

# ENVIRONMENTAL SCIENCES MAJOR: HYDROLOGY OPTION (B.S.)

<https://ceps.unh.edu/earth-sciences/program/bs/environmental-sciences-major-hydrology-option>

## Description

The College of Engineering and Physical Sciences (CEPS) and the College of Life Science and Agriculture (COLSA) jointly offer a bachelor of science degree in environmental sciences. Environmental sciences, an interdisciplinary field, focuses on the interaction of biological, chemical, and physical processes that shape our natural environment. Students graduating with a degree in environmental sciences will have an understanding of these interacting processes, the ability to communicate effectively with both scientific and lay audiences, competency in field methods appropriate for entry-level environmental science positions, competency in the use and application of Geographic Information Systems (GIS), a basic understanding of environmental policy, and the ability to contribute to multidisciplinary teams. The University of New Hampshire is a recognized leader in environmental sciences research, and the environmental sciences program capitalizes on faculty expertise in this area. The full-time faculty members comprising this program have major teaching and research emphases in the areas of biogeochemical cycling, environmental chemistry, geospatial science, ecosystem science, global change, hydrology, plant ecology, soil science, and water resource management.

Employment opportunities include: environmental consulting firms, educational facilities (e.g., science centers), environmental monitoring laboratories (e.g., water treatment plants; the Environmental Protection Agency), government agencies (e.g., the U.S. Geological Survey, Bureau of Land Management, Natural Resource Conservation Service), university and government research laboratories, and nongovernment environmental organizations. The environmental sciences program also constitutes an excellent preparation for graduate programs in several areas relating to the environment. Students should consult with their adviser early if their goals include further study.

The Program has four options, and specific course requirements for the major vary by option. The geosystems and hydrology options are both managed by the Department of Earth Sciences in CEPS, and the ecosystems and soils and watersheds options are both managed by the Department of Natural Resources and the Environment in the COLSA. The hydrology option provides students with a solid grounding in fundamental hydrological principles and quantitative reasoning.

## Requirements

### Degree Requirements

**Minimum Credit Requirement:** 128 credits

**Minimum Residency Requirement:** 32 credits must be taken at UNH

**Minimum GPA:** 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

In addition to the Discovery Program and University writing requirements, all students will take two required introductory courses, plus one other elective introductory environmental science course. Foundation courses include introductions to biology, physics, chemistry, geology, calculus, and statistics.

### INTRODUCTORY

Code	Title	Credits
NR 400	Professional Perspectives in Natural Resources	1
NR 403	Introduction to Environmental Science	4
Select one elective introductory course from the following:		4
NR 504	Freshwater Resources	
CEE 520	Environmental Pollution and Protection: A Global Context	
ESCI 405	Global Environmental Change	
ESCI 501	Introduction to Oceanography	
ESCI 514	Introduction to Climate	
GEOG 473	Elements of Weather	
<b>Total Credits</b>		<b>9</b>

### FOUNDATION

Code	Title	Credits
<b>Biology</b>		
BIOL 411	Introductory Biology: Molecular and Cellular	4
or BIOL 412	Introductory Biology: Evolution, Biodiversity and Ecology	
<b>Chemistry</b>		
Select one of the following:		4-8
CHEM 403	General Chemistry I	
& CHEM 404	and General Chemistry II	
or CHEM 405	Chemical Principles for Engineers	
<b>Physics</b>		
PHYS 407	General Physics I	4
PHYS 408	General Physics II	4
<b>Calculus</b>		
MATH 425	Calculus I	4
MATH 426	Calculus II	4
<b>Statistics</b>		
MATH 644	Statistics for Engineers and Scientists	
or BIOL 528	Applied Biostatistics I	
<b>Geology</b>		
Select one of the following:		4
ESCI 401	Dynamic Earth	
ESCI 402	Earth History	
ESCI 409	Geology and the Environment	
<b>Total Credits</b>		<b>32-36</b>

### CORE COURSES

Code	Title	Credits
ESCI 534	Techniques in Environmental Sciences	3
ESCI 654	Fate and Transport in the Environment	4
ESCI 777	GIS for Earth & Environmental Sciences	4
or NR 658	Introduction to Geographic Information Systems	
NR 602	Natural Resources and Environmental Policy	4
or NR 662	Environmental Policy, Planning and Sustainability in New Zealand	
Capstone Experience <sup>1</sup>		
<b>Total Credits</b>		<b>15</b>

<sup>1</sup> NR 791 Preparation for Capstone and an independent study or capstone course taken in the senior year and approved by their adviser and the program coordinator.

HYDROLOGY

Code	Title	Credits
<b>Geomorphology</b>		
ESCI 561	Landscape Evolution	4
<b>Soils/Mineralogy</b>		
ESCI 512	Principles of Mineralogy	4
or NR 501	Studio Soils	
<b>Surface Water Hydrology</b>		
ESCI 705	Principles of Hydrology	4
or CEE 754	Engineering Hydrology	
<b>Groundwater Hydrology</b>		
ESCI 710	Groundwater Hydrology	4
<b>Select one Quantitative Analysis course from the following:</b>		4
CS 410P	Introduction to Scientific Programming/Python	
ESCI 701	Quantitative Methods in Earth Sciences	
ESCI 764	Spectral Analysis of Geophysical Time Series Data	
MATH 525	Linearity I	
MATH 527	Differential Equations with Linear Algebra	
MATH 528	Multidimensional Calculus	
MATH 645	Linear Algebra for Applications	
MATH 739	Applied Regression Analysis	
MATH 740	Design of Experiments I	
<b>Select two or three approved electives from the following:</b>		8-12
CEE 650	Fluid Mechanics	
CEE 721	Environmental Sampling and Analysis	
CEE 723	Environmental Water Chemistry	
CEE 724	Environmental Engineering Microbiology	
CEE 751	Open Channel Flow	
CEE 758	Stormwater Management Designs	
CEE 759	Stream Restoration	
ESCI 642	Biogeosciences in the Earth System	
ESCI 741	Geochemistry	
ESCI 745	Isotope Geochemistry	
ESCI 747	Aqueous Geochemistry	
ESCI 762	Glacial Geology	
ESCI 778	Remote Sensing Earth & Environmental Sciences	
NR 660	Ecology and Biogeography of New Zealand	
NR 661	Restoration Ecology and Ecosystem Management in New Zealand	
NR 703	Watershed Water Quality Management	
NR 707	Environmental Modeling	
NR 744	Biogeochemistry	
NR 751	Aquatic Ecosystems	
NR 757	Remote Sensing of the Environment	
NR 759	Digital Image Processing for Natural Resources	
NR 761	Environmental Soil Chemistry	
<b>Total Credits</b>		28-32

Some students enroll in the EcoQuest program (a study abroad opportunity in New Zealand), which satisfies the policy requirement, and capstone requirement if taken senior year.

Students must complete additional courses for the hydrology option to total 88 credits in the major.

For further information about the hydrology option or to discuss alternative elective courses, students may contact [earth.sciences@unh.edu](mailto:earth.sciences@unh.edu). ([earth.sciences@unh.edu](mailto:earth.sciences@unh.edu))

Capstone Experience

A capstone experience is required of all undergraduate Earth sciences majors during their senior year. All capstone experiences at UNH must meet one or more of the following criteria:

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

Suggested ways of meeting the capstone requirement in the Department of Earth Sciences include approved INCO 790 Advanced Research Experience, ESCI 795 Topics/ESCI 796 Topics, ESCI 799 Senior Thesis, URA/SURF/IROP projects, internships, environmental/geologic field camps, REU programs, or Earth Sciences education and outreach activities designed according to the above criteria. Capstone experiences must be equivalent to a minimum of 2 academic credits. Students should work closely with their faculty advisors to define the most appropriate capstone experience for their Earth Sciences degree program, although the capstone mentor can be someone other than their primary faculty advisor. All capstone experiences must be approved and certified by the faculty advisor and the capstone mentor. Presentation of projects or experiences developed for the capstone is encouraged at the annual UNH Undergraduate Research Conference or other appropriate venue.

Degree Plan

<b>First Year</b>		
<b>Fall</b>		<b>Credits</b>
NR 400	Professional Perspectives in Natural Resources	1
NR 403	Introduction to Environmental Science	4
MATH 425	Calculus I	4
CHEM 403	General Chemistry I (and 403L)	4
ENGL 401	First-Year Writing	4
<b>Credits</b>		<b>17</b>
<b>Spring</b>		
ESCI 409	Geology and the Environment	4
MATH 426	Calculus II	4
CHEM 404	General Chemistry II (and 404L)	4
Discovery Discipline Course <sup>1</sup>		4
<b>Credits</b>		<b>16</b>
<b>Second Year</b>		
<b>Fall</b>		
ESCI 534	Techniques in Environmental Sciences	3
ESCI 561	Landscape Evolution	4
MATH 644	Statistics for Engineers and Scientists	4
Discovery Discipline Course <sup>1</sup>		4
<b>Credits</b>		<b>15</b>
<b>Spring</b>		
NR 504	Freshwater Resources	4

ESCI 512	Principles of Mineralogy	4
PHYS 407	General Physics I	4
Discovery Discipline Course <sup>1</sup>		4
<b>Credits</b>		<b>16</b>

**Third Year****Fall**

PHYS 408	General Physics II	4
BIOL 412	Introductory Biology: Evolution, Biodiversity and Ecology	4
ESCI 777	GIS for Earth & Environmental Sciences	4
Discovery Discipline Course <sup>1</sup>		4
<b>Credits</b>		<b>16</b>

**Spring**

ESCI 654	Fate and Transport in the Environment	4
NR 602	Natural Resources and Environmental Policy	4
NR 658	Introduction to Geographic Information Systems	4
NR 791	Preparation for Capstone	1
Quantitative analysis elective <sup>1</sup>		4
<b>Credits</b>		<b>17</b>

**Fourth Year****Fall**

ESCI 705	Principles of Hydrology	4
Senior Capstone (ESCI 799, INCO 790) or free-elective if capstone is otherwise satisfied		3-4
Approved Science Elective		4
Discovery Discipline Course <sup>1</sup>		4
<b>Credits</b>		<b>15-16</b>

**Spring**

ESCI 710	Groundwater Hydrology	4
Approved Science Elective		4
Free Elective		4
Discovery Discipline Course <sup>1</sup>		4
<b>Credits</b>		<b>16</b>

**Total Credits** **128-129**

evaluate how and why it is changing today, and assess coupled human and natural system interactions.

- Understand Earth processes and cycles.
- Demonstrate knowledge of core concepts in the hydrologic sciences: stream flow, groundwater, water budgets, hydrologic fluxes, and physical factors that affect them, and a basic understanding of the uses and limitations of a hydrologic model.
- Perform field measurements and simple calculations to collect, evaluate and interpret quantitative environmental or geological data. Understand the role that spatially explicit data and time series play in understanding environmental and hydrological sciences.
- Collect, interpret, and synthesize basic field observations and measurements to develop and test multiple working hypotheses to explain them. Additionally, become comfortable with the use of technology and computational methods in processing a range of scientific data.
- Analyze, summarize, evaluate, and explain/present their own scientific data and the primary Earth and environmental sciences literature.
- Communicate results of scientific inquiries orally, visually, and in writing.

<sup>1</sup> One course must be taken in each of the remaining Disciplinary Groups of the University Discovery Program (Environment Technology & Society; Historical Perspectives; World Culture; Fine & Performing Arts; Social Science; Humanities).

<sup>2</sup> Three technical electives must be approved in consultation with departmental advisor.

All students must take four writing intensive courses, including ENGL 401, a course in the major, and a course at the 600/700 level.

## Student Learning Outcomes

Students will be able to:

- Recognize common Earth and environmental materials.
- Understand the Earth as a system and be able to describe the broad attributes of and interactions within the Earth System and the environment through both short- and long- term perspectives,