MARINE, ESTUARINE AND FRESHWATER BIOLOGY MAJOR (B.S.)


Description

The Major in Marine, Estuarine, and Freshwater Biology is intended to give students interested in the fields of marine and freshwater biology the background and direct hands-on experience needed to pursue productive careers, including potential advanced study. This strategically cross-disciplinary major builds on a broad set of science courses in high-impact areas of study for today’s world, represented by a core curriculum in math, chemistry, physics, and biology. The core background is strengthened by a series of required and elective courses in a diverse range of aquatic sciences spanning watersheds to oceans, providing opportunities for study from organismal to ecosystem scales. Designed to provide a solid foundation of knowledge in freshwater, estuarine, and marine biology, the MEFB Major allows flexibility and encourages students to focus on particular areas of interest from molecular biology to ecosystem and policy studies. Students will have the opportunity to specialize in areas of their own interest, such as aquaculture and fisheries, animal behavior, ecological restoration, or management. While MEFB students must complete rigorous course requirements, our students are encouraged to tailor their elective courses within and across departments and colleges as needed to build their own, unique cross-disciplinary path.

The University of New Hampshire is uniquely located for the study of aquatic organisms and their habitats. We are centered between the Great Bay Estuary and the Gulf of Maine, with easy access to diverse marine environments as well as the freshwater habitats of New Hampshire’s Lakes Region and the White Mountain National Forest. We boast three Marine Laboratories that provide exceptional opportunities for our student’s research and educational needs, including Jackson Estuarine Laboratory (JEL), the Coastal Marine Lab (CML; part of the larger Judd Gregg Marine Research Center), and the Shoals Marine Laboratory (SML), as well as strong affiliations with the Great Bay National Estuarine Research Reserve. While JEL is located on Great Bay in Durham, CML is in nearby New Castle at the Seacoast, and SML is located seven miles off the coast. SML provides summer undergraduate programming with field-based marine courses that fulfill major electives, as well as internships and research opportunities for advanced study. In addition, UNH’s campus maintains two fish aquaculture facilities, a world-class genomics laboratory, and the State Veterinary Diagnostic Laboratory, which provide hands-on opportunities for undergraduates. There is also an active diving program with courses at both beginner and advanced levels. A major strength of the MEFB program is the hands-on approach to learning combined with an emphasis on involving undergraduate students in mentored research opportunities.

Off Campus Coursework and Study Abroad Opportunities

It is strongly recommended that students consider participating in a summer, semester, or year-long study abroad program. UNH’s Shoals Marine Laboratory ([https://www.shoalsmarinelaboratory.org/](https://www.shoalsmarinelaboratory.org/)), in conjunction with Cornell University, offers a host of marine biology-related college level courses that meet many degree requirements of the MEFB major over the summer on our island campus in the Isles of Shoals. SML offers both Merit and Need-based Scholarships, multi-course discounts, as well as competitive Research Internships offering summer stipends. UNH Global is the definitive resource for Study Abroad opportunities for undergraduates ([https://www.unh.edu/global/education-abroad](https://www.unh.edu/global/education-abroad)). UNH Global can provide information on programs of study, while students’ academic advisors can assist in course selection options that provide equivalencies to requirements in MEFB so progress toward degree is not compromised. In addition, Ecoquest, run by the Department of Natural Resources, offers summer and semester programs of environmentally oriented courses in New Zealand ([https://ecoquest.unh.edu/](https://ecoquest.unh.edu/)). These are just some of the many opportunities available for MEFB students and we encourage you to explore more.

Pre-health Professional Program

MEFB majors who wish to pursue postgraduate degrees in the health care professions should visit the premed advising website ([http://www.unh.edu/premed-advising](http://www.unh.edu/premed-advising)).

### Requirements

#### Degree Requirements

- **Minimum Credit Requirement:** 128 credits
- **Minimum Residency Requirement:** 32 credits must be taken at UNH
- **Minimum GPA Requirement:** 2.0 required for conferral

#### Core Curriculum Required:

- **Discovery & Writing Program Requirements**

- **Foreign Language Requirement:** No

All Major, Option and Elective Requirements as indicated.

*Major GPA requirements as indicated.*

#### Major Requirements

A minimum grade of C- is required in all biological science courses that are counted toward the requirements for a degree in MEFB. Students who expect to compete successfully for post-baccalaureate programs should attain a cumulative GPA of 3.0 or higher by the end of the sophomore year and maintain it at that level.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 412</td>
<td>Introductory Biology: Evolution, Biodiversity and Ecology</td>
<td>4</td>
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<tr>
<td>BIOL 411</td>
<td>Introductory Biology: Molecular and Cellular</td>
<td>4</td>
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<tr>
<td>BIOL 541W</td>
<td>Ecology</td>
<td>4</td>
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<tr>
<td>BMS 503</td>
<td>General Microbiology</td>
<td>5</td>
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<tr>
<td>&amp; BMS 504</td>
<td>General Microbiology Laboratory</td>
<td>4</td>
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<tr>
<td>GEN 604</td>
<td>Principles of Genetics</td>
<td>4</td>
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<tr>
<td>CHEM 403</td>
<td>General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 404</td>
<td>General Chemistry II</td>
<td>4</td>
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<tr>
<td>CHEM 545</td>
<td>Organic Chemistry</td>
<td>5</td>
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<tr>
<td>&amp; CHEM 546</td>
<td>Organic Chemistry Laboratory</td>
<td>4</td>
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<tr>
<td>BMCB 688A</td>
<td>General Biochemistry</td>
<td>3</td>
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<tr>
<td>MATH 4248</td>
<td>Calculus for Life Sciences</td>
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<tr>
<td>or BIOL 633</td>
<td>Data Analysis for Life Science</td>
<td>4</td>
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<td>or BIOL 711</td>
<td>Experimental Design &amp; Analysis</td>
<td>4</td>
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<tr>
<td>BIOL 528</td>
<td>Applied Biostatistics I</td>
<td>4</td>
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**University of New Hampshire**
Marine, Estuarine and Freshwater Biology Major (B.S.)

PHYS 401 Introduction to Physics I 4
PHYS 402 Introduction to Physics II 4

MEFB Required Courses
MEFB 401 Marine Estuarine and Freshwater Biology Freshmen Seminar 1
MEFB 503 Introduction to Marine Biology 4

Choose one Plant Survey course: 4.5
MEFB 625 Introduction to Marine Botany 5
or MEFB 747 Aquatic Plants in Restoration/Management

Choose one Freshwater course: 4
MEFB 717 Lake Ecology
ZDOL 708 Stream Ecology

Choose one Physiology/Function course: 4.5
ZOOL 625 & ZOOL 626W Principles of Animal Physiology and Animal Physiology Laboratory
or ZOOL 733 Physiology of Fishes

Choose one Marine or Estuarine course: 4
MEFB 735 Marine Ecology
or MEFB 755 Biological Oceanography

Choose one Animal Survey course: 4
ZDOL 542 Ornithology
or MEFB 628 Marine Invertebrate Evolution and Ecology
or ZOOL 710 Sharks and Bony Fishes

Capstone:
BIOL 780 Capstone Companion Course 1

MEFB Electives: Choose 3

Evolution, Systematics and Biodiversity
BIOL 566 Systematic Botany 4
BIOL 709 Data Science with R for the Life Sciences 4
GEN 713 Microbial Ecology and Evolution 4
MEFB 500 Coastal Habitat Field Research Methods (SML) 4
MEFB 510 Field Ornithology (SML) 4
MEFB 530 Evolution and Marine Diversity (SML) 4
MEFB 535 Marine Mammal Biology (SML) 4
MEFB 625 Introduction to Marine Botany 5
or MEFB 747 Aquatic Plants in Restoration/Management
MEFB 628 Marine Invertebrate Evolution and Ecology
MEFB 630 Biodiversity and Biology of Marine Invertebrates (SML) 4
MEFB 741 Sharks: Biology and Conservation (SML) 4
MEFB 754 Anatomy and Function of Marine Vertebrates (SML) 4
MEFB 747 Aquatic Plants in Restoration/Management (C) 4
NR 504 Freshwater Resources 4
NR 712 Mammalogy 4
ZDOL 518 Comparative Morphology and Biology of Vertebrates 4
ZDOL 542 Ornithology 4
ZDOL 690 Evolution 4
ZDOL 710 Sharks and Bony Fishes 4

Fisheries and Aquaculture
MEFB 702 Sustainable Marine Fisheries (SML) 4
MEFB 755 Biological Oceanography (C) 3
MEFB 772 Fisheries Biology Conservation and Management 4
MEFB 773 Physiology of Fishes 4
ZDOL 610 Principles of Aquaculture 4
ZDOL 710 Sharks and Bony Fishes 0 or 4

Marine, Estuarine and Freshwater Ecology
BIOL 720 Plant-Animal Interactions 4
ESCI 501 Introduction to Oceanography 4
GEN 713 Microbial Ecology and Evolution 4
MEFB 500 Coastal Habitat Field Research Methods (SML) 4
MEFB 508 Marine Ecosystem Research and Management (SML) 4
MEFB 625 Introduction to Marine Botany 5
MEFB 628 Marine Invertebrate Evolution and Ecology 5
MEFB 674 Ecology and Marine Environment (SML) 4
MEFB 714 Field Animal Behavior (SML) 4
MEFB 717 Lake Ecology 4
MEFB 721 Aquatic Invasive Species 4
MEFB 725 Marine Ecology 4
MEFB 741 Sharks: Biology and Conservation (SML) 4
MEFB 747 Aquatic Plants in Restoration/Management (C) 4
MEFB 751 Research in Marine Biology (SML) 4
MEFB 755 Biological Oceanography (C) 3
NR 703 Watershed Water Quality Management 4
NR 744 Biogeochemistry 4
ZDOL 708 Stream Ecology 4
ZDOL 739W Behavioral Ecology 0 or 4

Physiology, Behavior and Cell Biology
ANSC 701 Physiology of Reproduction 4
BIOL 701 Plant Physiology 4
BMCB 605 Principles of Cell Biology 4
BMS 716 Public Health: Food- and Water-borne Diseases 4
MEFB 504 Field Wildlife Forensics (SML) 2
MEFB 506 Marine Parasitology and Disease (SML) 4
MEFB 714 Field Animal Behavior (SML) 4
MEFB 773 Physiology of Fishes 4
ZDOL 625 Principles of Animal Physiology & ZOOL 626W Animal Physiology Laboratory 5
ZDOL 739W Behavioral Ecology 0 or 4
ZDOL 736 Genes and Behavior (C) 4
ZDOL 777W Neuroethology 4

Restoration Management and Policy
MARI 405 Introduction to Marine Mammal Science and Policy 3
MARI 705 Introduction to Marine Policy: Understanding US Ocean, Coastal and Great Lakes Policy 3
MEFB 505 Introduction to Applied Science Communication (SML) 4
MEFB 702 Sustainable Marine Fisheries 4
MEFB 747 Aquatic Plants in Restoration/Management (C) 4
MEFB 772 Fisheries Biology Conservation and Management 4
ZDOL 610 Principles of Aquaculture 4
Research and Special Projects
BIOL 795 Independent Investigations in Biology 1-4
BMS 795 Investigations in Biomedical Science 1-8
BIOL 799H Honors Senior Thesis 2-8
MEFB 403 Investigative Marine Biology Laboratory (SML) 2-4
MEFB 500 Coastal Habitat Field Research Methods (SML) 4
MEFB 600 Field Experience in Marine, Estuarine, and Freshwater Biology 1-4
MEFB 730 Underwater Research (SML) 4
MEFB 751 Research in Marine Biology (SML) 4
MEFB 770 Senior Seminar in Marine, Estuarine, and Estuarine Biology (C) 2
MEFB 795 Independent Investigations in Marine, Estuarine, and Freshwater Biology 1-4
TECH 797 Undergraduate Ocean Research Project (C) 3 2
MEFB 799H Honors Senior Thesis in Marine, Estuarine, and Freshwater Biology 2-4

1 A single course cannot be used for both a core requirement and an elective (e.g., ZOOL 542 cannot be used to fulfill the animal survey requirement and as an elective).
2 Primary focus of the project must be Marine, Estuarine and/or Freshwater. A 600, 695, 795, or 799 experience may substitute for one elective with academic advisor approval, but only if taken for at least four credits. These four credits may be spread over multiple semesters if they are consecutive and with the same faculty mentor.
3 This class requires enrollment in both fall and spring sections, 2 credits/semester for a total of 4 credits.

Capstone Experience
As part of the University of New Hampshire’s Discovery Program requirements, all students must complete a capstone experience during their senior year (after earning at least 90 credits). The capstone experience for students majoring in MEFB consists of BOTH (1) an approved individual experience AND (2) the successful completion of the BIOL 780 Capstone Companion Course. Students will not be approved for graduation until capstone certification has been granted.
1) The individual experience

The individual experience may be satisfied through various forms of experiential learning (e.g., Honors thesis, mentored research project, internship) or a course denoted with a “(C)” in the courses listed above. The individual experience must fulfill at least one of the University’s capstone criteria:

- synthesizes and applies disciplinary knowledge and skills
- fosters reflection on undergraduate learning and experience
- demonstrates emerging professional competencies
- applies, analyzes, and/or interprets research, data, or artistic expression
- explores areas of interest based on the integration of the prior learning

Before beginning any capstone individual experience, students must submit a completed capstone approval form to their Program Coordinator. Students can obtain this form on the Department’s Capstone page or from their Program Coordinator. Here they will describe their proposed individual experience and how it fulfills at least one of the University’s capstone criteria listed above. If the student is selecting a “C” course for their individual experience, they should obtain the course syllabus from the instructor for information about the course’s content and learning objectives.

2) Enrollment in BIOL 780 Capstone Companion Course

Students will also be required to enroll in BIOL 780 (1 cr.) during the semester of their individual experience. BIOL 780 is offered every Fall and Spring semester.

- If the individual experience is a two-semester thesis, BIOL 780 should be taken during the second semester.
- If the individual experience occurs during the summer (e.g., internship), BIOL 780 should be taken during the Fall semester that immediately follows.
- Note: Because BIOL 780 is not offered during the summer, students cannot complete their individual experience during the summer and graduate during that same August. Summer experiences could only be used as individual capstone experiences if completed the summer before the student’s senior year.

Student Learning Outcomes

- Show the ability to synthesize diverse sources of information and communicate it effectively.
- Demonstrate a broad understanding of the unique characteristics, as well as the similarities, governing freshwater, estuarine and marine systems.
- Have a broad understanding of biology from the molecular to the ecosystem with a particular appreciation for the abiotic and biotic factors relating to diverse aquatic ecosystems.
- Demonstrate the ability to describe basic principles of scientific inquiry and the importance of scientific study for understanding the natural world.
- Demonstrate the ability to design and experiment, collect data, analyze and graph it appropriately, and summarize the significant findings.