

# MARINE BIOLOGY AND ECOLOGY

---

Dept. Code: MBE

## Marine Biology and Ecology

The Bachelor of Science in Marine Biology and Ecology teaches fundamental concepts and precepts in ecology, physiology and organismal-environmental interactions. The educational goals are to understand the range of significant biological concepts from the molecular biology of DNA to how species interactions are affected by environmental change. These educational goals are enhanced by active research experiences that catalyze a student's understanding of the scientific process. This program is designed for students with a strong interest in academic research, graduate school, and professional careers that require critical thinking skills. For these high performing students, this program will develop competencies with which to successfully advance their careers.

There is enough flexibility in the Bachelor of Science in Marine Biology and Ecology program to allow students to do a minor or even a second major in the College of Arts and Sciences or other Schools. Students wishing to do a second major should review these disciplines for additional requirements.

### **MBE 230. Introduction to Marine Biology. 3 Credit Hours.**

The sea as an environment. Marine life, its special problems and adaptations. Emphasis on Caribbean organisms.

Prerequisite: BIL 150 or BIL 160.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

### **MBE 232. Introduction to Marine Biology Laboratory. 1 Credit Hour.**

Ecology, physiology, and behavior of marine organisms in south Florida marine habitats.

Pre/Corequisite: MBE 230 or BIL 230 and Prerequisite: BIL 151 or BIL 161.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

### **MBE 306. Marine Ecology. 3 Credit Hours.**

This course will examine the principles by which marine organisms interact with their external environment and other biota, and in turn, influence their external environment and other biota. This will include organismal ecology, population ecology, community ecology, ecosystem ecology, and paleoecology. While focused on marine ecology, it will make comparisons with terrestrial ecology.

Prerequisite: MBE 230 OR MSC 230 OR BIL 230 Requisite: Cannot take MBE 306 if already taken BIL 330.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

### **MBE 307. Physiology of Marine Organisms. 3 Credit Hours.**

This course will introduce basic principles of physiology by comparing how various marine animals and plants endure in marine environments. The approach will emphasize the integration of function between and within different physiological systems which results in the maintenance of constant internal state i.e., homeostasis. The physiological systems examined include: energy metabolism, ion regulation, calcification, neural and endocrine processes, reproduction, movement, respiration and circulation, osmoregulation.

Prerequisite: MBE 230 OR MSC 230 OR BIL 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

### **MBE 308. Genetics and Evolution. 3 Credit Hours.**

Genetics and Evolution is equivalent to common genetic courses except that it has a greater focus on heritability, quantitative and population genetics and how evolution effects these parameters. Evolution is included to provide insight about the genetics and phenotypic variation within and among populations and their change over time.

Prerequisite: MBE 230 OR MSC 230 OR BIL 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MBE 309. Marine Viruses - The Invisible Majority. 3 Credit Hours.**

Viruses are the most abundant biological entities in the ocean. In recent years, there has been increased appreciation of viruses infecting marine lives at every biological scales – from corals and whales, to tiny bacteria that populate the ocean. Through infection and death of billions of marine microorganisms, marine viruses also play a key role in the global chemical cycles. This course will introduce students to the exciting world of marine viruses and how they interact with marine life at all scales. We will cover their role in diseases of marine life, and how they impact the ecology and evolution all life in the ocean. The course will also introduce students to the cutting-edge insights on marine virus ecology and evolution, as we will cover the contemporary tools and techniques used to address broad questions in this field.

Pre-Requisites: BIL 150 and Junior or Senior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 310. Living Resources of the Ocean. 3 Credit Hours.**

Marine fish and shellfish of major commercial and recreational value: biology, techniques of harvesting, and resource management.

Prerequisite: MBE 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 319. Research Fundamentals. 1 Credit Hour.**

Research Fundamentals will provide an introduction to academic research methods including basic laboratory techniques, data analysis, and scientific communication. Students will read the primary literature and both analyze data and communicate results using multiple formats. The course emphasizes active learning (discussions, working with peers, writing, etc.) and is directed toward early stage undergraduate students interested in pursuing research.

Prerequisite: MSC 204 Or MTH 224.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 323. Invertebrate Zoology. 4 Credit Hours.**

Biology of invertebrates, with emphasis on tropical and subtropical marine forms. Field work and combined lecture-laboratory sessions.

Prerequisite: MBE 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 324. Biology of Fishes. 3 Credit Hours.**

Selected topics on the ecology and physiology of fishes. Lectures on reproduction, respiration, osmoregulation, sense systems, hormonal control.

Prerequisite: MBE 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 326. Marine Genomics. 4 Credit Hours.**

This course integrates lectures, discussions and research on genomics to understand the demography and evolutionary processes affecting populations. This research intensive course uses genomic data to better understand the health of species and ecological communities. This course is part of Saltwater Semester so that students can be actively involved in intensive research. As part of the Saltwater Semester, students are required to enroll in four of the 4-credit Saltwater Semester courses and one additional 1 credit professional development course (17 credits) where each course meets for 3 weeks at the Marine campus.

Prerequisite: MBE 230 or BIL 230 AND Corequisite: MBE 404, MBE 463, MBE 466, and MBE 467.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 328. Introduction to Aquaculture. 3 Credit Hours.**

This course will provide an introduction to the field of aquaculture, which represents one of the fastest growing industries in food production in the worlds and is a field that offers exciting job opportunities in science, business, marketing, resource management, and socioeconomics. This course will provide students with a sound background in aquaculture prior to engaging in higher-level courses in this field.

Prerequisite: MSC 111 AND Prerequisite or Corequisite: MBE 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 329. Marine Vertebrate Zoology. 3 Credit Hours.**

The course will be a comprehensive examination of the form and function of the vertebrate lineage of marine animals from early chordates to the evolution of cartilaginous and bony fish and the emergence of tetrapods, those that evolved from marine ancestors and have since returned to the seas. A comparative point of view will be used to assess the anatomy and physiology of each taxonomic group as well as behavioral and ecological adaptations related to their life history. Specifically, the course will cover the emergence of the vertebrate body plan and the evolution of fish from agnathans through modern teleosts, as well as the tetrapod lineage of marine reptiles, marine birds, and marine mammals. We will examine critical points in vertebrate evolution where genome-wide duplication events occurred as well as instances of convergent evolution in various lineages.

Prerequisite: MBE 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MBE 333. Ocean Human Health. 3 Credit Hours.**

The focus of this course is on the present, future, and potential effects of oceanic processes and marine organisms on human health and wellbeing and on human impacts on the marine environment.

Prerequisite: MBE 230 or BIL 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 350. Survey of Marine Mammals. 3 Credit Hours.**

The biology, physiology, natural history, behavior, and conservation of marine mammals.

Prerequisite: MBE 230 or BIL 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MBE 365. Tropical Coastal Ecosystems: Lab and Field Methods. 1 Credit Hour.**

This course will provide students with the theory and application of field sampling methods used to document status and trends in the health of coral reef, seagrass, and mangrove ecosystems. Students will learn about sampling theory, sampling methods, sampling equipment, and species identifications using a combination of classroom and field activities. This 1-credit course is designed as a companion to MBE 366 where theory detailed in this class is put to practice to design and execute a targeted, small-scale sampling program for the coastal ecosystems found in South Florida. Lectures will be complemented with field activities to be carried out at sites around Key Biscayne and at the UM Broad Key station.

Pre/Corequisite: MBE 366.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 366. Tropical Coastal Ecosystems. 3 Credit Hours.**

This course will provide a comprehensive background on the ecology, conservation, and restoration of the three main tropical coastal ecosystems: Mangroves, Seagrasses, and Coral Reefs. The first part of the course will consist of a review of ecological theory, followed by lectures on the dynamics of the three ecosystems, including diversity, community structure, stress ecology, management tools, and novel restoration paradigms. Classes will be complemented by student presentations, in-class activities, and media-outreach projects. Readings for this class will include a required textbook and papers from the primary literature. Grades will be based on exams, quizzes, in-class projects, and student presentations.

Prerequisite: MBE 230 or BIL 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 370. Current Research in Marine Biology: Seminars and Discussion. 2 Credit Hours.**

These discussions and seminars comprising a 2 cr course provide well-prepared undergraduate students interested in marine research with an introduction to graduate student-presented science in the specialization of marine biology.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 403. Marine Environmental Toxicology. 3 Credit Hours.**

This course will provide an introduction to the principles of environmental toxicology with an emphasis on marine ecosystems, considering a variety of different classes of toxicants, how they can impact marine organisms, the scientific methods used to assess impacts, and the regulatory frameworks used to monitor and manage their release to the environment.

Prerequisite: BIL 255 and CHM 121.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 404. Saltwater Semester Professional Development. 1 Credit Hour.**

This 1-credit course will complement the Saltwater Semester courses within each track offered. During an overnight weekend trip to Broad Key at the beginning of the semester, students in both Saltwater Semester tracks will take part in activities including but not limited to: snorkeling, seining, identifying fish, collecting research organisms, collecting and analyzing samples, team-building, interpreting their findings and presenting them in a formal laboratory report due two weeks after the trip, and/or conducting an experiment investigating a topical question in genomics, behavior, physiology, ecology, and/or conservation. Students will participate in professional development activities including but not limited to: learning statistics and R, how to write a CV, interview skills, panels with graduate students and researchers, and paper discussions. Students will be required to attend the MBE Seminar Series each Friday and end the semester with a presentation.

Prerequisites: MBE 230 or BIL 230 AND Co-requisite: Either MBE 326 or MBE 406.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 406. Tropical Marine Ecology: Sampling, Monitoring, and Restoration Methods. 4 Credit Hours.**

This course integrates lectures, discussions and authentic research on the ecology, conservation, and restoration of the three main tropical coastal ecosystems found in South Florida: Mangroves, Seagrasses, and Coral Reefs. This research intensive course focuses on the application of field sampling methods and integrate ecological theory to define the health and success of coastal ecosystems. This course is part of Saltwater Semester so that students can be actively involved in intensive research. As part of the Saltwater Semester, students are required to enroll in four of the 4-credit Saltwater Semester courses and one additional 1 credit professional development course (17 credits) where each course meets for 3 weeks at the Marine campus.

Prerequisite: MBE 230 or BIL 230 AND Corequisite: MBE 404, MBE 407, MBE 408, and MBE 409.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 407. Molecular Ecology and Physiology of Reef Coral Symbioses. 4 Credit Hours.**

Reef corals requires an intracellular symbiont to succeed. This course integrates lectures and molecular genetic research to quantify this symbiotic relationship. Students will be involved in research to define and quantify coral-symbionts interactions and how these interactions influences coral physiology and success. This course is part of Saltwater Semester so that students can be actively involved in intensive research. As part of the Saltwater Semester, students are required to enroll in four of the 4-credit Saltwater Semester courses and one additional 1 credit professional development course (17 credits) where each course meets for 3 weeks at the Marine campus.

Prerequisite: MBE 230 or BIL 230 AND Corequisite: MBE 404, MBE 406, MBE 408, and MBE 409.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 408. Climate Change: Limits of Marine invertebrate Adaptability. 4 Credit Hours.**

This course integrates lectures, discussions and authentic research on the effect of global climate change on the success of marine invertebrates. Students will be involved in research to understand how the predicted changes in the ocean environment (temperature, oxygen, and pH) affects the ability for marine organisms to acclimatize and adapt to these environments. This course is part of Saltwater Semester so that students can be actively involved in intensive research. As part of the Saltwater Semester, students are required to enroll in four of the 4-credit Saltwater Semester courses and one additional 1 credit professional development course (17 credits) where each course meets for 3 weeks at the Marine campus.

Prerequisite: MBE 230 or BIL 230 AND Corequisite: MBE 404, MBE 406, MBE 407, and MBE 409.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 409. Coral Immunology and Microbiology. 4 Credit Hours.**

This course integrates lectures, discussions and authentic research on coral immunology and microbiology for students to learn how the coral immune response and the coral associated microbes affect coral success. This research-intensive course integrates coral microbiome analysis with immunology assays to generate data on coral wellbeing. This course is part of Saltwater Semester so that students can be actively involved in intensive research. As part of the Saltwater Semester, students are required to enroll in four of the 4-credit Saltwater Semester courses (16 credits) where each course meets for 3 weeks at the Marine campus.

Prerequisite: MBE 230 Or BIL 230. And Corequisite: MBE 404, MBE 406, MBE 407, and MBE 408.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 410. Marine Conservation Science. 3 Credit Hours.**

Nature of marine biodiversity, what threatens it, and what can be done to recover the biological integrity of estuaries, coastal seas, and oceans. Topics include: distinctive aspects of marine populations and ecosystems; threats to marine biological diversity, singly and in combination; place-based management of marine ecosystems; and the human dimensions of marine conservation.

Junior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MBE 411. Research in Marine Biology and Ecology. 1-3 Credit Hours.**

Individual, independent research projects in Marine Biology and Ecology with faculty supervision. A formal written report is required after every semester. Each credit of research will correspond to a minimum of 3 hours of hands-on research experience per week. No more than 6 credits in total from ATM, GSC, MBE, or MSC 371, 411, and 412 can be counted towards the Rosenstiel School major or minor requirements with no more than 3 credits from each course.

Requisite: Junior or Senior Standing.

**Components:** THI.

**Grading:** CNC.

**Typically Offered:** Fall, Spring, & Summer.

**MBE 412. Undergraduate Thesis in Marine Biology and Ecology. 1 Credit Hour.**

Students will write a formal thesis summarizing the results of independent research carried out under faculty supervision. The thesis must be reviewed and approved by a committee. An approved public presentation of research findings (oral or poster presentation) is required at the end of the term. No more than 6 credits in total from ATM, GSC, MBE or MSC 371, 411, and 412 can be counted towards any of the Rosenstiel School major or minor requirements with no more than 3 credits from each course.

Pre-Requisite: ATM 411 or GSC 411 or MBE 411 or MSC 411, And Requisite: Senior Standing.

**Components:** THI.

**Grading:** GRD.

**Typically Offered:** Fall, Spring, & Summer.

**MBE 415. Coral Reef Science and Management. 3 Credit Hours.**

The interdisciplinary nature of coral reef science and management: biological, environmental, ecological and socioeconomic aspects of coral reef science, coral reef management problems and approaches at local to global scales, and the implications of climate change for coral reef science and management.

Prerequisite: MBE 230.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MBE 416. Marine Spatial Ecology. 3 Credit Hours.**

Overview of aims and methods used in marine spatial ecology, with emphasis on benthic and near-benthic organisms and assemblages, including fish.

Pre Requisite: MSC204 OR MTH224 AND Pre Requisite: BIL330 OR MBE306 OR MBE415 OR MSC422.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 426. Research in Microbial Genomics. 4 Credit Hours.**

This course integrates lecture and laboratory studies to focus on the structure, function, evolution, mapping and editing of microbial genomes belonging to the three domains of life; Archaea, Bacteria and Eukarya.

Prerequisites: BIL 150 and BIL 151 and BIL160 and BIL161 and BIL 250.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 432. Comparative Ecology of Terrestrial and Marine Systems. 3 Credit Hours.**

A comparison of various biotic and abiotic controls on terrestrial and marine ecosystems is undertaken. The course stresses proximate mechanisms and underlying evolutionary processes. Analysis methods and models of various ecosystems are compared and critiqued. Issues involved in sustainability and conservation of resources are discussed in relation to agriculture, fisheries and forestry. The importance of biodiversity and climate change in the future of ecosystems is stressed.

Prerequisite: MTH 162. And BIL 330. Or ECS 232.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring Odd Years.

**MBE 462. Marine Biomedicine. 3 Credit Hours.**

The course will cover diverse bioactive molecules that are derived from marine sources ranging from sponges to sharks. The isolation and characterization of these compounds as well as their potential application in clinical medicine and human health will be reviewed. The class will also cover marine-derived factors used in biotechnology and marine animal models used in biomedical research with an emphasis on marine immunology. Prerequisite: BIL 255 and CHM 121.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring Odd Years.

**MBE 463. Conservation Genomics. 4 Credit Hours.**

This course integrates lectures, discussions and research on genetics and genomics to understand population biology, conservation, and susceptibility of endangered species to extinction and the effect of invasive species on natural communities. This research intensive course sequences genomes and uses the data to better understand the health of species and ecological communities. This course is part of Saltwater Semester so that students can be actively involved in intensive research. As part of the Saltwater Semester, students are required to enroll in four of the 4-credit Saltwater Semester courses and one additional 1 credit professional development course (17 credits) where each course meets for 3 weeks at the Marine campus.

Prerequisite: MBE 230 or BIL 230 AND Corequisite: MBE 326, MBE 404, MBE 466, and MBE 467.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 464. Marine Comparative Immunology Lab. 1 Credit Hour.**

The laboratory course will cover immunology techniques used in the assessment of immune function and immune reactivity in diverse marine taxa from sponges to fish to mammals.

Prerequisite or Co-requisite: MBE 465.

**Components:** LAB.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 465. Marine Comparative Immunology. 3 Credit Hours.**

The course will cover immune function in diverse marine taxa from sponges to fish and the evolution of innate and adaptive immune mechanisms from a comparative point of view, with an emphasis on shark and fish immunology. Adaptations related to living in a microbe-rich marine environment will be highlighted. Potential applications of research findings will be addressed with respect to conservation and aquaculture. The role of invertebrate and vertebrate models in the study of the evolution of the immune system and applications for human health and medicine will be discussed.

Prerequisite: BIL 255.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall & Spring.

**MBE 466. Experimental Physiology. 4 Credit Hours.**

This course integrates lectures, discussions and research. Topics will include homeostasis, interactions with the external environment, and life with limited oxygen and water. Lectures will be highly discussion-based; students will be expected to read primary research articles as suggested by the professor before lecture to foster participation in those discussions and form hypotheses about accompanying laboratory. Each lab will be written up as a formal laboratory report (i.e., Introduction, Materials and Methods, Results and Discussion). This course is part of Saltwater Semester so that students can be actively involved in intensive research. As part of the Saltwater Semester, students are required to enroll in four of the 4-credit Saltwater Semester courses and one additional 1 credit professional development course (17 credits) where each course meets for 3 weeks at the Marine campus.

Prerequisite: MBE 230 or BIL 230 AND Corequisite: MBE 326, MBE 404, MBE 463, and MBE 467.

**Components:** HRK.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 467. Marine Animal Neurophysiology and Behavior. 4 Credit Hours.**

This course integrates lectures, discussions and research on neural and endocrine systems in marine animal models, and how these systems work together to control elements of physiology, sensation and perception of the environment and behavior. This course is part of Saltwater Semester so that students can be actively involved in intensive research. As part of the Saltwater Semester, students are required to enroll in four of the 4-credit Saltwater Semester courses and one additional 1 credit professional development course (17 credits) where each course meets for 3 weeks at the Marine campus.

Prerequisite: MBE 230 or BIL 230 AND Corequisite: MBE 326, MBE 404, MBE 463, and MBE 466.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 504. Biology of Marine Mammals. 3 Credit Hours.**

The purpose of this class is to introduce students to the biology, evolution, taxonomy, physiology, natural history, behavior, conservation, and management of marine mammals.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 505. Marine Mammal Disease and Medicine. 3 Credit Hours.**

This course will cover the basics (theory and application) of marine mammal disease and medicine. Applications will focus on the medical management of managed care and wild populations.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 506. Procedures in Marine Mammal Health and Disease. 1 Credit Hour.**

The aim of this course is to provide the student with more in-depth exposure and study of various practical health related techniques/skills that are integral to marine mammal health and disease assessment. While the procedures are most applicable to marine mammals in managed care, several of the procedures can be adapted and/or are used in study of wild marine mammals. Health and disease assessment procedures will be divided into the following five categories/areas: physical examination and behavioral assessment; multimodal and advanced diagnostics (eg., electrocardiogram, ultrasound, etc.); sample collection (types, procedures); clinical pathologic (eg., hematology, biochemistry, serology) interpretation; gross and histopathologic necropsy techniques and interpretation.

Enrollment Condition: Senior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 507. Marine Mammal Applied Behavior Analysis and Managed Care. 3 Credit Hours.**

This course involves a thorough examination of specific aspects of marine mammal managed care and conservation programs, with an emphasis on behavior management, analysis, and modification as a basis for adaptive response to changing environments both in-situ and ex-situ. Coursework will also focus on health management and assessment, emergency handling and transportation, government regulations, and wildlife conservation.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 514. Tropical Marine Biology. 3 Credit Hours.**

In this intensive one-week field course, students are introduced to the ecology, biology, and interconnections of all of South Florida's major marine habitats through a combination of lectures and field excursions from UM's remote private island research station in the Florida Keys.

Senior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring & Summer.

**MBE 515. Tropical Marine Ecology. 3 Credit Hours.**

Marine ecology with emphasis on tropical ecosystems and local habitats. Physical environmental and biotic adaptations, population, and community ecology are discussed. Field exercises in mangrove, sea grass, and coral reef ecosystems are also included.

Enrollment Condition: Senior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 518. Reef Coral Biology, Ecology, and Conservation. 3 Credit Hours.**

Scleractinian (stony) corals are the principal builders of contemporary coral reefs and their unique biology underpins the ecological success of reef ecosystems in the world's shallow tropical seas. This class covers the physiology and ecology of these critical organisms, the environmental factors governing their health, and their biotic interactions with other species. Examples of topics covered include algal symbiosis, calcification, reproduction, taxonomy, microbial ecology, competition with macroalgae, and herbivory, with insights at all levels from molecules to ecosystems. A special focus is on the decline of coral reefs due to anthropogenic stressors including climate change and coral bleaching, diseases, nutrient pollution, overfishing, and ocean acidification.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 521. Field Techniques and Instrumentation in Tropical Marine Ecology. 3 Credit Hours.**

This course covers the instrumentation and field techniques commonly used to characterize the structure and function of the three dominant ecosystems in the tropics and subtropics, i.e. coral reefs, seagrass beds and mangroves.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 522. Marine Microbial Dynamics. 3 Credit Hours.**

An overview of the function of microbes in the ocean from a chemical perspective, building a quantitative understanding of cellular needs and metabolic functions, and the role these microbial processes play in controlling chemical fluxes and biogeochemical cycles in the ocean.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 523. Marine Parasite Ecology. 3 Credit Hours.**

Parasites constitute the most common lifestyle among living organisms. They are found in nearly every Phylum and on or in nearly every living organism and in every ecosystem. Parasites range from microscopic single-cells to small sharks. Thus, an understanding of the ecology of parasites is essential for an understanding of ecology in general. This course focuses on the ecology of host-parasite interactions in the marine environment, with an emphasis on coral reef systems. It includes the role of parasites in diseases, food webs, host behavior, and species invasions. While it will include some single-celled parasites, the focus will be on multicellular macro parasites. The course meetings will be integrated lecture/lab and discussion and will include student presentations, guest presentations, and collection and examination of marine parasites.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 529. Population Genetics and Genomics. 3 Credit Hours.**

This course provides an introduction to population genetics, which examine the evolutionary processes that affect genomes of natural populations: mutation, genetic drift, natural selection, and gene flow.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 532. Marine Mammal Research Techniques. 3 Credit Hours.**

The goal of this course is to provide an overview of the field of marine mammal research (historic, current, and future), hands-on training in applied research skills relevant to the field of marine mammalogy, as well as an understanding of the biological and ecological significance of captive and wild research and contributions to management and conservation.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 535. Practical Computing for Biologists. 3 Credit Hours.**

Practical Computing for Biologists is a problem-centric course that provides resources for biologists to analyze the increasingly complex data sets generated by new technologies. Flexible, scalable tools will be covered to accomplish a diversity of tasks using open source software. Topics will include: regular expressions, command line operations, Python programming, and bioinformatics pipelines. Exercises relevant to the students' needs will be used to illustrate and develop new skills. After doing several assigned homework problems, students will have an opportunity to develop a bioinformatic analysis on their own data set.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 536. Scientific Programming and Simulation Modelling. 3 Credit Hours.**

Hands-on training in object-oriented programming using Java, including Java statistical packages, and in the development of agent-based and individual-based simulation models for ecological, physiological, social, economic, and physical sciences. Course includes introductions to cellular automata and models based on social and behavioral networks. No prior programming experience required.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 538. Tropical Marine Microbiomes. 3 Credit Hours.**

Ecosystem processes and organismal health depend on their interaction with microbial life, whether providing otherwise limiting nutrients or initiating dysbiosis. This course will review recent advancements in marine microbial ecology, the sampling and molecular methodologies employed, and will include hands-on training in common microbial bioinformatic analysis.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 539. Oceanic Productivity. 3 Credit Hours.**

History, methods, and current topics relevant to studies of marine primary production. Magnitude and fate of primary production in the sea is essential to understand secondary production, the success of fisheries recruitment, and global climate.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 542. Oceans and Human Health. 3 Credit Hours.**

The objective of this interdisciplinary course is to provide students with introductory knowledge of the broad and relatively young field of Oceans and Human Health. The focus is the present, future, and potential effects of oceanic processes and aquatic organisms on human health, and vice versa. These diverse factors reflect the physical, chemical, biotic and social processes which require an integration of information and knowledge from the medical, marine and social sciences. The course covers harmful algal blooms, marine microbes, and global climate change as well as an overview of coastal impacts and remedies (e.g. dredging from the sea and marine models) through a series of coordinated lectures and case studies on human health, physical environment, and oceanographic processes. Prerequisite: Permission of instructor.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 544. Tropical Coastal Restoration. 3 Credit Hours.**

This course provides an overview of the history of tropical coastal restoration, current restoration approaches, innovative techniques to enhance restoration in a changing environment, and the various metrics and monitoring methods to evaluate restoration success. Restoration fields covered include coral reef, artificial & hybrid reef, seagrass, sponge, mangrove, dune, historical, and biocultural restoration, along with marine debris removal. Students will have the opportunity to gain hands-on experience within these restoration fields through regular field trips. The ability to participate in strenuous fieldwork is required for enrollment.

Prerequisite: MBE 515 Or MBE 615.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 545. Microbial Ecology and Evolution. 4 Credit Hours.**

This course integrates lecture and laboratory studies to focus on the ecology and evolution of microbial organisms belonging to the three domains of life; Archaea, Bacteria and Eukarya. The laboratory component will have a focus on the analysis of the structure, function, evolution, mapping and editing of microbial genomes.

Prerequisite: BIL 150 and BIL 151 and BIL 160 and BIL 161 and BIL 250 and Requisite: Senior Status.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 548. Preparing Successful National Science Foundation GRFP Applications for Marine Scientists. 1 Credit Hour.**

The purpose of the course is to provide current graduate students and eligible undergraduate students in marine science with a research-based M.S. or Ph.D. with an opportunity to develop a fellowship grant application for the National Science Foundation Graduate Research Fellowship Program (NSF-GRFP).

Enrollment Condition: Senior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 550. Analytical Techniques in Marine Biology. 2 Credit Hours.**

Theory and applications of selected analytical techniques necessary to conduct quantitative research in marine biology (e.g., electrophoresis, metabolite assays, enzyme assays, radioisotope methodology). One hour lecture followed by three hour laboratory per week.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 551. Engaging the Arts in Science Communication. 1 Credit Hour.**

Modern education in science, technology, engineering, and mathematics (STEM) has left little place for the arts and humanities. Coincidentally, there is a large gap in scientific literacy between specialists and non-specialists. This interferes with the transmission of scientifically-generated knowledge to the broader society. Some members of the scientific community have recognized this problem, particularly in the context of failed attempts to motivate behavioral and policy changes that are deemed beneficial to society, and have recognized the power of the arts to motivate change. This has resulted in the re-emergence of art and science collaborations such as that between evolutionary biologist E.O. Wilson and actor Alan Alda, and the reintegration of arts in STEM education to create STEAM education. This seminar course explores the synergy between the arts and sciences. It particularly examines the role of arts and artists in improving communication of scientific research. Each semester the course is offered will focus on a specific topic within this broader theme.

**Components:** SEM.

**Grading:** GRD.

**Typically Offered:** Spring.

**MBE 570. Special Topics. 1-4 Credit Hours.**

Lectures, research projects or directed readings in special topics related to Marine Biology and Fisheries.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 571. Special Topics. 1-4 Credit Hours.**

Lectures, research projects or directed readings in special topics related to Marine Biology and Fisheries.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 572. Special Topics. 1-4 Credit Hours.**

Lectures, research projects or directed readings in special topics related to Marine Biology and Fisheries.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 574. Special Topics. 1-4 Credit Hours.**

Lectures, research projects or directed readings in special topics related to Marine Biology and Fisheries.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 576. Diseases of Marine Organisms. 3 Credit Hours.**

Infectious, genetic, and environmentally induced diseases of marine fishes and invertebrates as well as diagnostic methods, cellular, and molecular pathology. Lecture, 3 hours.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Offered by Announcement Only.

**MBE 578. Evolutionary Genetics. 3 Credit Hours.**

A Graduate course that presents and overview from "New Evolutionary Synthesis" (1900) to Evolutionary Genomics. The critical points to emphasize is the importance of standing genetic variation, the role of neutral evolutionary process versus evolution by natural selection and how a evolution perspective provides meaning insights into the biology.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Fall.

**MBE 586. Fish Physiology. 3 Credit Hours.**

Ecology, dispersal, and modes of life of fishes. Adaptations by larvae and adults to various habitats are covered as well as the effects of man on fish faunas and the importance of fishes to various ecological systems. Lecture, 3 hours.

Senior Standing.

**Components:** LEC.

**Grading:** GRD.

**Typically Offered:** Spring.