**MARINE, ESTUARINE, AND FRESHWATER BIOLOGY (MEFB)**

The marine, estuarine, and freshwater biology (MEFB) B.S. program is designed to provide a broad background for undergraduates interested in marine, estuarine, and freshwater biology, aquaculture, and fisheries. The program integrates theoretical and practical (hands-on laboratory and field) courses. Students are encouraged to become involved in one or more of the numerous undergraduate research opportunities available in the marine, estuarine, and freshwater sciences.

UNH is located on a seacoast that provides an extraordinary diversity of marine and estuarine habitats. It is also only a short distance from mountain streams, rivers, marshes, bogs, ponds, and lakes. All of the habitats provide outstanding resources for field courses and research. The marine, estuarine, and freshwater faculty are spread across all four departments of the College of Life Sciences and Agriculture. UNH is a Sea Grant university and has an international reputation for teaching and research in aquatic sciences. UNH has aquaculture facilities, and coastal and estuarine research laboratories. In collaboration with Cornell, UNH jointly administers the summer undergraduate programs at the Shoals Marine Laboratory on Appledore Island, seven miles off the coast of New Hampshire and Maine.

https://colsa.unh.edu/biological-sciences

### Programs


### Courses

**Marine Estuarine and Freshwater Biology (MEFB)**

**MEFB 401 - Marine Estuarine and Freshwater Biology: Freshmen Seminar**

**Credits:** 1

The purpose of this course is threefold: First to acquaint freshmen MEFB majors to the wide range of topics that are included in the broad area of marine, estuarine and freshwater biology. Second, to introduce new UNH students to many of the MEFB faculty at UNH and give them the opportunity to become aware of the types of research that is being conducted at UNH. Finally, to begin teaching freshmen how to read the primary literature, write concise summaries of papers they read, give oral presentations to their peers, and understand how scientific knowledge is acquired and disseminated. Students attend a series of seminars presented by a wide range of MEFB faculty. The topics presented vary from year to year depending on the faculty that agree to participate. In addition students are required to read the current literature, write short papers and give presentations to the class. Cr/F.

**MEFB 403 - Investigative Marine Biology Laboratory**

**Credits:** 2-4

This course in an intensive marine-based introduction to the scientific method and experimental biology taught a Shoals Marine Laboratory. The course takes advantage of the unique learning opportunities afforded by the pristine marine environment (especially the intertidal) around Appledore Island. The overall course philosophy is to allow students to learn the scientific method by doing it themselves under the guidance of veteran marine biologists. The course is structured around two class projects that are designed to expose students to concepts and techniques in marine ecophysiology and biomechanics. Permission required. Special fee.

**MEFB 410 - Marine Immersion**

**Credits:** 2

An intensive 2-credit course for incoming freshmen, surveying a range of marine-related fields (with an emphasis on biology and ecology), research approaches, and organisms. The course is based at the Shoals Marine Laboratory on Appledore Island, where students, and some faculty, will be in residence. "Marine Immersion" introduces students to the breadth, excitement, and challenges of marine sciences through lectures, demonstrations, and field experiences offered by a cohort of UNH faculty, and through short research projects carried out on the island. It also introduces them to resources and opportunities available at UNH, provides an opportunity to get to know some of their professors, and lets them build a network among their peers even before they arrive in Durham. Special fee.

**MEFB 500 - Coastal Habitat Field Research Methods**

**Credits:** 4

This two-week intensive field based course is intended for students who wish to explore and gain proficiency in various research and assessment methods of terrestrial and aquatic plant communities of the Isles of Shoals and nearby coastal habitats of the Seacoast and Great Bay Estuary. Topics covered will include quantitative surveys methods, GIS based an aerial (UAV) mapping of plant communities, taxonomy and systematics of major vascular taxa, island biogeography, rare species ecology and conservation, and the management of invasive species. Through both field and classroom exercises, we will use a variety of sampling protocols to document the existing plant communities, contribute to ongoing plant community studies, investigate the floristic changes that the Isles of Shoals have experienced from past to present, and use these data to predict trends into the future to help preserve their unique flora. Student will use skills developed in class to design and implement brief field research project in a related topic of their choice. Prereq: BIOL 411 or BIOL 412. Permission required. Special fee.

**MEFB 503 - Introduction to Marine Biology**

**Credits:** 4

Emphasizes the organization of marine biological communities. Various marine environments pelagic, benthic, temperate, tropical, and their characteristic communities. Major emphasis on the approaches (e.g., analysis of energy flow and predator-prey interactions) used to analyze marine communities as well as the sampling techniques employed for each approach and the characteristic habitat type. Prereq: BIOL 411 and BIOL 412. Special fee.
MEFB 504 - Field Wildlife Forensics  
Credits: 2  
Introduction to forensic science and the utilization of marine biology within the justice system. Comprehensive instruction concerning the recognition, documentation, collection, and preservation of physical evidence. Students develop practical incident response, scene management, and forensic teamwork skills. Prereq: BIOL 411 or BIOL 412. Special fee. Permission required.

MEFB 505 - Introduction to Applied Science Communication  
Credits: 4  
In this course students develop the capacity to solve increasingly challenging problems with greater independence. Students fill their science communication "tool box," learning how to engage a nonscientist audience. They will be introduced to video production, podcasts, Wikipedia editing, public science events, social media platforms, blogging and press release writing. After gaining basic skills with these communication platforms and tools, students will apply their skills to a topic of their own research interest on the island. Students will actively participate in a local public science event (Rock talks) and learn how to start a science cafe on their own. Students will receive feedback from their peers and their instructors, and by the end of this course they will become more effective science communicators. Skills gained in this course in this unique environment can be applied to any research field and are essential for every scientist. Prereq: BIOL 411, BIOL 412.

MEFB 506 - Marine Parasitology and Disease  
Credits: 2  
This course will focus on one of the most diverse and fascinating groups of marine organisms: parasites. The course will explore marine parasites and pathogens at multiple levels, including: (1) the evolutionary perspective with an emphasis on coevolutionary relationships; (2) parasitic diseases and life cycles (from simple to complex); (3) taxonomic and phylogenetic understanding of parasite and host groups (with a focus on metazoan parasites and hosts); (4) ecological implications of parasitism in marine systems at the population, community, and ecosystem levels; and (5) the effects of human induced global change on parasitism in marine communities. Prereq: Biol 411, BIOL 412.

MEFB 507 - Examining Marine Climate Changes on Appledore Island, ME  
Credits: 2  
Marine climatic changes will severely impact ocean-based ecosystems, coastlines, and human communities. Hands-on inquiry research in this course at the Shoals Marine Laboratory located on Appledore Island, ME will involve students in examining alterations to the marine environment due to global climatic changes. Students will use the Columbia University-National Aeronautics and Space Administration (NASA) Goddard Institute for Space Studies (GISS) Educational Global Climate Model (EdGCM) and smartphone applications to envision future shorelines. Guest lectures and fieldwork will be led by marine and climate scientists from University of New Hampshire and the Woods Hole Oceanographic Institution and involve examination of changes to the littoral zone, Gulf of Maine, and the world's oceans more broadly. Topics covered in this one-week field course include: Examining the evidence that the Earth's climate is changing, the greenhouse effect and natural forcings on global climate, climate change and sea-level rise, sea-levels and coasts of the geologic past, alterations to ocean chemistry and temperature, marine ecological impacts, human coastal impacts, and possible policy solutions. This course is targeted toward early and mid-career students with backgrounds in Earth and environmental science, marine science, or environmental policy. Prereq: BIOL 411, BIOL 412.

MEFB 510 - Field Ornithology  
Credits: 4  
Introduces field ornithology focusing on the biology, ecology, and behavior of avifauna on the Isles of Shoals. Includes such ornithological field methods as censusing techniques, territory mapping, banding, behavioral observation, and creating a field notebook. Fieldwork is designed to supplement many classroom concepts, including territoriality, breeding biology, and survivorship. Prereq: one year of college-level biology. Lab. (Summers only at Shoals Marine Lab.) Special fee. Permission required.

MEFB 515 - Marine Environmental Science and Conservation  
Credits: 4  
Focuses on the major principles of conservation biology and methods to bring human communities into a better relationship with natural resources: Coastal ecosystem processes; coastal biodiversity; threats to coastal ecosystems; species conservation; conserving ecosystem function and services. Projects: construct management goals/actions for local land owners. Prereq: BIOL 411 or BIOL 412. Special fee. Permission required.

MEFB 525 - Introduction to Aquatic Botany  
Credits: 4  
This team-taught course introduces students to microalgae, seaweeds, and vascular aquatic plants with an emphasis on unique habitats and plant adaptations to the aquatic environment. Students survey the diversity of algae and aquatic plants spanning fresh, estuarine, and marine habitats through a combination of lecture, field, and laboratory exercises. Special fee.

MEFB 527 - Aquatic Animal Diversity  
Credits: 4  
Provides a survey of aquatic animal groups from the simplest multicellular forms to birds and mammals. The emphasis is on comparing the basic functional systems (i.e., skeletal, digestive, reproductive, etc.) between groups and to illustrate how they change with increasing complexity and to describe adaptations to freshwater, estuarine and marine environments and the roles the groups play in aquatic communities. Special fee.

MEFB 530 - Evolution and Marine Diversity  
Credits: 4  
Patterns of diversity and processes of evolution. Topics include the diversity of life, the fossil record, macro-evolutionary patterns, the genetics and developmental basis of evolutionary change, processes at the population level, evolution by natural selection, modes of speciation, long-term trends in evolution, and human evolution. Prereq: BIOL 411 or BIOL 412. Special fee. Permission required.

MEFB 535 - Marine Mammal Biology  
Credits: 4  
This course explores the biology and conservation of the whales and seals, with a particular focus on species of the Gulf of Maine. Lectures examine many facets of marine mammal science including: taxonomy and species diversity, morphological and physiological adaptations for life in the sea, foraging ecology and behavior, reproductive cycles, bioacoustics, anthropogenic interactions, and management of threatened species. Land and open water observations of whale and seal behavior give students hands on opportunities to study marine mammals in the field. Prereq: BIOL 411 or BIOL 412. Special fee. Permission required.
MEFB 540 - Introductory Field Oceanography
Credits: 2 or 4
Over 70% of the earth's surface is covered by oceans. Students in this course will gain familiarity with the basic concepts and field techniques (and equipment) used by biological oceanographers as we explore the Gulf of Maine waters using the Isles of Shoals as our base. Minimal lecture time, maximum boat time is the theme of this field immersion course. Special fee. Prereq: BIOL 411 or BIOL 412. Permission required.

MEFB 609 - Biology of the Lobster
Credits: 3
An introduction to the biology of the American lobster, Homarus americanus. The course includes an overview of this ecologically and economically important species, and covers several major topics in depth, each taught by a lobster biologist expert in that field. Topics may include life history, larval development and metamorphosis, anatomy, physiological adaptation, fisheries and fishing methods, feeding mechanisms, ecology, and behavior. Lecture, laboratory, discussion, and field work. Special fee. (Summers only at Shoals Marine Lab.) Prereq: one year college level biology.

MEFB 615 - Field and Experiment Oceanography
Credits: 3
Intended for mid-upper division undergrads, this course provides a foundation in oceanography (the four oceanographic disciplines: geological, chemical, physical, and biological) applied in experimental and field settings. Includes two oceanographic trips in the Gulf of Maine. Student groups develop a small oceanographic project while on Appledore Island, carry it out, and present their study to the Shoals academic community. The course integrates investigative, practical, and theoretical aspects of oceanography. Prereq: one term college biology or permission. Special fee.

MEFB 616 - Tropical Coastal Plant Ecology
Credits: 4
A field-based course taught on location in Grenada, West Indies, providing an introduction to the physical, chemical and biological processes that form and sustain tropical coastal plant communities with an emphasis on mangroves and seagrasses. Plant adaptations to various environmental stresses will be examined over a range of habitats spanning a gradient of salinity from fresh to saline environments. As a dynamic ecosystem affected by both natural and anthropogenic disturbances from hurricanes to large-scale development, major environmental impacts and pressures will be examined first hand, and conservation and management actions will be discussed. A variety of on-going, community-based coastal habitat restoration and ecological monitoring sites will be visited throughout Grenada. Student participation in management actions will be encouraged through interaction with students from St. Georges University, local volunteers, and representatives from governmental environmental agencies and local non-governmental organizations. The course material is relatively specialized and is appropriate for juniors and seniors with interest/background in botany, coastal ecology and restoration, and conservation. Prereq: BIOL 411 and BIOL 412.
Co-requisite: INCO 589

MEFB 625 - Introduction to Marine Botany
Credits: 4
Life history, classification, and ecology of micro- and macroscopic marine plants, including phytoplankton, seaweed, and salt marsh plants, and the interactions between humans and marine plant communities. Occasional Saturday morning field trips. Prereq: BIOL 412 or PBIO 412 or permission. Special fee. Lab.

MEFB 630 - Biodiversity and Biology of Marine Invertebrates
Credits: 4
An introduction to the biology and evolution of the major invertebrate phyla, concentrating on marine representatives. Emphasis placed on the evolution of form and function, and the ecology, behavior, physiology, chemical ecology, and natural history of invertebrates. Appledore Island's unique location provides an excellent venue for the study of freshly collected and in situ representatives of most of the major phyla. Special fee. (Summers only at Shoals Marine Lab.) Prereq: one year college level biology. Permission required.

MEFB 631 - Ecotoxicology and Quantitative Reasoning
Credits: 4
An introduction to the field of ecotoxicology through hands-on laboratory research on the impact of biotoxins on wildlife, humans and ecosystems. Focus of the course is on development of the students ability to design and carry out actual research projects using modern technique in this field. Concepts and application of quantitative thinking and biostatistics are integrated throughout the course. Results are communicated through oral and written reports, publications and posters. Pre- or Co-reqs: BIOL 411, BIOL 412, CHEM 403, CHEM 404.

MEFB 674 - Ecology and Marine Environment
Credits: 4
Introduces the marine sciences with an emphasis on field work in natural habitats. Examines aspects of the systematics, morphology, physiology, behavior, and ecology of marine organisms, including intertidal plants and invertebrates, fishes, marine mammals and birds; fisheries biology; oceanography, marine geology; and human impacts on the marine environment. Sessions include lectures, discussions, field work, experience aboard a coastal research vessel, and excursions to distinctive habitats. Offered in cooperation with Cornell University. Students may not take Field Marine Science after taking Field Marine Biology and Ecology. Prereq: one full year of college-level biology or permission. Special fee. (Summers only at Shoals Marine Lab.) Permission required.

MEFB 702 - Sustainable Marine Fisheries
Credits: 4
An intensive course for undergraduate students that introduces students to the complex challenges facing today's fishing industry, which is being asked to simultaneously sustain the livelihood of fishermen while meeting long-term conservation goals. The course is held both at the UNH Campus and at the Shoals Marine Laboratory. New England fisheries are used as a case-study for this course through global fishing management, trends, and issues are also discussed. Special fee. Permission required.

MEFB 714 - Field Animal Behavior
Credits: 4
An animal's behavioral patterns represent its abilities to deal with the environment dynamically. Course focuses on ecological and evolutionary significance of behavioral patterns found in all organisms, particularly those animals that inhabit coastal marine environments. Strong emphasis on methods of behavioral research and interpretation of behavioral patterns using field observations of diverse fauna of Appledore Island and surrounding waters. Prereq: BIOL 412 or PBIO 412 or permission. Special fee. (Summers only at Shoals Marine Lab.) Permission required.
MEFB 717 - Lake Ecology  
Credits: 4  
Introduces the ecology of freshwater systems with emphasis on lakes. Origins of lakes and the effects of watersheds on lake chemistry and nutrient cycling are explored. Other topics include the impact of human disturbances on productivity and aquatic food webs and methods used for the management and restoration of lakes. Comparisons are made of the structure and functions of lake ecosystems found in temperate, tropical, and arctic regions. Prereq: general biology. 

MEFB 719 - Field Studies in Lake Ecology  
Credits: 4  
Ecology of lakes and other freshwater habitats examined through field studies. Emphasizes modern methods for studying lakes; analysis and interpretation of data; and writing of scientific papers. Seminars on research papers and student presentations of class studies. Field trips to a variety of lakes, from the coastal plain to White Mountains; investigate problems, such as eutrophication, acidification, biodiversity and biotoxins. Capstone experiences include interaction with state agencies, lake stakeholders and the submission of written manuscripts for publication. Prereq: introductory biology. Special fee. Writing intensive. 

Attributes: Writing Intensive Course

MEFB 722 - Marine Phycology  
Credits: 4  
Identification, classification, ecology, and life histories of the major groups of marine algae, particularly the benthonic marine algae of New England. Periodic field trips. Prereq: BIOL 412 or BIOL 703. Lab. (Offered alternate years.) Special fee. 

MEFB 725 - Marine Ecology  
Credits: 4  
Marine environment and its biota, emphasizing intertidal and estuarine habitats. Includes field, laboratory excercises, and independent research project. Prereq: general ecology; permission. Marine invertebrate zoology, oceanography, and statistics are desirable. Special fee. (Offered alternate years.) 

MEFB 727 - Algal Physiology  
Credits: 3  
Survey of major topics in the physiology and biochemistry of marine and freshwater algae including: nutrition, metabolic pathways, reproductive physiology, storage and extracellular products, cell inclusions, growth and development. Prereq: plant physiology or introductory biochemistry or permission. (Not offered every year.) 

MEFB 730 - Underwater Research  
Credits: 4  
Hypothesis testing and experimental design, theoretical and practical aspects of sampling, and critiques of current research papers. Includes special problems of conducting research underwater (diving physics and physiology, theory and use of diving tables, hyperbaric medicine) and underwater techniques (underwater photography and video, photo quadrates, tagging and marking, cages and enclosures). Students must supply their own equipment. Students with special research interests are encouraged to enroll in an additional third week of independent underwater research. Prereq: recognized scuba certification, a medical examination, one year of biology or other supporting science. (Summers only at Shoals Marine Lab.) Special fee. Permission required. 

MEFB 732 - Lake Management  
Credits: 4  
Lectures and seminars on interpreting lake water quality, developing a natural history inventory for lakes, the process of creating a lake management plan, and resolution of conflicting uses of lakes. Students develop lake management plans in cooperation with governmental agencies and lake associations. Guest speakers from state agencies and non-governmental organizations. Introduces use of GIS (Geographic Information Systems) methods for the analysis of lakes and watersheds. Presents lake management issues from scientific and social science points of view. Open to students from all disciplines. (Also offered as ZOOL 732.) Special fee. Lab. 

MEFB 734 - Diversity of Fishes  
Credits: 3  
Emphasizes the diversity of fishes in two aspects: diversity of evolutionary solutions to problems faced by fishes and the great diversity of different types of fishes that inhabit the world. Prereq: one full year of college level biology; background in vertebrate biology is recommended, but not required. Special fee. (Summers only at Shoals Marine Lab.) 

MEFB 741 - Sharks: Biology and Conservation  
Credits: 4  
The last 30 years have produced an explosion of new information on the biology of the approximately 1,000 living species of sharks, skates, rays, and chimaeras, which collectively make up the group Chondrichthyes. This course will cover advanced topics in the evolution, diversity, anatomy, functional morphology, physiology, sensory systems, behavior, reproduction, development, and conservation of cartilaginous fishes. Prereq: BIOL 411, BIOL 412; ZOOL 518 or ZOOL 625. 

MEFB 747 - Aquatic Plants in Restoration/Management  
Credits: 4  
A field-intensive class focusing upon freshwater and marine vascular plants with an emphasis on species commonly associated with ecological restoration, the identification and conservation of rare species, and the adaptations and management of invasive species of aquatic habitats in New England. Field trips emphasize the flora of various wetland habitats, including open water and vegetated fresh water wetlands, as well as coastal and estuarine habitats. Lectures and readings examine the current trends in research and management focusing upon specific taxa and pertinent facets of their taxonomy, physiology, and natural history. Prereq: PBIO 566 or permission. Special fee. 

MEFB 750 - Marine Ecological Genomics  
Credits: 4  
This course combines fieldwork for sample collection with extensive training in marine genomics research approaches including next generation sequence analysis, phylogenomics, differential gene expression and population genomics. Prereq: BIOL 411 and BIOL 412. Special fee. 

MEFB 751 - Research in Marine Biology  
Credits: 4  
Introduces the adaptations of organisms to marine environments and the role these adaptations have in structuring marine communities using an experimental approach. Emphasizes experimental design, implementation, data analysis, and scientific presentations. Prereq: one year of college-level biology or permission. Additional experience in biology, ecology or physiology is recommended. Prereq: BIOL 411, BIOL 412. Special fee. (Summers only at Marine Lab.)
MEFB 754 - Anatomy and Function of Marine Vertebrates
Credits: 4
The course is designed to introduce students to a comparative study of the principal organ systems of vertebrates (i.e., fishes, sea turtles, marine birds, marine mammals) that are specifically adapted to the marine environment. Rather than focusing only on description of anatomical structure, the anatomy of structures are investigated with function, biological role, and evolutionary relationships. Laboratory exercises cover osteology, dissection, behavior and biomechanics. Special fee. (Summers only at Shoals Marine Lab.) Prereq: one year college biology/or permission. Permission required.

MEFB 795 - Investigations in Marine, Estuarine, Freshwater Biology
Credits: 1-4
This course provides a mentored independent research opportunity for highly motivated undergraduate students to explore data and/or research interests with a faculty member. Research goals must be articulated by the student and approved by faculty prior to enrollment. Through weekly meetings faculty and subsequent independent work/study, successful students will engage in related activities that may include one or more of the following: conduct intensive literature review, conduct hands-on lab or work approved by the faculty mentor. Students will be required to complete weekly progress reporting and a final written report, formal presentation (such as a poster or talk for a professional conference or UNH Undergraduate Research Conference), or a draft manuscript for publication.

Faculty

https://colsa.unh.edu/biological-sciences/people