

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 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. (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 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. (Summers only at Shoals Marine Lab.)

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

Grade Mode: Letter Grading

Special Fee: Yes

MEFB 503 - Introduction to Marine Biology**Credits:** 0 or 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.

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

Equivalent(s): BOT 503, PBIO 503, ZOOL 503

Grade Mode: Letter Grading

Special Fee: Yes

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. (Summers only at Shoals Marine Lab.)

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

Grade Mode: Letter Grading

Special Fee: Yes

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.)

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 #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. (Summers only at Marine Shoals 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 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 censuring 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:** 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. (Summers only at Shoals Marine Lab.)

Prerequisite(s): BIOL 411 with a minimum grade of D- or BIOL 412 with a minimum grade of D-.**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, bio-acoustics, 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.)

Prerequisite(s): BIOL 411 with a minimum grade of D- or BIOL 412 with a minimum grade of D-.**Grade Mode:** Letter Grading**Special Fee:** Yes**MEFB 600 - Field Experience in Marine, Estuarine, and Freshwater Biology****Credits:** 1-4

A supervised experience providing the opportunity to apply academic experience in settings associated with future professional employment and/or related graduate opportunities. Must be approved by a faculty adviser selected by the student.

Repeat Rule: May be repeated for a maximum of 8 credits.**Grade Mode:** Credit/Fail Grading**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 409 with a minimum grade of D-.**Equivalent(s):** BOT 625, PBIO 625**Grade Mode:** Letter Grading**Special Fee:** Yes**MEFB 628 - Marine Invertebrate Evolution and Ecology****Credits:** 5

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- and BIOL 412 with a minimum grade of D-.**Grade Mode:** Letter Grading**Special Fee:** Yes**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. One year of college level biology required. (Summers only at Shoals Marine Lab.)

Equivalent(s): ZOOL 628, ZOOL 630**Grade Mode:** Letter Grading**Special Fee:** Yes**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.

Prerequisite(s): BIOL 411 (may be taken concurrently) with a minimum grade of D- and BIOL 412 (may be taken concurrently) with a minimum grade of D- and CHEM 403 (may be taken concurrently) with a minimum grade of D- and CHEM 404 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 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, ZOOL 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.

Grade Mode: Letter Grading**Special Fee:** Yes**MEFB 721 - Aquatic Invasive Species****Credits:** 4

Capstone course for a limited number of biological science majors to work closely with and help teach a Discovery course for non-majors in biology. Involves lectures, discussions, and laboratory and field exercises and write-ups focusing on managing aquatic invasive species based on an understanding of their ecology.

Grade Mode: Letter Grading**Special Fee:** Yes**MEFB 725 - Marine Ecology****Credits:** 4

Marine environment and its biota, emphasizing intertidal and estuarine habitats. Includes field, laboratory exercises, and independent research project. General ecology required. Marine invertebrate zoology, oceanography, and statistics are desirable. (Offered alternate years.)

Equivalent(s): PBIO 725, ZOOL 725**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, ZOOL 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.)

Prerequisite(s): BIOL 411 with a minimum grade of D- and BIOL 412 with a minimum grade of D- and (ZOOL 518 with a minimum grade of D- or ZOOL 625 with a minimum grade of D-).

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 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. (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-.

Equivalent(s): ZOOL 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): ZOOL 753, ZOOL 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 C- or BIOL 412 with a minimum grade of C-.

Equivalent(s): ESCI 750, ZOOL 750

Grade Mode: Letter Grading

MEFB 770 - Senior Seminar in Marine, Freshwater, and Estuarine Biology**Credits: 2**

Explore and synthesize your undergraduate MEFB knowledge and skills through an integrated outlook at a topic relating to your professional future. Each semester revolves around a different overarching topic on which students read assigned topical papers, prepare critical analyses, and give presentations to the class.

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): ZOOL 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 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

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