Sea Change Semester: Oceans Track

Students in the Bigelow Sea Change Semester take three, intensive, four-week courses in series and a research course that extends over the entire semester.

ES383: The Ocean Environment: A Cross-Disciplinary Foundation

The study of marine systems requires an understanding of multiple intersecting disciplines, including physics, chemistry, biology, geology, and human systems. This course will set the stage to cover the how these processes interact to create a variety of marine systems, from estuaries to the open ocean to the sea floor. The course will introduce modern methods of ocean observing, including data collection and analysis in the R programming environment. Students will become proficient in using the primary scientific literature to inform their research and understanding, and build an understanding of how oceanic processes link to human activities, such as policy, geoengineering, and sustainability.

BI384: Biological Oceanography: Diversity and Function of Life in Marine Ecosystems

The ocean is comprised of connected biological networks, from microorganisms to whales. Chemical and physical processes and interactions between biotic and abiotic components fuel this engine. The course will explore diversity and biological activities of oceanic life, with emphasis on microbial aspects, across contrasting ecosystems (open oceans, deep-sea, coral reefs). We will address topics that drive research, including: the role of diversity and interactions in sustaining healthy ecosystems, climate change, and human impacts. Students will gain a working knowledge and skill set such that they can participate in oceanographic cruises and analyze data from complex sampling programs.

CH385: Ocean Biogeochemistry on a Changing Planet

The ocean plays a key role in mediating climate and supporting Earth's life. In this course, students will build on topics covered in previous Bigelow courses to explore the biological, chemical, and physical processes that affect the cycling of elements in the ocean, e.g. photosynthesis and respiration, oxidation-reduction (redox) reactions, calcification and silicification, and ocean-sediment interactions, with emphasis on processes that directly affect global climate. The role of humans will be addressed through topics such as ocean acidification, coastal eutrophication and hypoxia, marine pollution, and geoengineering. Laboratory activities will investigate carbonate chemistry, redox reactions, metabolic energy transfer, and carbon cycling. In an extended laboratory activity students will work with Bigelow's communication professionals to compose short videos to explain ocean biogeochemistry topics.

BI386: Oceanographic field methods and independent research

This course is designed to provide students the opportunity to collect, process, and interpret oceanographic data, and to conduct mentor-guided independent research. The field component includes 6 research cruises. Students will collect physical (temperature, light penetration), chemical (macro-nutrient) and biological (bacterial, phytoplankton and zooplankton) data at 4 stations from within the Damariscotta River Estuary to the open ocean. Field research and analysis will be presented as a scientific poster. The independent research will be mentored. Students will have 4 "Roundtable on Research" meetings led by course instructors, culminating in a scientific talk at a research symposium. By the end of the semester, students will have experienced the full range of activities involved in oceanographic research.

Sea Change Semester: Marine Omics Track (proposed)

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BI 385: Marine ‘Omics: Deciphering the genetic code of the ocean

Molecular and genomic techniques have revolutionized ocean sciences over the past two decades. In this course, students will learn basic principles and theory behind ‘omic-based approaches (genomics, transcriptomics, proteomics, and metabolomics) and how they have led to major discoveries and new paradigms. Particular focus will be given to applying the most up-to-date technologies to approach ‘omics-based questions. Practically, students will learn how to design and use species-specific genetic assays to investigate ocean ecology and enhance management decisions for living marine resources. Lab work will include processing field samples for extraction of DNA, RNA, and proteins, as well as downstream applications such as PCR, qPCR, and DNA sequencing.

BI 367: Molecular Tools to Understand the Environment

This course is designed to provide students the opportunity to collect, process, and interpret molecular field data, and to conduct mentor-guided independent research. Students will engage in lab exercises focused on the alteration of genetic material, including building gene expression vectors, gene transfection, and genome editing with CRISPR/CAS9. Students will also undertake independent, mentored research with a focus on bioinformatic projects mining the eDNA samples for genes of interest. Students will meet regularly to get help from instructor and peers about techniques, discuss ethics and societal issues surrounding genetics (gene editing, GMO, synthetic biology and bioremediation, and synthetic biology and aquaculture), and prepare individual final presentations as well as a group presentation on their research.