# Earth Sciences, B.S.

**Begin Campus:** Any Penn State Campus  
**End Campus:** University Park

## Program Description

This major provides a comprehensive program in environmental sciences based on a strong emphasis in Earth sciences. It is especially directed toward study of the problems that arise from the complex interaction of humanity’s technological and social activities with the natural environment. Graduates are in demand for positions in government, industry, and consulting. Professional activities include gathering and evaluating data on environments; management and coordination of specialized programs in environmental control and modification; and industrial and government planning. Suitable choices of courses may qualify students for graduate work in several fields.

### What is Earth Sciences?

Earth sciences is the study of interactions between the lithosphere (solid Earth), hydrosphere (oceans and other bodies of water), atmosphere, and biosphere (humans and other animals). It involves a mixture of geosciences, geography, meteorology, and other natural sciences. Earth scientists seek to use a comprehensive understanding of the Earth and environmental processes to solve big picture problems in the world and answer outstanding questions about the universe. The flexible curriculum includes your choice of an interdisciplinary minor, which might include Climatology; Earth Systems; Earth and Sustainability; Energy Business and Finance; Marine Science; Planetary Science and Astronomy; or Watersheds and Water Resources. If you want to personalize your own curriculum, the Earth Sciences major may be right for you.

### You Might Like This Program If...

- You like learning about human interactions with the Earth.  
- You enjoy collaborating with people who have different perspectives and backgrounds.  
- You have a broad interest in geosciences, meteorology, and/or geography, and would like to explore all of these disciplines and learn where they intersect and overlap.  
- You seek to personalize an interdisciplinary curriculum that combines Earth science with other natural sciences such as planetary science or marine science.

## Entrance to Major

In order to be eligible for entrance to this major, a student must:

1. attain at least a C (2.00) cumulative grade-point average for all courses taken at the University; and  
2. have third-semester classification (http://www.registrar.psu.edu/registration/semester_classification.cfm).

READ SENATE POLICY 37-30: ENTRANCE TO AND CHANGES IN MAJOR PROGRAMS OF STUDY (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/37-00-entrance-to-a-college-or-major)

## Degree Requirements

For the Bachelor of Science degree in Earth Sciences, a minimum of 123 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Education</td>
<td>45</td>
</tr>
<tr>
<td>Requirements for the Major</td>
<td>99-101</td>
</tr>
</tbody>
</table>

21 of the 45 credits for General Education are included in the Requirements for the Major. This includes: 9 credits of GN courses; 6 credits of GQ courses; 6 credits of GWS courses.

### General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

**Foundations (grade of C or better is required.)**  
- Quantification (GQ): 6 credits  
- Writing and Speaking (GWS): 9 credits

### Knowledge Domains

- Arts (GA): 6 credits  
- Health and Wellness (GHW): 3 credits  
- Humanities (GH): 6 credits  
- Social and Behavioral Sciences (GS): 6 credits  
- Natural Sciences (GN): 9 credits

### Integrative Studies (may also complete a Knowledge Domain requirement)

- Inter-Domain or Approved Linked Courses: 6 credits

## University Degree Requirements

### First Year Engagement

All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

### Cultures Requirement

6 credits are required and may satisfy other requirements

- United States Cultures: 3 credits
- International Cultures: 3 credits

### University Degree Requirements

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### Cultures Requirement

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- United States Cultures: 3 credits
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Writing Across the Curriculum
3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits
A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work
Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition
The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major
To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

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Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

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Code    Title                                    Credits
Prescribed Courses
BIOL 110  Biology: Basic Concepts and Biodiversity  4
CHEM 110  Chemical Principles I                   3
CHEM 111  Experimental Chemistry I               1
CHEM 112  Chemical Principles II                 3
CHEM 113  Experimental Chemistry II              1
EMSC 100S Earth and Mineral Sciences First-Year Seminar  3
MATH 140  Calculus With Analytic Geometry I      4
MATH 141  Calculus with Analytic Geometry II     4
PHYS 211  General Physics: Mechanics             4
PHYS 212  General Physics: Electricity and Magnetism  4

Additional Courses
ENGL 15   Rhetoric and Composition               3
or ENGL 30 Honors Freshman Composition
Select 15 credits of introductory earth science of the following:  15
EARTH 2   The Earth System and Global Change
EARTH 101 Natural Disasters: Hollywood vs. Reality
EARTH 103 Earth in the Future: Predicting Climate Change and Its Impacts Over the Next Century
EARTH 105N Environments of Africa: Geology and Climate Change
GEOG 30N  Environment and Society in a Changing World
GEOG 110  Climates of the World
GEOG 111
GEOG 115  Landforms of the World

GEOG 160  Mapping Our Changing World
GEOSC 1   Physical Geology
GEOSC 21  Earth and Life: Origin and Evolution
METEO 3   Introductory Meteorology
SOILS 101 Introductory Soil Science

Select 3 credits of writing-intensive courses from within Earth and Mineral Sciences to include, but not limited to the following:  3
GEOG 310  Introduction to Global Climatic Systems
GEOG 412
GEOSC 402  Natural Disasters
GEOSC 470  Introduction to Field Geology
METEO 471  Observing Meteorological Phenomena

Additional Courses: Require a grade of C or better
Select 15 credits of advanced earth science of the following:  15
GEOG 412
GEOG 430  Human Use of Environment
GEOG 438W  Human Dimensions of Global Warming
GEOSC 204  Geobiology
GEOSC 320  Geology of Climate Change
GEOSC 340  Geomorphology
GEOSC 402  Natural Disasters
GEOSC 416  Stable and Radioactive Isotopes in Geosciences: Introduction
METEO 300  Fundamentals of Atmospheric Science
METEO 431  Atmospheric Thermodynamics

Supporting Courses and Related Areas
Select 3-4 credits of advanced math, statistics, computer science in consultation with an adviser
Select 3 credits of field, laboratory experience in consultation with an adviser
Select 8-9 credits in other approved courses (students may apply 6 credits of ROTC)

Supporting Courses and Related Areas: Require a grade of C or better
Select 18 credits, in consultation from an adviser, from one of the following Earth and Mineral Sciences interdisciplinary minors:

- Climatology
- Marine Science
- Watersheds & Water Resources
- Earth Systems

Global Business Strategies for Earth and Environmental Industries

Program Learning Objectives
1. To produce graduates who can collect, analyze, understand, and use data and model results relevant to the Earth and environmental sciences.
2. To produce graduates who possess an interdisciplinary understanding of Earth processes and resources through application of principles of meteorology, geography, and geosciences.

1 The following substitutions are allowed for students attending campuses where the indicated course is not offered: CAS 100 or ENGL 202C can be substituted for EMSC 100S.
2 Courses may not double count with minor requirements.
3. To produce graduates who can communicate the results of scientific inquiry through writing and speaking to an audience with diverse backgrounds and perspectives.

**Academic Advising**

The objectives of the university’s academic advising program are to help advisees identify and achieve their academic goals, to promote their intellectual discovery, and to encourage students to take advantage of both in-and out-of class educational opportunities in order that they become self-directed learners and decision makers.

Both advisers and advisees share responsibility for making the advising relationship succeed. By encouraging their advisees to become engaged in their education, to meet their educational goals, and to develop the habit of learning, advisers assume a significant educational role. The advisee’s unit of enrollment will provide each advisee with a primary academic adviser, the information needed to plan the chosen program of study, and referrals to other specialized resources.

READ SENATE POLICY 32-00: ADVISING POLICY (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/32-00-advISING-policy)

**University Park**

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University Park, PA 16802
814-865-7791
undergrad@geosc.psu.edu

**Suggested Academic Plan**

**University Park Campus**

The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with any degree audit accessible in LionPATH as either an Academic Requirements or What If report. Please consult with a Penn State academic adviser on a regular basis to develop and refine any academic plan that is appropriate for you.

<table>
<thead>
<tr>
<th>Supporting Course</th>
<th>3 Advanced EARTH elective*4</th>
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<tr>
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<th>Credits</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Fall</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Advanced EARTH elective*4</td>
<td>3 Advanced GEOSC/EARTH elective*4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Intro GEOSC/EARTH elective</td>
<td>3 Intro GEOSC/EARTH elective</td>
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<tr>
<td>Supporting Course*3</td>
<td>2 Minor Course*5</td>
<td>3</td>
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</tr>
<tr>
<td>Minor course*5</td>
<td>3 General Education knowledge domain</td>
<td>3</td>
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</tr>
<tr>
<td>General Education knowledge domain</td>
<td>3 Supporting Course*3</td>
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<thead>
<tr>
<th>General Education Health and Wellness (GHW)</th>
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<tr>
<th>Fourth Year</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
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<tr>
<td>Advanced EARTH elective*4</td>
<td>3 Advanced EARTH elective*4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Education Foundation selection (GWS)†</td>
<td>3 EARTH Field/lab experience</td>
<td>3</td>
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</tr>
<tr>
<td>Minor Course*5</td>
<td>3 Writing across the curriculum course in EMS</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>General Education knowledge domain</td>
<td>3 Minor Course*5</td>
<td>3</td>
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<td>1.5 Minor Course*5</td>
<td>3</td>
<td></td>
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<tr>
<td>Advanced Math/CMPSC/STAT</td>
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<table>
<thead>
<tr>
<th>Total Credits 123-124</th>
<th>16.5-17.5</th>
<th>15</th>
</tr>
</thead>
</table>

* Course requires a grade of C or better for the major
† Course requires a grade of C or better for General Education
# Course is an Entrance to Major requirement
‡ Course satisfies General Education and degree requirement

**University Requirements and General Education Notes:**

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of ‘C’ or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate

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<table>
<thead>
<tr>
<th>First Year</th>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 140 or 140G††</td>
<td>4 MATH 141 or 141G††</td>
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<tr>
<td>CHEM 110 (GN)†</td>
<td>3 CHEM 112</td>
<td>3</td>
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<tr>
<td>CHEM 111 (GN)†</td>
<td>1 CHEM 113</td>
<td>1</td>
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<tr>
<td>EMSC 100S (GWS)††</td>
<td>3 ENGL 15, 30, or ESL 15 (GWS)††</td>
<td>3</td>
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<td></td>
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<tr>
<td>Intro GEOSC/EARTH elective</td>
<td>3 Intro GEOSC/EARTH elective</td>
<td>3</td>
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<table>
<thead>
<tr>
<th>Second Year</th>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 211 (GN)†</td>
<td>4 PHYS 212 or 213 and 214</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 110 (GN)†</td>
<td>4 Intro GEOSC/EARTH elective</td>
<td>3</td>
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<tr>
<td>General Education knowledge domain</td>
<td>3 General Education knowledge domain</td>
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<td></td>
<td></td>
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<tr>
<td>General Education knowledge domain</td>
<td>3 Minor course*5</td>
<td>3</td>
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Commonwealth Campuses
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<tbody>
<tr>
<td>MATH 140†</td>
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<td>MATH 141†</td>
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<tr>
<td>CHEM 110 (GN)‡</td>
<td>3</td>
<td>CHEM 112</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 111 (GN)†</td>
<td>1</td>
<td>CHEM 113</td>
<td>1</td>
</tr>
<tr>
<td>Intro GEOSC/EARTH elective²</td>
<td>3</td>
<td>Intro GEOSC/EARTH elective²</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 15, 30, or ESL 15 (GWS)††</td>
<td>3</td>
<td>General Education Foundation selection (GWS)†</td>
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<thead>
<tr>
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<td>PHYS 212 or 213 and 214</td>
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| BIOL 110 (GN)†        | 3       |
| General Education knowledge domain | 3 |
| General Education knowledge domain | 3 |

Supporting Course³ | 3 General Education knowledge domain | 3

Third Year

<table>
<thead>
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<tr>
<td>Advanced EARTH elective⁴</td>
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<td>Advanced GEOSC/EARTH elective⁴</td>
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<td>Supporting Course³</td>
<td>2 Minor Course⁵</td>
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<tr>
<td>Minor course⁵</td>
<td>3 Supporting Course³</td>
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| General Education Health and Wellness (GHW) | 1.5 |

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Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

1 Students who begin their studies at non-UP locations and/or join the college after their first year should substitute CAS 100 (GWS), CAS 100A, CAS 100B, or CAS 100C; or ENGL 202C (GWS) for EM SC 100S (GWS). EM SC 100S Earth and Mineral Sciences First year Seminar (3) is a required course only for students who begin their studies at UP in the College of Earth and Mineral Sciences.


3 Supporting Course: Select 8-9 credits in other approved courses (Students may apply 6 credits of ROTC).

4 Advanced EARTH elective: Select 15 credits of advanced earth science from the following list (courses may not double count with minor requirements): GEOG 430(3), GEOG 438W(3), GEOG 412(3), GEOSC 204(4), GEOSC 320(3), GEOSC 340(3), GEOSC 402(3), GEOSC 416(3), METEO 300(4), METEO 431(3), METEO 475(3).

5 Select 18 credits, in consultation from an adviser, from one of the following Earth and Mineral Sciences interdisciplinary minors:
   CLIMATOLOGY
   MARINE SCIENCE
   WATERSHEDS & WATER RESOURCES
   EARTH SYSTEMS
   ENERGY BUSINESS & FINANCE

Career Paths
The interdisciplinary nature of Earth sciences makes it a suitable degree for a variety of Earth- and environment-related industries, as well as for postgraduate studies in a variety of environmental sciences fields. It is also excellent preparation for a career in science education.

Careers
Graduates are in demand for positions dealing with environmental science, teaching, or environmental law or policy within government, industry, and consulting. These roles focus on gathering and evaluating data on environments, managing and coordinating specialized programs in environmental control and modification, and industrial and government planning.

MORE INFORMATION ABOUT POTENTIAL CAREER OPTIONS FOR GRADUATES OF THE EARTH SCIENCES PROGRAM (http://www.geosc.psu.edu/careers)

Opportunities for Graduate Studies
Graduates of the program may continue on to graduate-level studies in the geosciences, environmental science, meteorology, oceanography, planetary science, or other Earth sciences, as well as environmental law and related programs.

MORE INFORMATION ABOUT OPPORTUNITIES FOR GRADUATE STUDIES (http://www.geosc.psu.edu/graduates)

Professional Resources
- Geosciences Club (https://www.facebook.com/groups/46384419817)
- Association for Women Geoscientists (https://sites.psu.edu/awgpennstate)
- American Water Resources Association Penn State Student Chapter (http://agsci.psu.edu/clubs/list/other/awra)

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