OCEANOGRAPHY (PH.D.)

https://ceps.unh.edu/earth-sciences/program/phd/oceanography

Description

The Oceanography (OCE) graduate program has a diverse set of faculty, staff, and students who examine ocean processes in broad fields of physical, biological, chemical, and geological oceanography and geophysics Basic and applied research of an experimental, numerical, and analytical nature is conducted in oceanic settings that range from shallow nearshore and estuarine waters to the deep ocean and span all ocean basins on earth including the Arctic.

OCE offers programs leading to M.Sc. and Ph.D. degrees. These interdisciplinary programs prepare students for professional careers in ocean-relate fields. In addition, students can also pursue an ocean mapping option within the Department of Earth Sciences and carried out within the Center for Coastal and Ocean Mapping.

Research and Facilities

The oceanography graduate program within the Department of Earth Sciences and the School of Marine Science and Ocean Engineering (SMSOE) is enhanced by the ocean engineering and marine biology graduate programs, and by other departments and institutes at UNH, including the civil and mechanical engineering and biology departments; the Institute for the Study of Earth, Oceans, and Space (EOS); the Center for Coastal and Ocean Mapping (CCOM); and the Ocean Processes Laboratory (OPAL). Other related programs include the N.H. Sea Grant Program, the Center for Collaborative Science, and the Atlantic Marine Aquaculture Center, Coastal Response Research Center (CRRC), Northeast Consortium (NEC), and the Piscataqua Region Estuaries Partnership (PREP). Oceanographic laboratories at UNH include the Shoals Marine Laboratory (SML) on Appledore Island, the Coastal Marine Laboratory (CML) in Newcastle, the Jackson Estuarine Laboratory (JEL) at Adams Point on the Great Bay, and the Chase Ocean Engineering Laboratory (COEL) on the main UNH campus. Additional laboratories for the oceanography faculty are located on campus in James, Morse, Rudman, and Spaulding Halls. The SMSOE operates a marine support facility and two UNH research vessels moored in Portsmouth Harbor at the UNH pier, the R/V Gulf Challenger and the R/V Gulf Surveyor, as well as a number of small boats. The SMSOE also supports the UNH Diving Program and oversees a shared use Instrumentation Pool for student and faculty use.

Admission Requirements

Applicants should have completed an undergraduate major related to one of the oceanography disciplines, including biology, chemistry, engineering,geology, physics, or mathematics, or an appropriate array of science and engineering courses within their major field. Applicants are expected to have completed one year each of calculus and chemistry and two semesters of physics and/or biology. It is not necessary to have had previous coursework in oceanography.

Requirements

Ph.D. Requirements

Students plan a program of study in conjunction with a faculty guidance committee (FGC). Students entering the program without a master's degree are expected to complete a minimum of 36 credit hours. Students with an M.S. degree in oceanography or related field in physical science from UNH or another university should first demonstrate (through accredited transcript or the qualifying examination) acceptable mastery in the basic core areas. Those deficient in any discipline will be required to complete the respective course.

All students must complete all four core oceanography courses, and at least one course from each of the following categories: methods, ethics/policy/law, and seminar. Please see below for a list of courses that meet these specifications (other courses may qualify and should be approved by the FGC). Additional credit hours are determined by the FGC (typically 15 credit hours). Foreign language requirement is determined by the FGC. Students must complete a Coursework Approval Form, which summarizes all courses to be taken, and obtain signatures from their adviser, committee members, and the OCE program coordinator once the coursework is completed.

Students wishing to be admitted to doctoral candidacy will undergo a qualifying examination by the guidance committee designed to test the student's in-depth knowledge in their major field and their ability to conduct independent and original research in oceanography. Qualifying students will present to the guidance committee a research proposal in which the soundness, originality, and feasibility of the investigation are clearly stated, and which when approved based on a proposal examination by the committee, will form the basis for the doctoral dissertation.

Students are advanced to candidacy after successfully completing the comprehensive exam, proposal exam, and all coursework required by the guidance committee. Students must complete a dissertation, present their results at a public seminar, and pass an oral examination by the thesis committee.

Although not a strict requirement, all graduate students are encouraged to obtain teaching experience, preferably as a teaching assistant.

All students are required to spend time in the field, even if their research project and interests are primarily based on analytical research, modeling studies, or laboratory experiments. The field requirement could include extended time at sea onboard one of the UNH, UNOLS, NOAA, or similar oceanographic research vessels, or include field experiments at locations in New Hampshire, the U.S., or around the globe, and includes possible nearshore and estuarine studies, Antarctic expeditions, or other land--based studies related to oceanography. Successful completion of the field requirement will be determined by the guidance committee.

Code	Title	Credits
Core Oceanography Courses		
BIOL 855	Biological Oceanography	
ESCI 852	Chemical Oceanography	
ESCI 858	Introduction to Physical Oceanography	
ESCI 859	Geological Oceanography	

Code	Title	Credits
Methods Courses		
CHEM 862	Instrumental Methods of Chemical Analysis	
ESCI 801	Quantitative Methods in Earth Sciences	

ESCI 820	Ocean Measurements Lab
ESCI 871	Geodesy and Positioning for Ocean Mapping
ESCI 864	Spectral Analysis of Geophysical Time Series Data
ESCI 874	Integrated Seabed Mapping Systems
ESCI 875	Advanced Topics in Ocean Mapping
ESCI 972	Hydrographic Field Course
ESCI 996	Advanced Topics (Ocean Modelling)
IAM 940	Asymptotic and Perturbation Methods
ME 807	Analytical Fluid Dynamics
MATH 835	Statistical Methods for Research
MATH 839	Applied Regression Analysis
MATH 845	Foundations of Applied Mathematics I
MATH 853	Introduction to Numerical Methods

Code	Title	Credits
Ethics, Policy, and Law Courses		
ECON 908	Environmental Economics: Theory and Policy	
MARI 805	Introduction to Coastal and Marine Policy: Understanding US Ocean, Coastal, and Great Lakes Policy	
NR #801	Ecological Sustainability and Values	
NR 820	International Environmental Politics and Policies for the 21st Century	
NR 824	Resolving Environmental Conflicts	
GRAD 930	Ethics in Research and Scholarship	

Code	Title	Credits
Seminar and Proposal Development Courses		
OE 990	Ocean Seminars I	
OE 991	Ocean Seminars II	
ESCI 997	Seminar in Earth Sciences	
ESCI 998	Proposal Development	
BIOL 901	Introductory Graduate Seminar	

Code	Title	Credits
Other Relevant Graduate Courses		
BIOL 828	Marine Bioacoustics	
CEE 822	Introduction to Marine Pollution and Control	
ESCI #834	Geophysics	
ESCI 841	Geochemistry	
ESCI 845	Isotope Geochemistry	
ESCI 847	Aqueous Geochemistry	
ESCI 854	Sedimentology	
ESCI 856	Geotectonics	
ESCI 860	Paleoceanography	
ESCI 862	Glacial Geology	
ESCI 865	Paleoclimatology	
ESCI 895	Topics (Ocean Biogeochemistry)	
ESCI 896	Topics (Nearshore Processes)	
ESCI 995	Advanced Topics (Geophysical Fluid Mechanics)	
ESCI 996	Advanced Topics (Nearshore Hydrodynamics)	
ME 807	Analytical Fluid Dynamics	
ME 812	Waves in Fluids	
ME 910	Turbulence	
MEFB 872	Fisheries Biology: Conservation and Management	
OE 853	Ocean Hydrodynamics	
NR 844	Biogeochemistry (or ESCI 896 Topics/Biogeochemistry)	
OE 854	Ocean Waves and Tides	
OE 857	Coastal Engineering and Processes	
OE 895	Special Topics (Underwater Acoustics)	
OE 995	Graduate Special Topics (Coastal Sediment Transport)	
ZOOL 810	Sharks and Bony Fishes	

Student Learning Outcomes

Students graduating with a Ph.D. in Oceanography should achieve the following learning outcomes:

Core Knowledge

- Demonstrate a foundation of knowledge in all 4 of the main branches of oceanography: Geological, Biological, Physical, or Chemical.
- Geological Oceanography: An understanding marine geology and geophysics, including major geological features and history of the world's oceans, processes of the ocean floor, composition and structure of the Earth, plate tectonic theory, marine sedimentology, and paleoceanography.
- Biological Oceanography: An understanding of marine ecosystems, primary and secondary productivity, trophodynamics, plankton diversity, zooplankton ecology, global ocean dynamics, and the physical and chemical processes that govern nutrient and light availability, the concept of food webs, role of microbes, and fisheries and anthropogenic interactions with fish stocks.
- Physical Oceanography: An understanding of the physics of the ocean, including general wind-driven and thermohaline circulation, geostrophic flow, upwelling, waves and tides, continental and nearshore processes. the effect of the earth's rotation on large scale global ocean circulation, and instrumentation and methods used in obtaining observations.
- Chemical Oceanography: An understanding of the physical and biogeochemical process that determine the composition of seawater, including biological effects on chemistry, ocean nutrient cycles, air-sea gas exchange, radiogenic and stable isotopes as tracers of ocean properties, sediment and trace metal chemistry.
- Demonstrate basic knowledge of how the processes within the main branches of oceanography interact with each other.
- Demonstrate specialized knowledge of a field within oceanography sufficient to conduct and lead substantive independent research.

Research Methods and Analysis

- Identify and demonstrate knowledge of a range of qualitative and quantitative methodologies typically used in oceanographic research and critically evaluate research that uses these methods.
- Discover and critically read published research articles in oceanographic and related fields of the Earth Sciences, mathematics, statistics, physics, chemistry, and biology.
- Frame empirical research and/or theory guided by prior knowledge.
- Implement rigorous theoretical, numerical, field, or laboratory studies using appropriate methods, measurements, and/or techniques.
- Critically evaluate and systematically analyze data to reach appropriate findings and interpretations.

Research Independence

- Develop and implement independent research projects that meet high standards of theoretical and methodological rigor.
- Formulate and propose new hypotheses to test present understanding and discuss directions for future research with broad international audiences.

Scholarly Communication

- Structure a coherent argument that rigorously presents and evaluates evidence to support claims.
- Review and cogently synthesize relevant literature.
- Write at a level and in a style of English consistent with that found in leading academic journals.
- Understand and properly use styles of citing, referencing, and formatting found in leading academic journals.

- Clearly convey research findings through oral presentation supported by appropriate digital media.
- Cogently summarize research and its significance to non-specialist audiences.

Professionalism and Pedagogy

- Prepare and submit manuscripts that meet the standards of academic and research journals and respond appropriately to recommendations for revision that lead to publication.
- Be able to prepare and submit research proposals to funding agencies to secure extramural funding.
- Communicate through oral and media presentation to effectively convey knowledge to students, colleagues, and the community in academic lecture, public outreach, and national and international conference settings.
- Demonstrate collaboration, leadership and teamwork with colleagues, peers, and the public.
- Create a welcoming environment that is supportive, inclusive and equitable.
- Make effective contributions to university, community and professional service and be able to lead discussions with both experts and non-experts in the field.