

# Earth and Environmental Science, B.S.

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## Degree Offered

- Bachelor of Science

## Nature of the Program

The Bachelor of Science in Earth and Environmental Science exposes students to Earth systems, the processes that drive them, their impacts on human society, and how to apply the scientific method to investigate real-world problems. Graduates will be prepared for both specific and evolving career pathways including: environmental, hydrologic, geochemical, and geospatial consulting; the evolving energy industry (e.g., geothermal energy production, carbon extraction, and sequestration, and discovery and recovery of minerals critical to the battery/electronic production (e.g., rare earth elements)); regulatory agencies at state and federal levels; and entrepreneurial efforts to capitalize on the societal shifts that necessarily accompany our global shift towards a more sustainable future. They will also be well prepared for admission to graduate and professional schools.

Students in the Earth and Environmental Science BS will take courses that focus on geohazard assessment and mitigation, exploration and efficient use of land, water, energy and mineral resources, and developing adaptation and mitigation strategies to environmental and climate change.

## Minors

All students have the possibility of earning one or more minors; a list of all available minors and their requirements (<http://catalog.wvu.edu/undergraduate/minors/>) is available. Please note that students may not earn a minor in their major field.

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## FACULTY

### CHAIR

- Brent McCusker - Ph.D. (Michigan State University)

### ASSOCIATE CHAIR

- Jaime Toro - Ph.D. (Stanford University)

### PROFESSORS

- Kathleen Benison - Ph.D. (The University of Kansas)  
Regular Graduate Faculty, Sedimentary Geology - Planetary Geology
- Dengliang Gao - Ph.D. (Duke University)  
Regular Graduate Faculty, Exploration Geophysics, Petroleum and Structural Geology
- Amy Hessler - Ph.D. (University of Arizona)  
Regular Graduate Faculty, Biogeography, Forest Ecosystems, Climate Variability
- Brent McCusker - Ph.D. (Michigan State University)  
Regular Graduate Faculty, Land Use Change, Africa, Policy Making
- Shikha Sharma - Ph.D. (University of Lucknow)  
Regular Graduate Faculty, Isotope Geochemistry
- Jaime Toro - Ph.D. (Stanford University)  
Regular Graduate Faculty, Structure and Tectonics
- Dorothy Vesper - Ph.D. (Pennsylvania State University)  
Regular Graduate Faculty, Aqueous Geochemistry, Hydrogeology

### ASSOCIATE PROFESSOR

- Jamison Conley - Ph.D. (Pennsylvania State University)  
Regular Graduate Faculty, Spatial Analysis, Geocomputation, Health Geography
- Karen Culcasi - Ph.D. (Syracuse University)  
Regular Graduate Faculty, Geopolitics, Identity, Middle East
- Cynthia Gorman - Ph.D. (Rutgers University)  
Regular Graduate Faculty, Gender, Migration, Human Rights, Refugee Communities
- James Lamsdell - Ph.D. (The University of Kansas)  
Regular Graduate Faculty, Paleobiology, Arthropods, Macroevolution, Heterochrony, Paleoecology, Phylogenetics
- Joseph Lebold - Ph.D. (West Virginia University)  
Regular Graduate Faculty, Paleoecology, Paleontology, Regional Geology

## 2 Earth and Environmental Science, B.S.

- Brenden McNeil - Ph.D. (Syracuse University)  
Regular Graduate Faculty, GIS, Environmental modeling, Forest Ecosystem Services
- Maria Alejandra Perez - Ph.D. (University of Michigan)  
Regular Graduate Faculty, Cultural Geography, Science & Technology Studies, Speleology, Latin America and the Caribbean
- Amy Weislogel - Ph.D. (Stanford University)  
Regular Graduate Faculty, Sedimentology
- Bradley Wilson - Ph.D. (Rutgers University)  
Regular Graduate Faculty, Social Movements, Local/Global Food Systems, Food Justice

### ASSISTANT PROFESSOR

- Vikas Agrawal - Ph.D. (West Virginia University)  
Associate Graduate Faculty, Chemical Hygiene Officer, Isotopic and Biogeochemical Characterization of Geological Materials, Energy and Environment
- Michael Harman - Ph.D. (West Virginia University)  
3D visualization, modeling complex landforms and processes, GIS
- Aaron Maxwell - Ph.D. (West Virginia University)  
Regular Graduate Faculty, Geospatial Instruction, Remote Sensing, Image Analysis, Spatial Modeling
- Charles Shobe - Ph.D. (University of Colorado - Boulder)  
Regular Graduate Faculty, Geomorphology, Earth Surface Processes, Landscape Evolution, Rivers, Source-to-Sink, Numerical Modeling

### PROFESSOR EMERITI

- Robert Behling - Ph.D. (The Ohio State University)
- Timothy Carr - Ph.D. (University of Wisconsin - Madison)
- Joe Donovan - Ph.D. (Pennsylvania State University)
- Greg Elmes - Ph.D. (Pennsylvania State University)
- Trevor Harris - Ph.D. (University of Hull)
- Thomas Kammer - Ph.D. (Indiana University)
- Steven Kite - Ph.D. (University of Wisconsin)
- Kenneth C. Martis - Ph.D. (Michigan University)
- Henry Rauch - Ph.D. (Pennsylvania State University)
- Robert C. Shumaker - Ph.D. (Cornell University)
- Richard Smosna - Ph.D. (University of Illinois)
- Timothy Warner - Ph.D. (Purdue University)
- Thomas Wilson - Ph.D. (West Virginia University)

### Admissions

- First-Time Freshmen are admitted directly into the Earth and Environmental Science major.
- Students transferring from within WVU with 30 or fewer hours must have a minimum GPA of 2.0 to be directly admitted to the Earth and Environmental Science major. Students with 31 hours or more must have completed MATH 124 or MATH 126 with a C- or better and have a minimum GPA of a 2.0.
- Students transferring from another university with 30 or fewer hours must have a minimum GPA of 2.0 to be directly admitted to the Earth and Environmental Science major. Students with 31 hours or more must have completed MATH 124 or MATH 126 with a C- or better and have a minimum GPA of a 2.0

### ADMISSION REQUIREMENTS 2024-2025

The Admission Requirements above will be the same for the 2024-2025 Academic Year.

Major Code: 14F6

### General Education Foundations

Please use this link to view a list of courses that meet each GEF requirement. (<http://registrar.wvu.edu/gef/>)

NOTE: Some major requirements will fulfill specific GEF requirements. Please see the curriculum requirements listed below for details on which GEFs you will need to select.

Code	Title	Hours
<b>General Education Foundations</b>		
F1 - Composition & Rhetoric		3-6
ENGL 101 & ENGL 102 or ENGL 103	Introduction to Composition and Rhetoric and Composition, Rhetoric, and Research Accelerated Academic Writing	
F2A/F2B - Science & Technology		4-6
F3 - Math & Quantitative Reasoning		3-4
F4 - Society & Connections		3
F5 - Human Inquiry & the Past		3
F6 - The Arts & Creativity		3
F7 - Global Studies & Diversity		3
F8 - Focus (may be satisfied by completion of a minor, double major, or dual degree)		9
Total Hours		31-37

Please note that not all of the GEF courses are offered at all campuses. Students should consult with their advisor or academic department regarding the GEF course offerings available at their campus.

## Degree Requirements

Students must complete WVU General Education Foundations requirements, College B.S. requirements, STEM Foundations requirements, major requirements, and electives to total a minimum of 120 hours. For complete details on these requirements, visit the B.S. Degrees tab on the Eberly College of Arts and Sciences (<http://catalog.wvu.edu/undergraduate/eberlycollegeofartsandsciences/#bachelorofsciencetext>) page.

## Departmental Requirements for the B.S. in Earth and Environmental Science

- **Capstone Requirement:** The university requires the successful completion of a Capstone requirement. In Earth and Environmental Science, based on the Area of Emphasis (AoE): GEOL 403, GEOL 404, GEOG 452, or GEOL 496. The course selected for the capstone should not be already used to meet any other major requirement.
- **Writing and Communication Requirement:** Earth and Environmental Science Bachelor of Science students fulfill the Writing and Communication Skills requirement by completing ENGL 101 and ENGL 102 (or ENGL 103), and two additional **SpeakWrite Certified Courses™**.
- **Areas of Emphasis:** Earth and Environmental Science majors will choose a curriculum from one of these Areas of Emphasis:
  - Climate and Environmental Science
  - Geoscience and Sustainable Energy
  - GIS Methods
- **Calculation of the GPA in the Major:** A minimum grade of C- is required in all courses applied to major requirements. If a course is repeated, all attempts will be included in the calculation of the GPA, unless the course is eligible for a D/F repeat.
- **Benchmark Expectations:** For details, go to the **Earth and Environmental Science progress tab**.

## Curriculum Requirements

Code	Title	Hours
	University Requirements	49
	ECAS B.S. Requirements	
	Departmental Requirements	21
	Earth and Environmental Science Major Requirements	50
Total Hours		120

## University Requirements

Code	Title	Hours
	General Education Foundations (GEF) 1, 2, 3, 4, 5, 6, 7, and 8 (31-37 Credits)	
	Outstanding GEF Requirements 1, 4, 5, 6, and 7	18
SUST 191	First-Year Seminar	1

General Electives	30
Total Hours	49

## ECAS Bachelor of Science Requirements

Code	Title	Hours
	Global Study and Diversity Requirement (F7)	

## Departmental Requirements

Code	Title	Hours
Mathematics and Statistics Requirement:		7
STAT 211	Elementary Statistical Inference	
Select one option:		
MATH 153/154 or MATH 155	Calculus 1a with Precalculus Calculus 1	
SCIENCE REQUIREMENT:		14
Select one set:		
PHYS 101 & 101L & PHYS 102 & PHYS 102L	Introductory Physics 1 and Introductory Physics 1 Laboratory and Introductory Physics 2 and Introductory Physics 2 Laboratory	
PHYS 111 & 111L & PHYS 112 & PHYS 112L	General Physics 1 and General Physics 1 Laboratory and General Physics 2 and General Physics 2 Laboratory	
Select one set: *		
CHEM 115 & 115L & CHEM 116 & CHEM 116L	Fundamentals of Chemistry 1 and Fundamentals of Chemistry 1 Laboratory and Fundamentals of Chemistry 2 and Fundamentals of Chemistry 2 Laboratory	
CS 110 & CS 111	Introduction to Computer Science and Introduction to Data Structures	
Total Hours		21

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Students should consult with an adviser to select the proper set based on AoE selected.

## Earth and Environmental Science Major Requirements

Code	Title	Hours
<b>FOUNDATION COURSES</b>		<b>19</b>
SUST 101 & 101L	Sustainable Earth and Sustainable Earth Laboratory	
SUST 102	Global Sustainability	
SUST 201 & 201L	Earth System Science and Earth System Science Laboratory	
SUST 240	Earth Data Analytics	
SUST 250 & 250L	Digital Earth and GIS and Digital Earth and GIS Laboratory	
SUST 388	Careers in Sustainability	
<b>AREA of EMPHASIS:</b>		<b>16</b>
Climate and Environmental Science		
Geoscience and Sustainable Energy		
GIS Methods		
<b>UPPER-DIVISION ELECTIVES *</b>		<b>12</b>
Select 12 credits of GEOL, GEOG or SUST at the 300-or above		

**CAPSTONE: 3**

Select one from the following based on the AoE selected:

GEOL 403	Geological Data Analysis
GEOL 404	Geology Field Camp
GEOG 452	Geographic Information Science: Applications
GEOL 496	Senior Thesis

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Total Hours 50

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Courses used to fulfill an AoE requirement may not be used to fulfill upper-division electives.

**Suggested Plans of Study****First Year**

<b>Fall</b>	<b>Hours</b>	<b>Spring</b>	<b>Hours</b>
SUST 101 & 101L (ECAS First Area Course 1; F2A)		4 F4	3
SUST 102 (ECAS First Area Course 2; F8)		3 ENGL 101 (F1)	3
SUST 191		1 Select one of the following (ECAS B.S. Second Area Course 1):	3-4
MATH 155 (F3)		4 CHEM 115 & 115L	
General Elective		3 CS 110	
		SUST 240	3
		General Elective	3
		<hr/>	
		15	15

**Second Year**

<b>Fall</b>	<b>Hours</b>	<b>Spring</b>	<b>Hours</b>
Select one of the following (ECAS B.S. Second Area Course 2):		3-4 ENGL 102 (F1)	3
CHEM 116 & 116L		ECAS Global Studies and Diversity Requirement (f7)	3
CS 111		PHYS 101 & 101L (ECAS Area 3 Course 1)	4
STAT 211 (F8)		3 AoE Course 1	3
SUST 201 & 201L		4 General Elective	2
SUST 250 & 250L (F8)		4	
General Elective		1	
		<hr/>	
		15	15

**Third Year**

<b>Fall</b>	<b>Hours</b>	<b>Spring</b>	<b>Hours</b>
PHYS 102 & 102L (ECAS Area 3 Course 2)		4 SUST Studies Elective Course 1	3
SUST 388		1 SUST Studies Elective Course 2	3
AoE Course 2		3 AoE Course 4	3
AoE Course 3		4 General Elective	3
F5		3 F6	3
		<hr/>	
		15	15

**Fourth Year**

<b>Fall</b>	<b>Hours</b>	<b>Spring</b>	<b>Hours</b>
AoE Course 5		3 Capstone	3
SUST Studies Elective Course 3		3 SUST Studies Elective Course 4	3
General Elective		3 General Elective	3

General Elective	3 General Elective	3
General Elective	3 General Elective	3
	15	15

Total credit hours: 120

## Areas of Emphasis

- Climate and Environmental Science
- Geoscience and Sustainable Energy
- GIS Methods

## Climate and Environmental Science Area of Emphasis Curriculum

Code	Title	Hours
<b>CLIMATE &amp; ENVIRONMENTAL SCIENCE CORE COURSES:</b>		<b>10</b>
SUST 207 & 207L	Climate System Science and Climate System Science Laboratory	
GEOL 275	Geologic Field & Computer Methods	
GEOL 365	Environmental Geology	
<b>CLIMATE &amp; ENVIRONMENTAL SCIENCE ELECTIVES:</b>		<b>6</b>
Select 2 courses from the following:		
GEOL 321	Geomorphology	
GEOL 463	Physical Hydrogeology	
SUST 308	Climate Modeling	
Total Hours		16

## Geoscience and Sustainable Energy Area of Emphasis Curriculum

Code	Title	Hours
GEOL 275	Geologic Field & Computer Methods	3
GEOL 286 & 286L	Introduction to Minerals & Rocks and Introduction to Minerals & Rocks Laboratory	4
GEOL 311 & 311L	Stratigraphy and Sedimentation and Stratigraphy and Sedimentation Laboratory	4
GEOL 341 & 341L	Structural Geology and Structural Geology Laboratory	4
SUST 372	Sustainable Energy	3
Total Hours		18

## GIS Methods Area of Emphasis Curriculum

Code	Title	Hours
<b>GIS METHODS CORE COURSES:</b>		<b>10</b>
GEOG 350 & 350L	Geospatial Problem Solving and Geospatial Problem Solving Lab	
GEOG 451	Introduction to GIS Programming	
GEOG 455 & 455L	Introduction to Remote Sensing and Introduction to Remote Sensing Laboratory	
<b>GIS METHODS ELECTIVES:</b>		<b>6</b>
Select 2 courses from the following:		
GEOG 300	Geographical Data Analysis	
GEOG 409	Applied International Development	
GEOG 452	Geographic Information Science: Applications	
GEOG 453	Spatial Databases	
GEOG 454	Environmental Geographic Information Systems	
GEOG 456	Remote Sensing Applications	

GEOG 457	Open-Source Spatial Analytics
GEOG 461	Web GIS
GEOG 462	Digital Cartography
SUST 302	Research for Sustainable Development

Total Hours	16
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## Degree Progress

- Majors are expected to maintain a 2.0 GPA overall and a 2.0 in all SUST, GEOG and GEOL courses.
- By the end of the 4th semester in the major, students should have completed SUST 201, 240, and 250 and should be making satisfactory progress through the sequence of STEM requirements for the major (CHEM 115 or CS 110; PHYS 101 or 111; and MATH 150 or 153 or 155)
- All majors must meet with their departmental advisor each semester to evaluate progress.

Students who do not meet these benchmarks may be removed from their major.

## Major Learning Outcomes

### EARTH AND ENVIRONMENTAL SCIENCE

1. Apply knowledge of the relationship between earth systems and society to sustainability challenges.
2. Develop and evaluate sustainable solutions using quantitative, qualitative, computational, or geospatial skills.
3. Identify, document, and describe relationships between rock, water, air, and life in the context of Earth as a complex and dynamic system.
4. Apply the scientific method to generate, interpret, model and evaluate 2D, 3D, and temporal data to address Earth Science and Sustainability-related problems.
5. Communicate technical information clearly and effectively in written, oral, graphical, and geospatial format to diverse audiences in order to inform evidence-based decision-making.

### WVUTeach: Earth and Space Science

Code	Title	Hours
ARSC 120	Inquiry Approaches to Teaching	1
ARSC 220	Inquiry-Based Lesson Design	1
GEOL 376L	Research Methods Laboratory	3
MATH 318	Perspectives on Mathematics and Science	3
UTCH 221	Knowing and Learning in Mathematics and Science	3
UTCH 322	Classroom Interactions in Math and Science	3
UTCH 420	Project-Based Instruction in Mathematics and Science	3
UTCH 430	Apprentice Teaching in Math and Science	10
Total Hours		27