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>

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 cornerstone 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

21 of these 45 credits are included in the Requirements for the Major.

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

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). For more information, check the Suggested Academic Plan for your intended program.

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

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. To graduate, a student must earn at least a 2.00 grade-point average for all courses completed within their degree program.

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.

### Supporting Courses and Related Areas
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

#### Prescribed Courses

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

#### Additional Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ENGL 15</td>
<td>Rhetoric and Composition</td>
<td>3</td>
</tr>
<tr>
<td>or ENGL 30</td>
<td>Honors Freshman Composition</td>
<td></td>
</tr>
<tr>
<td>Select</td>
<td>credits of introductory earth science of the following:</td>
<td>15</td>
</tr>
<tr>
<td>EARTH 2</td>
<td>The Earth System and Global Change</td>
<td></td>
</tr>
<tr>
<td>EARTH 101</td>
<td>Natural Disasters: Hollywood vs. Reality</td>
<td></td>
</tr>
<tr>
<td>EARTH 103</td>
<td>Earth in the Future: Predicting Climate Change and Its Impacts Over the Next Century</td>
<td></td>
</tr>
<tr>
<td>EARTH 105N</td>
<td>Environments of Africa: Geology and Climate Change</td>
<td></td>
</tr>
<tr>
<td>METEO 3</td>
<td>Introductory Meteorology</td>
<td></td>
</tr>
<tr>
<td>GEOG 30N</td>
<td>Environment and Society in a Changing World</td>
<td></td>
</tr>
<tr>
<td>GEOG 110</td>
<td>Climates of the World</td>
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<tr>
<td>GEOG 111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOG 115</td>
<td>Landforms of the World</td>
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</tr>
</tbody>
</table>

#### Supporting Courses and Related Areas
Select 3-4 credits of advanced earth science, 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 15 credits of advanced earth science of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>GEOG 412</td>
<td>Human Use of Environment</td>
</tr>
<tr>
<td>GEOG 438W</td>
<td>Human Dimensions of Global Warming</td>
</tr>
<tr>
<td>METEO 300</td>
<td>Fundamentals of Atmospheric Science</td>
</tr>
<tr>
<td>METEO 431</td>
<td>Atmospheric Thermodynamics</td>
</tr>
</tbody>
</table>

#### Supporting Courses and Related Areas: Require a grade of C or better
Select 18 credits from the following Earth and Mineral Sciences interdisciplinary minors:

#### Global Business Strategies for Earth and Environmental Industries

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 need 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**

Jacob Hoover
Undergraduate Program Coordinator
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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 your 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 an academic plan that is appropriate for you.

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<thead>
<tr>
<th>First Year</th>
<th>Credits Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
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<td></td>
</tr>
<tr>
<td>MATH 140 or 140G†‡</td>
<td>4 MATH 141 or 141G†‡</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 110 (GN)†</td>
<td>3 CHEM 112</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 111 (GN)†</td>
<td>1 CHEM 113</td>
<td>1</td>
</tr>
<tr>
<td>EMSC 100S (GWS)††</td>
<td>3 ENGL 15, 30, or ESL 15 (GWS)††</td>
<td>3</td>
</tr>
<tr>
<td>Intro GEOSC/EARTH elective²</td>
<td>3 Intro GEOSC/EARTH elective²</td>
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<tr>
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<table>
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<tr>
<th>Second Year</th>
<th>Credits Spring</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
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</tr>
<tr>
<td>PHYS 211 (GN)†</td>
<td>4 PHYS 212 or 213 and 214</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 110 (GN)†</td>
<td>4 Intro GEOSC/EARTH elective²</td>
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<td>General Education knowledge domain</td>
<td>3 General Education knowledge domain</td>
<td>3</td>
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<tr>
<td>General Education knowledge domain</td>
<td>3 Minor course *⁵</td>
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<table>
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<tr>
<th>Third Year</th>
<th>Credits Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
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<td></td>
</tr>
<tr>
<td>Advanced EARTH elective *⁴</td>
<td>3 Advanced GEOSC/EARTH elective *⁴</td>
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</tr>
<tr>
<td>Intro GEOSC/EARTH elective²</td>
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<td>Supporting Course *⁶</td>
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<tr>
<td>Minor course *⁵</td>
<td>3 General Education knowledge domain</td>
<td>3</td>
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<tr>
<td>General Education knowledge domain</td>
<td>3 Supporting Course *³</td>
<td>3</td>
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<tr>
<td></td>
<td>General Education Health and Wellness (GHW)</td>
<td>1.5</td>
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<td>14</td>
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<td></td>
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<thead>
<tr>
<th>Fourth Year</th>
<th>Credits Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced EARTH elective *⁴</td>
<td>3 Advanced EARTH elective *⁴</td>
<td>3</td>
</tr>
<tr>
<td>General Education Foundation selection (GWS)‡</td>
<td>3 EARTH Field/lab experience</td>
<td>3</td>
</tr>
<tr>
<td>Minor Course *⁵</td>
<td>3 Writing across the curriculum course in EMS</td>
<td>3</td>
</tr>
<tr>
<td>General Education knowledge domain</td>
<td>3 Minor Course *⁵</td>
<td>3</td>
</tr>
<tr>
<td>General Education Health and Wellness (GHW)</td>
<td>1.5 Minor Course *⁵</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Math/CMPSC/STAT</td>
<td>3-4</td>
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<td></td>
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<td>16.5-17.5</td>
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</tbody>
</table>

Total Credits 123-124

* 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
an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

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.


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

Advanced earth science 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).

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

Commonwealth Campuses

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 your 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 an academic plan that is appropriate for you.

First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 140†</td>
<td>4</td>
<td>MATH 141†</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 110 (GN)†</td>
<td>3</td>
<td>CHEM 112</td>
<td>3</td>
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<tr>
<td>CHEM 111 (GN)†</td>
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<td>CHEM 113</td>
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<tr>
<td>Intro GEOSC/EARTH elective²</td>
<td>3</td>
<td>Intro GEOSC/EARTH elective²</td>
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<tr>
<td>ENGL 15, 30, or ESL 15 (GWS)††</td>
<td>3</td>
<td>General Education Foundation selection (GWS)††</td>
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Total Credits 14

Second Year

<table>
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<th>Fall</th>
<th>Credits</th>
<th>Spring</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>PHYS 211 (GN)†</td>
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Total Credits 14

<table>
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<td>BIOL 110 (GN)†</td>
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<td>Supporting Course³</td>
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Third Year

<table>
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<th>Credits</th>
<th>Spring</th>
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<td>Supporting Course³</td>
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<tr>
<td>Minor course⁵</td>
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<td>Supporting Course³</td>
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<td>General Education knowledge domain</td>
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<td>Minor Course⁵</td>
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<tr>
<td>General Education Health and Wellness (GHW)</td>
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Fourth Year

<table>
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<th>Credits</th>
<th>Spring</th>
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<tr>
<td>Advanced EARTH elective⁴</td>
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<td>General Education Foundation selection (GWS)†</td>
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<td>3</td>
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Total Credits 123-124

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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.

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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 (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 (http://www.geosc.psu.edu/graduates)