenetic relationships and evolution of the invertebrates. Lectures, lab, plus field trips.
Same as: BIOHOPK 161H

BIOHOPK 262H. Comparative Animal Physiology. 5 Units.
(Graduate students register for 262H.) How animals work. Topics: physiology of respiration, circulation, energy metabolism, thermal regulation, osmotic regulation, muscle physiology, and locomotion. Evolutionary and ecological physiology. Lectures, lab, and field research. An option to combine the course work with a more intensive research focus, with more units, is available. Satisfies Central Menu Area 3 for Bio majors. Prerequisite: Consent of instructor.
Same as: BIOHOPK 162H

BIOHOPK 263H. Oceanic Biology. 4 Units.
(Graduate students register for 263H.) How the physics and chemistry of the oceanic environment affect marine plants and animals. Topics: seawater and ocean circulation, separation of light and nutrients in the two-layered ocean, oceanic food webs and trophic interactions, oceanic environments, biogeography, and global change. Lectures, discussion, and field trips. Satisfies Central Menu Area 4 for Bio majors. Recommended: PHYSICS 21 or 51, CHEM 31, or consent of instructor.
Same as: BIOHOPK 163H

BIOHOPK 264H. POPULATION GENOMICS. 1-2 Unit.
Introduces students to the analysis of single nucleotide polymorphism data from next generation sequencing projects. Computer analysis, hypothesis testing, and projects based on existing data sets will be pursued.

BIOHOPK 265H. The Extreme Life of the Sea. 3 Units.
(Graduate students register for 265H). Lecture course that explores the way marine species live in extreme ocean habitats. We will cover the deepest, hottest, coldest, and shallowest habitats and the biggest, fastest, most fecund, oldest and smallest species. We will focus on the molecular, physiological and ecological adaptations that allow species to thrive in these unusual environments.
Same as: BIOHOPK 165H

BIOHOPK 266H. Molecular Ecology. 5 Units.
(Graduate students register for 266H.) How modern technologies in gene sequencing, detection of nuclear nucleotide polymorphisms, and other approaches are used to gather data on genetic variation that allow measurement of population structure, infer demographic histories, inform conservation efforts, and advance understanding of the ecology of diverse types of organisms.
Same as: BIOHOPK 166H

BIOHOPK 267H. Nerve, Muscle, and Synapse. 5 Units.
(Graduate students register for 267H.) Fundamental aspects of membrane excitability, nerve conduction, synaptic transmission, and excitation-contraction coupling. Emphasis is on biophysical, molecular, and cellular level analyses of these processes in vertebrate and invertebrate systems. Labs on intra- and extracellular recording and patch clamp techniques. Lectures, discussions, and labs. Satisfies Central Menu Area 3 for Bio majors Prerequisites: PHYSICS 23, 28, 43, or equivalent; CHEM 31, calculus; or consent of instructor.
Same as: BIOHOPK 167H

BIOHOPK 268H. Disease Ecology: from parasites evolution to the socio-economic impacts of pathogens on nations. 3 Units.
(Graduate students register for 268H.) Course will lead participants on a journey through the dynamics of infectious diseases that will start at the smallest level from within-host parasite dynamics and will progressively scale up to parasite evolution, disease ecology, public health policies, disease driven poverty traps and the socio-economic impact of infectious diseases on nations. The course will be organized around case studies, including among the others, schistosomiasis, malaria, cholera and sleeping sickness. Participants will have the opportunity to develop a capstone project.
Same as: BIOHOPK 168H

BIOHOPK 273H. Marine Conservation Biology. 4 Units.
(Graduate students register for 273H.). Introduction to the key concepts of ecology and policy relevant to marine conservation issues at the population to ecosystems level. Focus on the origin and maintenance of biodiversity and conservation applications from both the biology and policy perspectives (for example, endangered species, captive breeding, reserve design, habitat fragmentation, ecosystem restoration/rehabilitation). Also includes emerging approaches such as ecosystem based management, ocean planning, and coupled social-ecological systems. The course will include lectures, readings and discussions of primary literature, and attendance at seminars with visiting scholars. Prerequisite: introductory biology; suggested: a policy and/or introductory ecology course.
Same as: BIOHOPK 173H

BIOHOPK 273HA. Marine Conservation Biology - Seminar and Discussion Only. 1-2 Unit.
(Graduate students register for 273HA.). Introduction to the key concepts of ecology and policy relevant to marine conservation issues at the population to ecosystems level. Focus on the origin and maintenance of biodiversity and conservation applications from both the biology and policy perspectives (for example, endangered species, captive breeding, reserve design, habitat fragmentation, ecosystem restoration/rehabilitation). Also includes emerging approaches such as ecosystem based management, ocean planning, and coupled social-ecological systems. The course will include lectures, readings and discussions of primary literature, and attendance at seminars with visiting scholars. Prerequisite: introductory biology; suggested: a policy and/or introductory ecology course.nStudents should enroll in this course if they are only joining the seminar and discussion. Students who will engage in the full course should enroll in BIOHOPK 173H/273H.
Same as: BIOHOPK 173HA

BIOHOPK 274. Hopkins Microbiology Course. 3-12 Units.
(Formerly GES 274S.) Four-week, intensive. The interplay between molecular, physiological, ecological, evolutionary, and geochemical processes that constitute, cause, and maintain microbial diversity. How to isolate key microorganisms driving marine biological and geochemical diversity, interpret culture-independent molecular characterization of microbial species, and predict causes and consequences. Laboratory component: what constitutes physiological and metabolic microbial diversity; how evolutionary and ecological processes diversify individual cells into physiologically heterogeneous populations; and the principles of interactions between individuals, their population, and other biological entities in a dynamically changing microbial ecosystem. Prerequisites: CEE 274A and CEE 274B, or equivalents.
Same as: BIO 274S, CEE 274S, ESS 253S

BIOHOPK 274H. Experimental Design and Probability. 3 Units.
(Graduate students register for 274H.) Variability is an integral part of biology. Introduction to probability and its use in designing experiments to address biological problems. Focus is on experimental design and the use of linear models in testing hypotheses (e.g., analysis of variance, regression). Students will use R to explore and analyze locally relevant biological datasets. No programming or statistical background is assumed. Prerequisite: consent of instructor.
Same as: BIOHOPK 174H

BIOHOPK 275H. Marine Science and Conservation in a Changing World. 16 Units.
Graduate students register for 275H. This hands-on, experiential course provides a broad foundation in marine science, and explores emerging opportunities for innovation in the study of life in the sea. Students are resident at Stanfords Hopkins Marine Station in Pacific Grove (90 miles south of main campus) where the diverse organisms and environments of Monterey Bay provide the focus for the course. Class meets daily with lectures, discussions, labs, and field work throughout the day. Three linked concentrations¿each 3 weeks long¿are taught sequentially to address (1) the extraordinary diversity of marine organisms and habitats, (2) the physiology and behavior of marine animals, and (3) the principles of marine ecology. Connecting these concentrations is a weekly seminar-based discussion of topics in marine conservation. This design permits deep concentration on each subject, and places emphasis on discussion, group dialog, individual exploration, and experiential learning. In the final week of the quarter, students complete an individual capstone project of their choosing. For the Biology major, this course fulfills the same requirements as BIO 47 and BIO 81. Satisfies WIM in Biology.
Same as: BIOHOPK 175H

BIOHOPK 276H. Estimates and Errors: The Theory of Scientific Measurement. 3 Units.
Measurement plays a fundamental role in science, but many biologists have no formal training in what it means to measure something. Errors are inevitable in any measurement. Which are inherent, and which can be controlled? How do errors propagate? How can you decide which data to reject? When are uncertainties normal? In this course we will work our way into the theory of measurement, covering some topics that overlap with inferential statistics (but from a new and perhaps more intuitive perspective), and extending beyond those basics to include spectral analysis and the dangers of measurement in the digital realm.

BIOHOPK 277H. Dynamics and Management of Marine Populations. 4 Units.
(Graduate students register for 277H.) Course examines the ecological factors and processes that control natural and harvested marine populations. Course emphasizes mathematical models as tools to assess the dynamics of populations and to derive projections of their demographic fate under different management scenarios. Course objectives will be met by a combination of theoretical lectures, assigned readings and class discussions, case study analysis and interactive computer sessions.
Same as: BIOHOPK 177H

BIOHOPK 279H. Physiological Ecology of Marine Megafauna. 3 Units.
(Graduate students register for 279H.) The ocean is home to the largest animals of all-time. How, when, and why did gigantism evolve in different taxa? What are the consequences of large body size? This course will focus on how biological processes scale with body size, with an emphasis on oceanic megafauna including marine mammals, birds, fishes, and reptiles. In particular, the course will explore the functional mechanisms that generate the scaling relationships for physiological and ecological traits, such as metabolism, ecosystem function and body size evolution. Students will also be introduced to state-of-the-art technologies used to student marine megafauna in some of the most logistically challenging habitats on earth.
Same as: BIOHOPK 179H

BIOHOPK 280. Short Course on Ocean Policy. 3 Units.
The course will introduce graduate students in the natural and social sciences to ocean policy and governance in the US at national, regional, state, and local levels. Together with leaders in ocean science and policy, students will examine pressing issues in ocean sustainability from natural science, social science, and legal and policy perspectives, with an emphasis on the role of science in the policy and governance processes. Students will learn and apply practical skills in communication, leadership and interdisciplinary problem-solving through participation in a group project, interactive discussions and simulations, and field trips. Prerequisite: consent of instructor and by application due in winter.

BIOHOPK 281H. Physiology of Global Change. 2 Units.
(Graduate students register for 281H.) Global change is leading to significant alterations in several environmental factors, including temperature, ocean acidity and oxygen availability. This course focuses on: (i) how these environmental changes lead to physiological stress and (ii) how, and to what extent, are organisms able to adapt through short-term acclimatization and evolutionary adaptation to cope with these stresses. A major focus of the class is to link changes in species' distribution patterns with underlying physiological mechanics that establish environmental optima and tolerance limits.
Same as: BIOHOPK 181H

BIOHOPK 284H. Holistic Biology. 16 Units.
(Graduate students register for 284H.) For majors and non-majors. Complexity in natural systems is examined from complementary points of view, including scientific, historical, philosophical and literary. Lectures and discussions will focus on the writings of Ed Ricketts and John Steinbeck, poetry of Robinson Jeffers and on historical and contemporary works concerning marine and fresh-water systems, resource management and climate change. A group project with individual contributions will be carried out and presented at a symposium. This course will involve a significant amount of creative writing, and it satisfies the Writing in Major requirement for Biology. It is open to all majors and classes. Only 6 units may count towards the Biology major.
Same as: BIOHOPK 184H

BIOHOPK 285H. Ecology and Conservation of Kelp Forest Communities. 5 Units.
(Graduate students register for 285H.) Five week course. Daily lectures, labs, and scuba dives focused on scientific diving and quantitative ecological methods in kelp forests.. Topics include identification and natural history of resident organisms, ecological processes, and subtidal field techniques. Class projects contribute to long-term monitoring at Hopkins Marine Station. It is recommended (but not required) that students complete the Stanford Scientific Diver Training session, typically offered prior to the start of the course. Prerequisites: consent of instructor; rescue scuba certification and scuba equipment.
Same as: BIOHOPK 185H

BIOHOPK 287H. Sensory Ecology. 4 Units.
(Graduate students register for 287H.) Topics: the ways animals receive, filter, and process information gleaned from the environment, sensory receptor mechanisms, neural processing, specialization to life underwater, communication within and between species, importance of behavior to ecosystem structure and dynamics, impact of acoustic and light pollution on marine animals. Emphasis is on the current scientific literature. The laboratory portion of the class explores sensory mechanisms using neurobiological methods and methods of experimental animal behavior.
Same as: BIOHOPK 187H

BIOHOPK 290H. Teaching Practicum in Biology. 1-15 Unit.
Open to upper-division undergraduates and graduate students. Practical supervised teaching experience in a biology or lecture course. Training often includes attending lectures, initiating and planning discussion sections, and assisting in the preparation of course materials. May be repeated for credit. Prerequisite: consent of instructor.

BIOHOPK 291H. Teaching of Stanford at Sea. 10 Units.
Only open to graduate students who are teaching assistants for Stanford at Sea. Provides practical experience in teaching field oceanography and marine biology. Serving as an assistant in a lecture course (five weeks) is coupled with acting as a laboratory teaching assistant on board an oceanographic research vessel during a five-week research cruise with the Stanford at Sea course. Prerequisite: consent of instructor.

BIOHOPK 299H. Advanced Topics in Marine Conservation. 2 Units.
Graduate students only. Topics will change from year to year but will include such topics as sustainable fisheries, protected areas, ocean planning, social-ecological systems, dynamic management, sustainable seafood, and impacts of climate change.

BIOHOPK 300H. Research. 1-15 Unit.
Graduate study involving original work undertaken with staff in the fields indicated. B. Block: Comparative Vertebrate Physiology (biomechanics, metabolic physiology and phylogeny of pelagic fishes, evolution of endothermy); L. Crowder: Marine ecology, fisheries, bycatch, integrating science and policy, marine conservation; G. De Leo: Population dynamics and management, wildlife diseases, environmental policies and sustainable development; M. Denny: Biomechanics (the mechanical properties of biological materials and their consequences for animal size, shape, and performance); W. Gilly: Neurobiology (analysis of giant axon systems in marine invertebrates from molecular to behavioral levels); J. Goldbogen: Physiological and Behavioral Ecology (functional morphology and biomechanics of marine organisms): C. Lowe: Evolution of Development (origin of chordates, early evolution of body plans); F. Micheli: Marine Ecology (species interactions and community ecology, scale-dependent aspects of community organization, marine conservation and design of multi-species marine protected areas, behavioral ecology); S. Palumbi: Molecular Evolution (mechanisms of speciation, genetic differentiations of populations, use of molecular tools in conservation biology, design of marine protected areas); S. Thompson: Neurobiology (neuronal control of behavior and mechanisms of ion permeation, signal transduction, calcium homeostasis, and neutrotransmission);.

BIOHOPK 315H. Career Development for Graduate Students. 2 Units.
The course will cover multiple skills required to succeed in graduate school and beyond, including fund raising, publishing, selecting career options, job application and negotiation, and teaching, through lectures, group discussions, and practical excercises.

BIOHOPK 320H. Physical Biology. 3 Units.
Physics, mathematics, and biology are often studies as separate subjects. In this two-week intensive course we will attempt to bring them together in a dynamic combination of lectures and hands on projects. We will draw on the diverse flora and fauna of Monterey Bay for our experimental organisms, and will take advantage of the facilities at Hopkins Marine Station to explore questions at levels ranging from molecules to ecological communities.

BIOHOPK 323H. Stanford at Sea. 16 Units.
(Graduate students register for 323H.) Five weeks of marine science including oceanography, marine physiology, policy, maritime studies, conservation, and nautical science at Hopkins Marine Station, followed by five weeks at sea aboard a sailing research vessel in the Pacific Ocean. Shore component comprised of three multidisciplinary courses meeting daily and continuing aboard ship. Students develop an independent research project plan while ashore, and carry out the research at sea. In collaboration with the Sea Education Association of Woods Hole, MA. Only 6 units may count towards the Biology major. 2020-21 academic year offering of this course is dependent on COVID-19 regulations.
Same as: BIOHOPK 182H, EARTHSYS 323, ESS 323

BIOHOPK 330H. Scientific Writing. 2 Units.
This writer's seminar will workshop the elements of good scientific writing by focusing on a paper's Introduction. We will chart the elements of an effective Introduction, designed for different audiences and types of scientific journals. The course will provide participants with the chance to craft an Introduction to a current paper or proposal and have it evaluated in light of the ideal structure we define.

BIOHOPK 355. Coral Reefs of the Western Pacific: Interdisciplinary Perspectives, Emerging Crises, and Solutions. 1 Unit.
This new graduate-level course focusses on the complex interplay of biology, physics, chemistry, and human activities that both promotes and limits the development of coral reefs. We will examine the ecology of these biodiverse systems as well as the service they provide in terms of rapid nutrient recycling, coastal protection, and maintenance of large populations of fish. New advances in our understanding of coral reefs will be highlighted, including the role of climate variability and micro- and mesoscale fluid flow in controlling reef growth and persistence, the physiology, genomics, and physics underpinning thermal resilience in corals, contributing and mitigating factors involved in the current decline of coral reefs, ocean acidification, fishing, reef-scale trophic modeling, ecological interactions and trophic cascades, and reefs as part of complex seascapes and linkages with other marine ecosystems. The course will conclude with an analysis of science to policy case studies and future opportunities. The faculty leaders collectively have over 100 years of field experience working in coral reefs of the Pacific and despite our forced online teaching and learning format will endeavor to bring the coral reef field experience to life for this class.
Same as: BIO 355, CEE 363I, ESS 355

BIOHOPK 801H. TGR Project. 0 Units.
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BIOHOPK 802H. TGR Dissertation. 0 Units.
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