Cradite

# EARTH SCIENCES MAJOR (B.S.)

https://ceps.unh.edu/earth-sciences/program/bs/earth-sciences-major

#### Description

The Bachelor of Science degree in the Department of Earth Sciences has four specializations designed for students interested in focusing on Earth's climate, geology, geophysics or oceanography. The program provides a strong concentration in geoscience, built upon a solid foundation in mathematics and the physical sciences. The B.S. degree is especially well-suited for students who wish to work in the environmental and geoscience industries, energy sector and climate technologies, teaching at the secondary level, state and federal environmental agencies, or to pursue graduate studies in the Earth sciences, oceanography, and related fields of study. The degree requires a central core of courses and a required specialization in one of climate, geology, geophysics, or oceanography to develop depth in a particular area of the Earth sciences. Students are encouraged to participate in research, field, lab, or internship opportunities to round out their experiences in the degree program.

#### 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**

Code	litle	Credits
Required Courses		
MATH 425	Calculus I <sup>1</sup>	4
MATH 426	Calculus II	4
CHEM 403	General Chemistry I <sup>1,2</sup>	4
CHEM 404	General Chemistry II <sup>1,2</sup>	4
PHYS 407	General Physics I <sup>1</sup>	4
PHYS 408	General Physics II <sup>1</sup>	4
Core Curriculum		
ESCI 401	Dynamic Earth	4
or ESCI 409	Geology and the Environment	
ESCI 402	Earth History	4
ESCI 501	Introduction to Oceanography	4
ESCI 512	Principles of Mineralogy	4
ESCI 530	Geological Field Methods <sup>3</sup>	4
or ESCI 534	Techniques in Environmental Sciences	
Select one of the following:		4
ESCI 654	Fate and Transport in the Environment	
ESCI 690	Capstone & Professional Development	
ESCI 701	Quantitative Methods in Earth Sciences <sup>4</sup>	

Specializations	
Select one of the following approved specializations:	
Climate	
Geology	
Geophysics	
Oceanography	
Science/Math Electives	
Complete three additional approved science/math electives <sup>5</sup>	
Capstone	
Complete the capstone requirement	
Total Credits	48

- Some of these courses may also satisfy Discovery Program requirements.
- <sup>2</sup> Or CHEM 405 Chemical Principles for Engineers if applicable
- <sup>3</sup> ESCI 530 Geological Field Methods is required for the geology and geophysics specializations
- <sup>4</sup> Geophysics specialization must select ESCI 701 Quantitative Methods in Earth Sciences
- <sup>5</sup> The following should be considered: additional 700-level Earth sciences courses; additional chemistry, mathematics, and physics courses; courses in computer science, engineering, and the biological sciences; and an off-campus field camp.

## **Specialization Requirements**

oode	The second se	
Climate Specialization		
ESCI 514	Introduction to Climate	3
ESCI 561	Landscape Evolution	4
Select at least two of the fo	ollowing:	6-7
ESCI 758	Introductory Physical Oceanography	
ESCI 760	Paleoceanography	
ESCI 762	Glacial Geology	
ESCI 765	Paleoclimatology	
Select three advanced-leve	l approved electives	9-12
Total Credits		22-26
Code	Title	Credits
Geology Specialization		
ESCI 561	Landscape Evolution	4
ESCI 614	Introduction to Petrology	4
ESCI 631	Structural Geology	4
BIOL 412	Introductory Biology: Evolution, Biodiversity and Ecology	4
Three approved electives, t	wo of which are at the 700 level	6-8
Total Credits		22-24
Code	Title	Credite
Code	Title	Credits
Code Geophysics Specialization	Title	Credits
Code Geophysics Specialization MATH 527 MATH 528	Title Differential Equations with Linear Algebra	Credits
Code Geophysics Specialization MATH 527 MATH 528	Title Differential Equations with Linear Algebra Multidimensional Calculus	Credits 4 4
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614	Title Differential Equations with Linear Algebra Multidimensional Calculus Landscape Evolution Introduction to Petrology	Credits 4 4 4
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 61	Title Differential Equations with Linear Algebra Multidimensional Calculus Landscape Evolution Introduction to Petrology Structural Geology	Credits 4 4 4
Code Geophysics Specialization MATH 527 MATH 528 ESCI 551 or ESCI 614 ESCI 631 ESCI 631	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology	Credits 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Illowing:         Global Geophysics	Credits 4 4 4 4 4 4 8 8
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 736	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Illowing:         Global Geophysics         Gentertonics	Credits 4 4 4 4 8
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 759	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Illowing:         Global Geophysics         Geotectonics         Geotectonics	Credits 4 4 4 4 8
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 756 ESCI 759 One approved 700-level ele	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Illowing:         Global Geophysics         Geological Oceanography         ctive	Credits 4 4 4 4 4 8 8 34
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 759 One approved 700-level elevel Total Credits	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Introduction to Petrology         Global Geophysics         Geological Oceanography         cttve	Credits 4 4 4 4 4 4 4 8 3 4 3 4 27-28
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 756 ESCI 759 One approved 700-level elee Total Credits	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Structural Geology         Global Geophysics         Geological Oceanography         cttrue	Credits 4 4 4 4 4 8 3 4 3 4 27-28
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 756 ESCI 759 One approved 700-level ele Total Credits	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Illowing:         Global Geophysics         Geological Oceanography         cttve	Credits 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 756 ESCI 759 One approved 700-level ele Total Credits Code	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Illowing:         Global Geophysics         Geological Oceanography         cttve	Credits 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 756 ESCI 759 One approved 700-level ele Total Credits Code Oceanography Specializati BIOL 411	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Introduction to Petrology         Global Geophysics         Geological Oceanography         ctive         Title         on         Introductory Biology. Molecular and Cellular	Credits 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 756 ESCI 759 One approved 700-level ele Total Credits Code Oceanography Specializati BIOL 411 ESCI 514	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Structural Geology         Global Geophysics         Geotectonics         Geological Oceanography         ctive         Title         or         Introductory Biology; Molecular and Cellular         Introduction to Climate	Credits 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 5 6 7 7 7 2 7 2 7 2 7 2 7 2 7 4 3 4 3 4 3 4 3 4 4 3 4 4 3 4 4 4 4 4
Code Geophysics Specialization MATH 527 MATH 528 ESCI 561 or ESCI 614 ESCI 631 Select at least two of the for ESCI 734 ESCI 734 ESCI 759 One approved 700-level ele Total Credits Code Oceanography Specializati BIOL 411 ESCI 514 Select at least three of the	Title         Differential Equations with Linear Algebra         Multidimensional Calculus         Landscape Evolution         Introduction to Petrology         Structural Geology         Structural Geology         Blobal Geophysics         Geotectonics         Geological Oceanography         cttre         Title         or         Introductory Biology: Molecular and Cellular         Introduction to Climate         following:	Credits 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 5 6 7 7 7 8 7 7 8 7 7 8 7 7 8 7 8 7 8 7 8

Total Credits		26-30
Complete three adva	anced-level approved electives	9-12
MEFB 755	Biological Oceanography	
ESCI 759	Geological Oceanography	
ESCI 758	Introductory Physical Oceanography	
ESCI 752	Chemical Oceanography	

### **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.
- 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**

#### **Sample Degree Plan**

This sample degree plan serves as a general guide; students collaborate with their academic advisor to develop a personalized degree plan to meet their academic goals and program requirements.

# **Climate Specialization**

First Year		
Fall		Credits
ESCI 400	Freshman Field Seminar	1
ESCI 401	Dynamic Earth	4
MATH 425	Calculus I	4
CHEM 403	General Chemistry I	4
ENGL 401	First-Year Writing	4
	Credits	17
Spring		
ESCI 402	Earth History	4
MATH 426	Calculus II	4
CHEM 404	General Chemistry II	4

Inquiry Discovery	Course <sup>1</sup>	4
	Credits	16
Second Year		
Fall		
ESCI 501	Introduction to Oceanography	4
ESCI 530	Geological Field Methods	4
or ESCI 534	or Techniques in Environmental Sciences	
PHYS 407	General Physics I	4
Discovery Course	1	4
	Credits	16
Spring		
ESCI 512	Principles of Mineralogy	4
ESCI 514	Introduction to Climate	3
PHYS 408	General Physics II	4
Discovery Course	1	4
	Credits	15
Third Year		
Fall		
FSCI 561	Landscape Evolution	4
ESCI 758	Introductory Physical Oceanography (or	3
or ESCI 760	6/7 )	5
	or Paleoceanography	
ESCI or Free E	lective	4
Discovery Course	1	4
Seminar or Resea	rch Experience	1
	Credits	16
Spring		
ESCI 654	Fate and Transport in the Environment	4
or ESCI 701	or Quantitative Methods in Earth Sciences	
ESCI 762	Glacial Geology (or 6/7_)	4
or ESCI 765	or Paleoclimatology	
ESCI 690	Capstone & Professional Development	1
Science Elective <sup>2</sup>		4
Discovery course		4
	Credits	17
Fourth Year		
Fall		
ESCI 6/7		4
ESCI 758	Introductory Physical Oceanography (or	3
or ESCI 760	6/7_)	
o i – – – – 2	or Paleoceanography	
Science Elective	1	4
Discovery Course		4
Seminar or Resea	rch Experience	I
	Credits	16
Spring		
ESCI 762	Glacial Geology (or 6/7)	4
OF ESUI 765	or Paleoclimatology	
Discourse Course	1	4
Discovery Course		4

Senior Capstone		4
	Credits	16
	Total Credits	129

# **Geology Specialization**

First Year		
Fall		Credits
ESCI 400	Freshman Field Seminar	1
ESCI 401	Dynamic Earth	4
MATH 425	Calculus I	4
CHEM 403	General Chemistry I	4
ENGL 401	First-Year Writing (or pass placement test)	4
	Credits	17
Spring		
ESCI 402	Earth History	4
MATH 426	Calculus II	4
CHEM 404	General Chemistry II	4
Inquiry Discovery	Course <sup>1</sup>	4
	Credits	16
Second Year		
Fall		
ESCI 530	Geological Field Methods	4
ESCI 561	Landscape Evolution	4
PHYS 407	General Physics I	4
Discovery Course	1	4
	Credits	16
Spring		
ESCI 501	Introduction to Oceanography	4
ESCI 512	Principles of Mineralogy	4
PHYS 408	General Physics II	4
Discovery Course	1	4
	Credits	16
Third Year		
Fall		
ESCI 614	Introduction to Petrology	4
ESCI 631	Structural Geology	4
BIOL 412	Introductory Biology: Evolution, Biodiversity	4
	and Ecology	
Discovery Course	1	4
	Credits	16
Spring		
ESCI 654	Fate and Transport in the Environment (or	4
or ESCI 701	b_)	
	Sciences	
ESCI 690	Capstone & Professional Development	1
Free Elective		4
Science Elective <sup>2</sup>		4
Discovery Course	1	4
	Credits	17

Fourth Year	
Fall	
ESCI 7	4
Free Elective	4
Science Elective <sup>2</sup>	4
Discovery Course <sup>1</sup>	4
Credits	16
Spring	
ESCI 7	4
Science Elective <sup>2</sup>	4
Discovery Course <sup>1</sup>	4
Senior Capstone	4
Credits	16
Total Credits	130

**Geophysics Specialization** 

First Year	-	
Fall		Credits
ESCI 400	Freshman Field Seminar	1
ESCI 401	Dynamic Earth	4
MATH 425	Calculus I	4
CHEM 403	General Chemistry I	4
ENGL 401	First-Year Writing (or pass placement test)	4
	Credits	17
Spring		
ESCI 402	Earth History	4
MATH 426	Calculus II	4
CHEM 404	General Chemistry II	4
Inquiry Discovery	Course <sup>1</sup>	4
	Credits	16
Second Year		
Fall		
ESCI 530	Geological Field Methods	4
ESCI 561	Landscape Evolution (or 6/7_)	4
PHYS 407	General Physics I	4
Discovery Course	1	4
	Credits	16
Spring		
ESCI 501	Introduction to Oceanography	4
ESCI 512	Principles of Mineralogy	4
PHYS 408	General Physics II	4
Discovery Course	1	4
	Credits	16
Third Year		
Fall		
ESCI 614	Introduction to Petrology (or 6/7)	4
ESCI 631	Structural Geology	4
MATH 527	Differential Equations with Linear Algebra	4
Discovery Course	1	4
	Credits	16
Spring		

Total Credits	130
Credits	16
2	4
e <sup>1</sup>	4
2	4
Global Geophysics (or ESCI 756)	4
Credits	16
2	4
2	4
	4
Geological Oceanography	4
Credits	17
e <sup>1</sup>	4
2	4
Multidimensional Calculus	4
Capstone & Professional Development	1
	Capstone & Professional Development Multidimensional Calculus Credits Geological Oceanography Credits Global Geophysics (or ESCI 756) Credits Credits Total Credits

# **Oceanography Specialization**

First Year		
Fall		Credits
ESCI 400	Freshman Field Seminar	1
ESCI 401	Dynamic Earth	4
MATH 425	Calculus I	4
CHEM 403	General Chemistry I	4
ENGL 401	First-Year Writing (or pass placement test)	4
	Credits	17
Spring		
ESCI 402	Earth History	4
MATH 426	Calculus II	4
CHEM 404	General Chemistry II	4
Inquiry Discovery	y Course <sup>1</sup>	4
	Credits	16
Second Year		
Fall		
ESCI 501	Introduction to Oceanography	4
ESCI 530 or ESCI 534	Geological Field Methods or Techniques in Environmental Sciences	4
PHYS 407	General Physics I	4
Discovery Cours	e <sup>1</sup>	4
	Credits	16
Spring		
ESCI 512	Principles of Mineralogy	4
ESCI 514	Introduction to Climate	3
PHYS 408	General Physics II	4
Discovery Course	e <sup>1</sup>	4
	Credits	15

#### Third Year Fall **ESCI 758** Introductory Physical Oceanography (or 3 6/7\_) ESCI 6/7\_\_ or Free Elective 4 Science Elective<sup>2</sup> 4 Discovery Course <sup>1</sup> 4 1 Seminar or Research Experience Credits 16 Spring **ESCI 654** Fate and Transport in the Environment (or 4 or ESCI 710 6/7\_) or Groundwater Hydrology ESCI 690 Capstone & Professional Development 1 ESCI 6/7\_\_ or Free Elective 4 **MEFB 755 Biological Oceanography** 4 4 **Discovery Course** 17 Credits Fourth Year Fall ESCI 6/7\_ 4 **ESCI 759** Geological Oceanography (or 6/7\_\_) 4 2 4 Science Elective **Discovery Course** 4 Credits 16 Spring ESCI 752 3 Chemical Oceanography (or 6/7\_) Science Elective<sup>2</sup> 4 **Discovery Course** 4 4 Senior Capstone Seminar or Research Experience 1.0 16 Credits **Total Credits** 129

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

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

#### **Student Learning Outcomes**

### **Program Learning Outcomes Students will be able to:**

- Recognize common Earth materials and structures.
- Describe how Earth scientists construct the geological time scale and apply geochronologic dating techniques.
- Describe the broad attributes of and interactions within the Earth System, as well as its geological history, how and why it is changing today, and how those changes impact society.
- · Understanding Earth processes and cycles.

- Perform simple calculations to process and evaluate quantitative Earth science data..
- Collect, interpret, and synthesize basic field observations and measurements to develop and test multiple working hypotheses to explain them.
- Become proficient in basic geological and Earth science laboratory skills.
- Successfully apply basic calculus and chemistry to Earth science problems.
- Summarize, analyze, and evaluate student-generated scientific data and the primary Earth sciences literature.
- Effectively communicate results of scientific inquiries orally, visually, and in writing.