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 at least one course from each of the following categories: natural sciences, 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.

**Natural Sciences**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ESCI 852</td>
<td>Chemical Oceanography</td>
<td></td>
</tr>
<tr>
<td>ESCI 858</td>
<td>Introduction to Physical Oceanography</td>
<td></td>
</tr>
<tr>
<td>ESCI 859</td>
<td>Geological Oceanography</td>
<td></td>
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</table>

**Methods**

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CHEM 862</td>
<td>Instrumental Methods of Chemical Analysis</td>
<td></td>
</tr>
<tr>
<td>ESCI 801</td>
<td>Quantitative Methods in Earth Sciences</td>
<td></td>
</tr>
<tr>
<td>ESCI 820</td>
<td>Ocean Measurements Lab</td>
<td></td>
</tr>
<tr>
<td>ESCI 871</td>
<td>Geodesy and Positioning for Ocean Mapping</td>
<td></td>
</tr>
<tr>
<td>ESCI 864</td>
<td>Spectral Analysis of Geophysical Time Series Data</td>
<td></td>
</tr>
</tbody>
</table>
Demonstrate a foundation of knowledge in at least 1 of the main branches of oceanography: Geological, Biological, Physical, or Chemical.

Geological Oceanography: An understanding marine geology and geophysics, including the structure of the Earth, Plate Tectonic Theory, marine sedimentology, paleoceanography, and the global carbon cycle.

Biological Oceanography: An understanding of marine ecosystems, including the physical and chemical processes that govern nutrient and light availability, the concept of food webs, and fisheries and anthropogenic interactions with fish stocks.

Physical Oceanography: An understanding of the physics of the ocean, including how wind and thermal forcing at the surface interact with the Earth's rotation to drive ocean circulation in the deep basins and shallow continental shelves and oceanic plateaus, tides, and surface gravity waves.

Chemical Oceanography: An understanding of the chemistry and chemical interactions in seawater, including biogeochemical processes that govern the distribution and cycling of elements and nutrients, processes that add and remove elements in the ocean, isotopic fractionation, and how ocean chemistry interacts with seafloor sediments and the ocean crust.

Seminar and Proposal Development

Code | Title | Credits
--- | --- | ---
ECON 908 | Environmental Economics: Theory and Policy | 3
NR #801 | Ecological Sustainability and Values | 3
NR #818 | Law of Natural Resources and Environment | 3
NR 820 | International Environmental Politics and Policies for the 21st Century | 3
NR 824 | Resolving Environmental Conflicts | 3
NR #902 | Ecological Ethics and Values | 3
GRAD 930 | Ethics in Research and Scholarship | 3

Other Relevant Graduate Courses

Code | Title | Credits
--- | --- | ---
CEE 822 | Introduction to Marine Pollution and Control | 3
ESCI #834 | Geophysics | 3
ESCI 841 | Geochemistry | 3
ESCI 845 | Isotope Geochemistry | 3
ESCI 847 | Aqueous Geochemistry | 3
ESCI 854 | Sedimentology | 3
ESCI 856 | Geotectonics | 3
ESCI 860 | Paleooceanography | 3
ESCI 862 | Glacial Geology | 3
ESCI 865 | Palaeoecology | 3
ESCI 896 | Topics (Nearshore Processes) | 3
ESCI 995 | Advanced Topics (Geophysical Fluid Mechanics) | 3
ME 807 | Analytical Fluid Dynamics | 3
ME 812 | Waves in Fluids | 3
ME 910 | Turbulence | 3
OE 853 | Ocean Hydrodynamics | 3
NR 844 | Biogeochemistry (or ESCI 896 Topics (Biogeochemistry)) | 3
OE 854 | Ocean Waves and Tides | 3
OE 857 | Coastal Engineering and Processes | 3
OE 895 | Special Topics (Underwater Acoustics) | 3
OE 905 | Graduate Special Topics (Coastal Sediment Transport) | 3
ZOOL 810 | Sharks and Bony Fishes | 3
ZOOL 872 | | 3

Student Learning Outcomes

A. Student Learning Outcomes for Oceanography, Ph.D. Students graduating with a Ph.D. in Oceanography should be able to:

Core Knowledge

- Demonstrate a foundation of knowledge in at least 1 of the main branches of oceanography: Geological, Biological, Physical, or Chemical.
- Geological Oceanography: An understanding marine geology and geophysics, including the structure of the Earth, Plate Tectonic Theory, marine sedimentology, paleoceanography, and the global carbon cycle.
- Biological Oceanography: An understanding of marine ecosystems, including the physical and chemical processes that govern nutrient and light availability, the concept of food webs, and fisheries and anthropogenic interactions with fish stocks.
- Physical Oceanography: An understanding of the physics of the ocean, including how wind and thermal forcing at the surface interact with the Earth's rotation to drive ocean circulation in the deep basins and shallow continental shelves and oceanic plateaus, tides, and surface gravity waves.
- Chemical Oceanography: An understanding of the chemistry and chemical interactions in seawater, including biogeochemical processes that govern the distribution and cycling of elements and nutrients, processes that add and remove elements in the ocean, isotopic fractionation, and how ocean chemistry interacts with seafloor sediments and the ocean crust.
- 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 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 read research that uses these methods.
- Discover and critically read published research 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 a rigorous research using appropriate methods, measures and techniques.
- Critically evaluate and systematically analyze data to reach appropriate findings and interpretations.

Independent

- Develop and implement independent research projects that meet high standards of theoretical and methodological rigor.

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.
- This outcome is too broad for meaningful assessment.
Professionalism and Pedagogy

- Prepare manuscripts that meet the standards of academic and research journals and respond appropriately to recommendations for revision. Communicate effectively to groups in a lecture format.
- Demonstrate collaboration, leadership and teamwork.
- Make effective contributions to university, community and professional service.