

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

- Marine, Estuarine and Freshwater Biology Major (B.S.)
- Marine Biology Minor

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.

Grade Mode: Credit/Fail Grading

MEFB 403 - Investigative Marine Biology Laboratory

Credits: 2-4

This course is an intensive marine-based introduction to the scientific method and experimental biology taught at the 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. (Summers only at Shoals Marine Lab.)

Grade Mode: Letter Grading

Special Fee: Yes

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 begin building a network among their peers even before they arrive in Durham. (Summers only at Shoals Marine Lab.)

Equivalent(s): ZOOL 410

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 460 - Biological Illustration

Credits: 4

In this course, students build a foundation of skills needed for biological illustration using the many visual opportunities that Appledore Island offers for natural science subjects. Lectures and demos introduce each of five projects using a variety of media including graphite and graphite dust, pen & ink, watercolor, and colored pencil. Basic standards needed in the creation of professional work are covered, include observational drawing, attention to detail and accuracy, composition, color, tonal values, and perspective. The class will visit many locations on the island for inspiration and visual reference. Students will create a final project demonstrating skills they have developed with one of the media covered in the course. (Summers only at Shoals Marine Lab.)

Equivalent(s): ZOOL 460

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 503 - Introduction to Marine Biology

Credits: 3

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.

Prerequisite(s): (BIOL 411 with a minimum grade of D- or BIOL 411H with a minimum grade of D- or BIOL 413 with a minimum grade of D-) and (BIOL 412 with a minimum grade of D- or BIOL 412H with a minimum grade of D- or BIOL 414 with a minimum grade of D-).

Grade Mode: Letter Grading

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. (Summers only at Shoals Marine Lab.)

Prerequisite(s): BIOL 411 with a minimum grade of D- and BIOL 412 with a minimum grade of D-.

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 506 - Marine Parasitology and Disease**Credits:** 4

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. (Summers only at Shoals Marine Lab.)

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 508 - Marine Ecosystem Research and Management**Credits:** 4

This course challenges students with real-world problems in the Gulf of Maine related to ecosystem research and management. Students learn the tools to conduct field and laboratory research and how to apply these tools in a real-world conservation management problem. Students work in small groups to design and implement and short research project. Results are presented to local and regional conservation practitioners in the Gulf of Maine. One semester of college biology should be taken prior to this course.

Grade Mode: Letter Grading

Special Fee: Yes

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. One year of college level biology required. Lab. (Summers only at Shoals Marine Lab.)

Equivalent(s): ZOOL 510

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 530 - Evolution and Marine Diversity**Credits:** 5

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. (Summers only at Shoals Marine Lab.)

Grade Mode: Letter Grading

Special Fee: Yes

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. (Summers only at Shoals Marine Lab.)

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 545 - Field Bioacoustics and Soundscape Ecology**Credits:** 4

In this course students will gain hands-on introductory experience in bioacoustics and soundscape ecology research, including biological concepts behind animals' sound production and hearing, skills for deploying acoustic sensors in terrestrial and underwater habitats, and acoustic data analysis methods. The course will consist of several lectures covering fundamental concepts in acoustics, soundscapes, and digital sound signal processing. The majority of class time will be spent deploying and recovering acoustic sensors and conducting experiments in the field, as well as in computer-lab sessions to analyze and summarize collected data. We will primarily focus on "Passive Acoustic Monitoring (PAM)" which involves non-invasive recording of sounds present in an environment (i.e., soundscapes) with microphones (when deployed on land) or hydrophones (when deployed underwater). Gulls and other seabird residents of the Isles of Shoals will be the main focal animals for terrestrial field work, and opportunistic recordings may be made of other vocalizing animal inhabitants including mammals, fishes, and invertebrates. Students will further learn how to study the contributions of anthropogenic sounds (i.e., from human-made sources) to natural soundscapes. Students will also conduct field-based acoustic playback experiments to study how different properties of gull vocalizations influence gull behavior.

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 590 - Coastlines in Crisis**Credits:** 4

Pairing students from coastal geographies through synchronous online and in-person lecture, we'll explore trends threatening resilience of our coasts and their inhabitants. The science and public perception of coastal threats, sea level rise, and climate related issues will build a baseline for understanding the issues coastal communities face, including contributing factors, and the role of science, technology, and environmental policy in the delicate balancing act between nature and infrastructure.

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 625 - Introduction to Marine Botany**Credits:** 5

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. Lab. Offered alternating years only.

Prerequisite(s): BIOL 412 with a minimum grade of D- or BIOL 412H with a minimum grade of D- or BIOL 414 with a minimum grade of D- or BIOL 409 with a minimum grade of D-.

Equivalent(s): PBIO 625**Grade Mode:** Letter Grading**Special Fee:** Yes**MEFB 628 - Marine Invertebrate Evolution and Ecology****Credits:** 4

Stresses the rich diversity of marine invertebrates by integrating phylogenetic trends with physiological and behavioral adaptation, and with ecological and symbiotic interactions. Offers a comparative survey of invertebrates from protozoans to protochordates; deals with aspects of form and function, development, evolution, classification, ecology, and natural history. Students work with live and preserved animals. Extensive dissections and a field component are required.

Prerequisite(s): (BIOL 411 with a minimum grade of D- or BIOL 411H with a minimum grade of D- or BIOL 413 with a minimum grade of D-) and (BIOL 412 with a minimum grade of D- or BIOL 412H with a minimum grade of D- or BIOL 414 with a minimum grade of D-).

Grade Mode: Letter Grading**Special Fee:** Yes**MEFB 633 - Quantitative Reasoning and Analysis for Marine Sciences****Credits:** 4

Expand your statistical knowledge and resume by learning R. Use project-based learning to explore marine mammal populations, intertidal systems, and fisheries while learning statistical skills and R. In this course students will learn to become proficient in R (data manipulation, graphing, hypothesis testing, importing and cleaning data) and learn to effectively communicate statistical results. (Summers only at Shoals Marine Lab.)

Mutual Exclusion: No credit for students who have taken BIOL 633.

Grade Mode: Letter Grading**Special Fee:** Yes**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. One year of college level biology required. (Summers only at Shoals Marine Lab.)

Equivalent(s): ZOOL 674, ZOOL 675**Grade Mode:** Letter Grading**Special Fee:** Yes**MEFB 675 - Marine Mammal Biology and Conservation****Credits:** 3

This course is designed to be a detailed investigation into the biology of cetaceans, pinnipeds, and other marine mammals. In this course we will learn about the evolution of marine mammals, general adaptations to a marine existence, morphology, systematics and biogeography, reproduction, diving physiology, communication and echolocation, feeding and migratory behavior, and marine mammal/human interactions. The course will include a survey of major conservation concerns and potential management solutions, as well as a unit on cultural competencies and the historic relationship between humans and marine mammals.

Prerequisite(s): BIOL 412 with a minimum grade of D- or BIOL 412H with a minimum grade of D- or BIOL 414 with a minimum grade of D-.

Equivalent(s): MEFB 535**Grade Mode:** Letter Grading**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. (Summers only at Shoals Marine Lab.)

Grade Mode: Letter Grading**Special Fee:** Yes**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. One year of college level biology required. (Summers only at Shoals Marine Lab.)

Equivalent(s): ZOOL 714**Grade Mode:** Letter Grading**Special Fee:** Yes**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. General biology required prior to taking this course.

Equivalent(s): BOT 717, PBIO 717, ZOOL 717**Grade Mode:** Letter Grading

MEFB 719W - 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. Introductory Biology required prior to taking this one.

Attributes: Writing Intensive Course**Equivalent(s):** MEFB 719, PBIO 719, ZOO 719**Grade Mode:** Letter Grading**Special Fee:** Yes**MEFB 720 - Marine Invasive Species: Ecology, Evolution and Management****Credits:** 4

This course explores the spread, establishment, and impact of invasive species. Students will become familiar with ecological and evolutionary theories pertaining to species invasions, and methods for assessing their spread and impact at local and global scales. The course examines: (1) ecological impacts and predictors of invasive species; (2) evolutionary insights of invasions; (3) taxonomic identification and survey techniques; (4) management implications of invasive species; and (5) the effects of global change on their spread. One semester of college biology or equivalent should be taken prior to this course. Summers only at Shoals Marine Lab.

Grade Mode: Letter Grading**Special Fee:** Yes**MEFB 725 - Marine Ecology****Credits:** 3

This course is an exploration of marine ecology principles. Students will engage in field-based research projects to investigate ecological processes in marine environments. Emphasis will be placed on the structure and function of temperate rocky intertidal systems, the drivers of ecological change, statistical analysis of ecological data, and the influence of human activities on marine benthic systems. Key topics include recruitment ecology, physiological stress, competition, disturbance, trophic ecology, facilitation, and positive interactions.

Prerequisite(s): (BIOL 412 with a minimum grade of D- or BIOL 412H with a minimum grade of D-) and MEFB 503 with a minimum grade of D-.**Grade Mode:** Letter Grading**Special Fee:** Yes**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. Required prior to taking this course: recognized scuba certification, a medical examination, one year of biology or other supporting science. (Summers only at Shoals Marine Lab.)

Equivalent(s): KIN 730, MARI 730, ZOO 730**Grade Mode:** Letter Grading**Special Fee:** Yes**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. (Summers only at Shoals Marine Lab.)

Grade Mode: Letter Grading**Special Fee:** Yes**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. Offered alternating years only.

Equivalent(s): BOT 747, PBIO 747**Grade Mode:** Letter Grading**Special Fee:** Yes**MEFB 751 - Research in Biology at the Shoals Marine Lab****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. (Summers only at Shoals Marine Lab.)

Equivalent(s): ZOO 751**Grade Mode:** Letter Grading**Special Fee:** Yes**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. One year of college biology required prior to taking this course. (Summers only at Shoals Marine Lab.)

Equivalent(s): ZOO 753, ZOO 754**Grade Mode:** Letter Grading**Special Fee:** Yes

MEFB 755 - Biological Oceanography**Credits:** 3

Biological processes of the oceans, including primary and secondary production, trophodynamics, plankton diversity, zooplankton ecology, ecosystems and global ocean dynamics.

Prerequisite(s): (BIOL 411 with a minimum grade of D- or BIOL 411H with a minimum grade of D- or BIOL 413 with a minimum grade of D-) and (BIOL 412 with a minimum grade of D- or BIOL 412H with a minimum grade of D- or BIOL 414 with a minimum grade of D-).

Equivalent(s): ESCI 750, ZOO 750

Grade Mode: Letter Grading

MEFB 772 - Fisheries Biology: Conservation and Management**Credits:** 4

Globally, many fished populations are declining, but 3.2 billion people eat fish and the average human eats >40 pounds of fish a year. This course identifies what biological characteristics are important to management and how they are measured. The course also explores quantitative methods describing fishery-population interactions and other management tools. Lastly, students will learn about the impacts of fishing on ecosystems.

Prerequisite(s): BIOL 411 with a minimum grade of D- and BIOL 412 with a minimum grade of D-.

Equivalent(s): ZOO 772

Grade Mode: Letter Grading

MEFB 773 - Physiology of Fishes**Credits:** 4

Investigates the physiological processes responsible for maintaining homeostasis in fishes. Focuses on the function and regulation of the major organ systems during stress and environmental adaptation. Topics include reproduction, osmoregulation, digestion, endocrinology, and sensory perception.

Grade Mode: Letter Grading

MEFB 795 - Independent Investigations in Marine, Estuarine, and Freshwater Biology**Credits:** 1-4

Independent study in a topic related to Marine, Estuarine, or Freshwater Biology, arranged by the student with a faculty sponsor. Enrollment by permission only.

Repeat Rule: May be repeated for a maximum of 8 credits. May be repeated up to 5 times.

Grade Mode: Letter Grading

MEFB 796 - Shoals Undergraduate Research**Credits:** 1

This course is for students who are participating in the Shoals Undergraduate Research Group and conducting independent research at the Isles of Shoals arranged by the student with a faculty sponsor. This course emphasizes hypothesis design, experimental design, implementation, data analysis, and scientific presentations. One year of college-level biology required prior to taking this course. (Summers only at Shoals Marine Lab.)

Repeat Rule: May be repeated for a maximum of 3 credits. May be repeated up to 3 times.

Grade Mode: Letter Grading

MEFB 799H - Honors Senior Thesis in Marine, Estuarine, and Freshwater Biology**Credits:** 2-4

Independent research requiring a written proposal, a thesis, and a final public presentation (e.g. the Undergraduate Research Conference). Intended for MEFB majors completing Honors-in-major requirements. Contact MEFB program coordinator prior to senior year to arrange supervision and obtain permission. Two consecutive semesters. (4 credit minimum total; 8 credits maximum).

Attributes: Honors course

Repeat Rule: May be repeated for a maximum of 8 credits.

Grade Mode: Letter Grading

Faculty

[MEFB Program Faculty](#)