Geology-Physics/ Mathematics

Geophysics involves the application of physics and mathematics to the study of processes that operate on and within the Earth and other planets, over short and long timescales. The AB degree requires a total of 14 courses, including 6 geoscience courses, 3 physics or engineering courses, and 3 math and applied math courses. The ScB degree requires a total of 20 courses, including 8 geoscience courses, 4 physics or engineering courses, and 3 math and applied courses; students can choose courses from both solid Earth geophysics and climate science themes. Geoscience courses emphasize an analytical and process-oriented approach, with hands-on experiences in labs and on field trips. Active and collaborative learning is encouraged, as is practice in written and oral communication. There are many opportunities for students to engage in research (typically in paid positions) during the academic year or in the summer, in areas such as analysis of seismic waves in subduction zones, theoretical modeling of convection in the Earth’s mantle, modeling the effects of the warming climate in the oceans and atmosphere, and remote sensing of how climate change affects vegetation.

Standard program for the A.B. degree

Recommended for students seeking a liberal education and interested in applying physical and mathematical principles toward an understanding of the processes affecting planets, Earth, and the environment and how they are modeled. Some course requirements may be flexible based on consultation with concentration advisor.

### Four theme courses (choose either the Solid Earth Geophysics Theme or the Climate Science Theme)

**Solid Earth Geophysics Theme**

- GEOL 0220 Physical Processes in Geology
- GEOL 0250 Computational Approaches to Modelling and Quantitative Analysis in Natural Sciences: An Introduction

*or* GEOL 0350 Mathematical Methods of Fluid and Solid Geophysics and Geology

**Climate Science Theme**

- GEOL 0240 Earth: Evolution of a Habitable Planet (climate science theme)
- GEOL 1350 Weather and Climate (climate science theme)

### Additional courses

And select two of the following:

- GEOL 1130 Ocean Biogeochemical Cycles (climate science theme)
- GEOL 1310 Global Water Cycle (climate science theme)
- GEOL 1430 Principles of Planetary Climate (climate science theme)
- GEOL 1510 Introduction to Atmospheric Dynamics (climate science theme)
- GEOL 1520 Ocean Circulation and Climate

**Choose one of the following:**

- PHYS 0050 Foundations of Mechanics

### Additional courses (for the Solid Earth Geophysics Theme)

- CHEM 0330 Physical Chemistry

### Additional courses (for the Climate Science Theme)

- PHYS 0070 Analytical Mechanics
- ENGN 0040 Dynamics and Vibrations

**Choose one of the following:**

- PHYS 0060 Foundations of Electromagnetism and Modern Physics
- ENGN 0310 Mechanics of Solids and Structures
- ENGN 0810 Fluid Mechanics

### Additional courses (for the Solid Earth Geophysics Theme)

- APMA 0330 Methods of Applied Mathematics I, II
- APMA 0340 Methods of Applied Mathematics I, II
- CHEM 0330 Equilibrium, Rate, and Structure (or advanced placement)

**One additional course from upper level geological sciences, mathematics, or supporting sciences with approval from the departmental concentration advisor.**

Total Credits: 14

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1. One course cannot be used to satisfy two requirements.
2. ENGN 0810 or GEOL 1820 are recommended for those completing the Climate Science theme.
3. In addition to courses listed elsewhere, in the Geology-Physics/Math concentrations, these courses are of particular relevance: GEOL 0810, GEOL 1320, GEOL 1710, GEOL 1960A.

### Standard program for the Sc.B. degree

This program is recommended for students interested in graduate study and careers in geophysics, climate science and related fields. Students will be prepared to understand and use models, make measurements, and use theories of the processes studied in these fields. Some course requirements may be flexible based on consultation with concentration advisor.

**Solid Earth Geophysics Theme**

- GEOL 0220 Physical Processes in Geology
- GEOL 1430 Principles of Planetary Climate
- GEOL 1610 Solid Earth Geophysics (solid earth geophysics theme)

**Climate Science Theme**

- GEOL 0240 Earth: Evolution of a Habitable Planet (climate science theme)

### Additional courses

And select two from the following:

- GEOL 1130 Ocean Biogeochemical Cycles (climate science theme)
- GEOL 1310 Global Water Cycle (climate science theme)
- GEOL 1430 Principles of Planetary Climate (climate science theme)
- GEOL 1510 Introduction to Atmospheric Dynamics (climate science theme)
- GEOL 1520 Ocean Circulation and Climate

**Choose one of the following:**

- PHYS 0050 Foundations of Mechanics

### Additional courses (for the Solid Earth Geophysics Theme)

- CHEM 0330 Physical Chemistry

### Additional courses (for the Climate Science Theme)

- PHYS 0070 Analytical Mechanics
- ENGN 0040 Dynamics and Vibrations

**Choose one of the following:**

- PHYS 0060 Foundations of Electromagnetism and Modern Physics
- ENGN 0310 Mechanics of Solids and Structures
- ENGN 0810 Fluid Mechanics

### Additional courses (for the Solid Earth Geophysics Theme)

- APMA 0330 Methods of Applied Mathematics I, II
- APMA 0340 Methods of Applied Mathematics I, II
- CHEM 0330 Equilibrium, Rate, and Structure (or advanced placement)

**One additional course from upper level geological sciences, mathematics, or supporting sciences with approval from the departmental concentration advisor.**

Total Credits: 14

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1. One course cannot be used to satisfy two requirements.
2. ENGN 0810 or GEOL 1820 are recommended for those completing the Climate Science theme.
3. In addition to courses listed elsewhere, in the Geology-Physics/Math concentrations, these courses are of particular relevance: GEOL 0810, GEOL 1320, GEOL 1710, GEOL 1960A.
Choose one:
- GEOL 1510 Introduction to Atmospheric Dynamics
- GEOL 1520 Ocean Circulation and Climate

And choose three from the following:  
- GEOL 1130 Ocean Biogeochemical Cycles
- GEOL 1310 Global Water Cycle
- GEOL 1330 Global Environmental Remote Sensing
- GEOL 1510 Introduction to Atmospheric Dynamics
- GEOL 1520 Ocean Circulation and Climate

Or a field or sea course
- PHYS 0050 Foundations of Mechanics
  - or PHYS 0070 Analytical Mechanics
  - or ENGN 0040 Dynamics and Vibrations
- PHYS 0060 Foundations of Electromagnetism and Modern Physics
  - or ENGN 0310 Mechanics of Solids and Structures
  - or ENGN 0810 Fluid Mechanics

Select two of the following:  
- PHYS 0470 Electricity and Magnetism
- PHYS 0500 Advanced Classical Mechanics
- PHYS 1600 Computational Physics
- ENGN 0510 Electricity and Magnetism
- ENGN 0810 Fluid Mechanics
- ENGN 1370 Advanced Engineering Mechanics
- GEOL 1820 Geophysical Fluid Dynamics

Three courses in mathematics including
- APMA 0330 Methods of Applied Mathematics I, II
  - or APMA 0340 Methods of Applied Mathematics I, II

Two additional courses from upper level geological sciences, mathematics, or supporting sciences with approval from the departmental concentration advisor.
- CHEM 0330 Equilibrium, Rate, and Structure
- GEOL 1970 Individual Study of Geologic Problems

Total Credits: 20

1. One course cannot be used to satisfy two requirements
2. ENGN 0810 or GEOL 1820 are recommended for those completing the Climate Science theme.
3. In addition to courses listed elsewhere, in the Geology-Physics/ Math concentrations, these courses are of particular relevance: GEOL 0810, GEOL 1320, GEOL 1710, GEOL 1960A.