EARTH AND ENVIRONMENTAL GEOSCIENCES

Majors:

- Bachelor of Science, Earth and Environmental Geosciences (p. 1)

Minor:

- Earth and Environmental Sciences (p. 1)
- Geographic Information Systems (p. 2)

Bachelor of Science, Earth and Environmental Sciences (EEG), minimum 120 hours

Geosciences study both past and present of the Earth. They incorporate many aspects of our complex planet including its composition, structure, environment, internal and surficial processes, and the development of life, continents, and oceans through time. They play a critical role in interpreting the Earth's long history of physical and biological changes, finding and managing natural resources, and understanding natural hazards and future environmental change. The Earth and Environmental Geosciences program provides a broad foundation in the fundamentals of earth and environmental science as well as an interdisciplinary curriculum that includes geosciences, biology, chemistry, and other allied science courses. It also prepares students for both careers in the Earth and environmental geosciences, and for further academic studies.

Science Breadth Requirements		
BIO 152	Concepts of Biology II: Evolution & Ecology	3
CHM 123 & 123L	General Chemistry I and General Chemistry Laboratory	4
CHM 124 & 124L	General Chemistry II and General Chemistry II Laboratory	4
MTH 148	Introductory Calculus I [1]	3
MTH 149	Introductory Calculus II [1]	3
PHY 201	College Physics I [2]	3
PHY 202	College Physics II [2]	3
GIS 450	Applied Geographic Information Systems	4
or GIS/HRS 451	Geographic Information Systems (GIS) for Human Rights	
or GIS 452	Geographic Information Systems Applications in Water Resources Planning & Management	
Total Hours		**27**

Major Requirements		
GEO 115 & 115L	Physical Geology and Physical Geology Laboratory	4
GEO 116 & 116L	Geological History of the Earth and Geological History of the Earth Laboratory	4
Select among the following major electives, including at least one capstone option (to total at least 30 credit hours):		**30**
GEO 201 & 201L	Mineralogy and Mineralogy Laboratory	
GEO 202 & 202L	The Inner Earth and The Inner Earth Laboratory	
GEO 301 & 301L	Structural Geology and Structural Geology Laboratory	
GEO 308 & 308L	Problems & Decisions in Environmental Geology and Problems & Decisions in Environmental Geology Laboratory	
GEO 401 & 401L	Paleontology and Paleontology Laboratory	
GEO 402 & 402L	Glacial Geology and Glacial Geology Laboratory	
GEO 404	Problems in Geology	
GEO 407 & 407L	Sculpted Planet: Geomorphology, Surface Processes, and the Origins of Earth's Topography and Sculpted Planet Laboratory	
GEO 409 & 409L	Surface & Groundwater Hydrology and Surface and Groundwater Hydrology Laboratory	
GEO 410 & 410L	Stratigraphy and Sedimentology and Stratigraphy and Sedimentology Laboratory	
GEO 412 & 412L	Introductory Geochemistry and Introductory Geochemistry Laboratory	
GEO 477	Honors Thesis Project	
GEO 479L	Environmental Instrumentation Laboratory	
SEE 301	Earth Systems & Global Climate Change	
GIS 455	Environmental Remote Sensing	
GIS 460	Advanced Geographic Information Systems	
Capstone Options		
GEO 303	Field Geology	
GEO 495	Geosciences Seminar	
GEO 498	Geological Research and Thesis	
Total Hours		**38**

Breadth		
ASI 150	Introduction to the University Experience	1
Total Hours to total at least		120

1 MTH 148 and MTH 149 can be substituted by MTH 168 and MTH 169.

2 PHY 201 and PHY 202 can be substituted with PHY 206 and PHY 207.

Minor in Earth and Environemental Geosciences

Geosciences study both past and present of the Earth. They incorporate many aspects of our complex planet including its composition, structure, environment, internal and surficial processes, and the development of life, continents, and oceans through time. They play a critical role in interpreting the Earth's long history of physical and biological changes, finding and managing natural resources, and understanding natural hazards and future environmental change. The Earth and Environmental Geosciences program provides a broad foundation in the fundamentals of earth and environmental science as well as an interdisciplinary curriculum that includes geosciences, biology, chemistry, and other allied science courses.

Earth and Environmental Geosciences	
GEO courses (200-level or higher)	12
Total Hours	**12**

Minor in Geographic Information Systems

Geographic information systems (GIS) is used in a wide range of disciplines, and the minor is a great option for undergraduate students who are interested in becoming proficient at managing, analyzing, and displaying all forms of geographically referenced information.

Geographic Information Systems		
Select one of the following:		**4**
GIS 450	Applied Geographic Information Systems	
GIS/HRS 451	Geographic Information Systems (GIS) for Human Rights	
GIS 452	Geographic Information Systems Applications in Water Resources Planning & Management	
Required courses		
GIS 455	Environmental Remote Sensing	4
GIS 460	Advanced Geographic Information Systems	4
Total Hours		**12**

First Year

Fall	Hours	Spring	Hours
ASI 150	1	GEO 116 & 116L	4
GEO 115 & 115L	4	CHM 124 & 124L	4
CHM 123 & 123L	4	MTH 149	3
MTH 148 (Satisfies CAP Mathematics)	3	HUM 102 (CAP Humanities Commons)	3
HUM 101 (CAP Humanities Commons)	3	CMM 100 (CAP Oral Communication)	3
	15		**17**

Second Year

Fall	Hours	Spring	Hours	Summer	Hours
BIO 152	3	PHY 202	3	GEO 303 (Satisfies CAP Major Capstone)	6
PHY 201	3	GEO Elective w/ Lab (200-400 level)	4		
ENG 200 (CAP Second-Year Writing)	3	GEO Elective w/ Lab (200-400 level)	4		
GEO Elective w/ Lab (200-400 level)	4	CAP Arts Course	3		
GEO Elective w/ Lab (200-400 level)	4	CAP Social Science Course	3		
	17		**17**		**6**

Third Year

Fall	Hours	Spring	Hours
GIS 450	4	GEO Elective w/ Lab (200-400 level)	4
GEO Elective w/ Lab (200-400 level)	4	GEO Elective w/ Lab (200-400 level)	4
GEO Elective w/ Lab (200-400 level)	4	Social Science Elective	3
CAP Advanced Religious Studies/Faith Traditions Course	3	CAP Advanced Historical Studies/Interdisciplinary Investigations Course	3
	15		**14**

Fourth Year

Fall	Hours	Spring	Hours
CAP Advanced Philosophical Studies/ Practical Ethical Action Course	3	CAP Diversity and Social Justice Course	3
GEO Elective w/ Lab (optional)	4	GEO Elective w/ Lab (optional)	4
General Electives	6	General Electives	5
	13		**12**

Total credit hours: 126

Geology Courses

GEO 103. Principles of Geography. 3 Hours
The study of spatial processes that shape the Earth's physical and cultural environment through a survey of major branches of physical and human geographic inquiry.

GEO 109. Earth, Environment, and Society. 3 Hours
This course examines the complex relationship between natural geologic processes and their effects on human society. The course will examine fundamental geologic processes and associated hazards (such as earthquakes, tsunamis, volcanic eruptions, flooding) while also assessing human impacts such as pollution, energy industry and land-use planning. This course provides an opportunity to discuss, from a geologic perspective, the ramifications of and potential solutions to problems associated with utilization of Earth's resources. Laboratory optional but not required. No prerequisite.

GEO 109L. Earth, Environment, and Society Lab. 1 Hour
Laboratory exercises in Earth and Environmental Science to accompany GEO 109 Lecture. Two hours each week. Prerequisites: (GEO 109 or GEO 103 or GEO 115 or GEO 208 or GEO 218 – or co-req); permission of instructor.

GEO 115. Physical Geology. 3 Hours
Introductory course in geologic principles and processes. Examines Earth's major systems including the solid Earth, atmosphere, hydrosphere, and cryosphere. Laboratory optional for non-majors.

GEO 115L. Physical Geology Laboratory. 1 Hour
Physical Geology Lab - laboratory exercises in Physical Geology to accompany GEO 115 lecture. Prerequisite(s): (GEO 109 or GEO 115 or GEO 208 or SCI 210 – or co-req); permission of instructor.

GEO 116. Geological History of the Earth. 3 Hours
Study of earth history over the last 4.6 billion years - from its origins to the present day. Includes earth origins, the development of the earth during the Precambrian including evolution of the atmosphere, and the appearance of prokaryotic and eukaryotic life. Major biological development and environmental, tectonic, and climatic changes during the last half-billion years (the Phanerozoic) will be examined, including the Pleisotocene "Ice Age" and Anthropocene conditions. Prerequisite(s): (GEO 109 or GEO 115 or GEO 208 or SCI 210); permission of instructor.

GEO 116L. Geological History of the Earth Laboratory. 1 Hour
Geological History of the Earth Laboratory - laboratory exercises in Historical Geology to accompany GEO 116 lecture. Corequisites: GEO 116.

GEO 198. Geology, Landscape & Environment of the Miami Valley. 3 Hours
Field-based course examining the geologic history of the Miami Valley and Dayton area; processes leading to the modern landscape; the impact of human activity will be assessed. Prerequisite(s): GEO 109 or GEO 115 or permission of instructor.

GEO 1HG. Human Geography. 0-3 Hours

GEO 201. Mineralogy. 3 Hours
Introduction to crystallography, crystal chemistry and crystal structure. Study of the major groups of rock-forming minerals, their association and occurrence with emphasis on identification by physical properties and optical techniques. Prerequisites: GEO 109, GEO 115, GEO 208, or SCI 210 or permission of instructor. Corequisites: GEO 201L.

GEO 201L. Mineralogy Laboratory. 1 Hour
Course to accompany GEO 201. Three hours per week. Prerequisites: GEO 109, GEO 115, GEO 208, or SCI 210. Corequisites: GEO 201.

GEO 202. The Inner Earth. 3 Hours
Exploration of the Earth's internal processes of magmatism, metamorphism and deformation as part of its larger-scale processes of convection, conduction, and plate tectonics. Prerequisites: GEO 201 and GEO 201L. Corequisites: GEO 202L.

GEO 202L. The Inner Earth Laboratory. 1 Hour
Laboratory course to accompany GEO 202 The Inner Earth. 3 hours per week. Prerequisites: GEO 201 and GEO 201L. Corequisites: GEO 202.

GEO 208. Environmental Geology. 3 Hours
Envirionmental Geology is the study of the relationship of geologic factors to natural hazards and the problems of water supply, pollution, erosion, land use, and earth resource utilization. Laboratory optional.

GEO 208L. Environmental Geology Laboratory. 1 Hour
Laboratory course to accompany GEO 208. This lab is designed to provide practical exercises that will enhance a student's understanding of how human beings interact with the geological environment. Lab activities will take an experiential, inquiry#based approach to topics relevant in past, present, and future societies. One two#hour laboratory per week concurrently run with the GEO 208 lecture course. Prerequisites: (GEO 109 or GEO 115 or GEO 208 or SCI 210 – or co-req); permission of instructor.

GEO 218. Geological Site Investigation for Engineers. 3 Hours
Exploration of the principles of geological site investigation applied to land-use planning, geohazard risk analysis, and diverse engineering applications.

GEO 234. Energy Resources. 3 Hours
The chemical and geological aspects of formation, production, and benefits/costs (including environmental impacts) of energy derived from fossil fuels (coal and hydrocarbons), biofuels (e.g., ethanol production), radioactive materials (nuclear power), and renewable sources (e.g., geothermal, hydro, wind, and solar power).

GEO 301. Structural Geology. 3 Hours
The origin and development of structural features of the earth's crust; folding, faulting, mountain building processes, and deformational fabrics. Prerequisites: GEO 109 or GEO 115 or SCI 210 or GEO 208 or GEO 218. Corequisites: GEO 301L.

GEO 301L. Structural Geology Laboratory. 1 Hour
Course to accompany GEO 301. Three hours each week. Corequisites: GEO 301.

GEO 303. Field Geology. 6 Hours
Field studies in Geology and Environmental Geology. This course focuses on geologic field techniques, rock outcrop description and interpretation. Current field sites include Colorado and New Zealand. Prerequisite(s): GEO 115 or GEO 109 or GEO 208 or GEO 218.

GEO 308. Problems & Decisions in Environmental Geology. 3 Hours
An in-depth examination of selected environmental problems and the way in which scientific information guides practice and policy. Topics will range from investigations of natural hazards to considerations of land use and water resources. Prerequisites: GEO 109 or GEO 115 or GEO 208 or SCI 210.

GEO 308L. Problems & Decisions in Environmental Geology Laboratory. 1 Hour
Course to accompany GEO 308. Three hours each week and periodic field work.

GEO 401. Paleontology. 3 Hours
The study of ancient life. The morphology, ecology, evolution, and stratigraphic distributions of selected invertebrates, vertebrates, and plants.

GEO 401L. Paleontology Laboratory. 1 Hour
Course to accompany GEO 401. Two hours each week.

GEO 402. Glacial Geology. 3 Hours
The origin of mountain and continental glaciers; their depositional features, erosive activity and dynamics; history of glaciation in geologic past with special emphasis on North American Quaternary ice advances. Prerequisites: GEO 115 or GEO 109 or SCI 210 or GEO 208.

GEO 402L. Glacial Geology Laboratory. 1 Hour
Course to accompany GEO 402. Three hours each week.

GEO 404. Problems in Geology. 0-3 Hours
In this course, students will engage in faculty mentored experiential learning in Geology and Environmental Geosciences. These experiences may be related to geoscience research activity in a field or laboratory setting and course outcomes will be assessed through a final report following the experience. Prerequisites: Instructor Permission.

GEO 407. Sculpted Planet: Geomorphology, Surface Processes, and the Origins of Earth's Topography. 3 Hours
Detailed study of the processes shaping the Earth's surface and the landforms and deposits that they produce. Prerequisites: GEO 115 or GEO 109 or SCI 210 or GEO 208 or GEO 218.

GEO 407L. Sculpted Planet Laboratory. 1 Hour
Course to accompany GEO 407. Three hours each week. Corequisites: GEO 407.

GEO 409. Surface & Groundwater Hydrology. 3 Hours
This course is designed to provide a science or engineering student with the fundamental concepts and principles central to the study of water as a resource. This will include an examination of all components of the hydrologic cycle including surface-water hydrology and management, groundwater hydrogeology, and water resource management. Prerequisites: GEO 115 or SCI 210 or GEO 208 or GEO 109 or GEO 218 or permission of instructor.

GEO 409L. Surface and Groundwater Hydrology Laboratory. 1 Hour
Laboratory exercises to accompany GEO 409. Three hours per week. Corequisites: GEO 409.

GEO 410. Stratigraphy and Sedimentology. 3 Hours
Investigation and interpretation of sedimentary rocks, sedimentary environments, and the stratigraphic record. Prerequisites: GEO 116.

GEO 410L. Stratigraphy and Sedimentology Laboratory. 1 Hour
Laboratory exercises to accompany GEO 410. Three hours each week. Corequisites: GEO 410.

GEO 412. Introductory Geochemistry. 3 Hours
Study of elementary thermodynamics, aqueous geochemistry, and principles governing the distribution of trace elements, radioisotopes and stable isotopes in igneous, metamorphic and sedimentary rocks. Emphasis on applications and solution of geological problems. Prerequisite(s): GEO 201 or permission of instructor.

GEO 412L. Introductory Geochemistry Laboratory. 1 Hour
Course to accompany GEO 412. Three hours each week.

GEO 420. The Internet of Things. 3 Hours
Introduction to the multi-disciplinary topic of Internet of Things (IoT), a blend of engineering and science. The course begins with a fundamental technical understanding of the IoT architecture. From this foundation, students experience hands-on labs in a team environment with theoretical justification. The applied work features environmental sensor networking with geospatial data. Each surface area in IoT is explored from sensors and embedded devices to protocols and virtual servers highlighted by current trends within IoT. Lastly, the history, software and influential people will be discussed to provide class context. Ultimately, students scaffold their knowledge through a series of labs, team challenges and supporting lectures to create a final business proposal for a real client IoT value proposition. Prerequisite(s): Sophomores, Juniors, and Seniors only.

GEO 477. Honors Thesis Project. 3 Hours
First of two courses leading to the selection, design, investigation, and completion of an independent, original Honors Thesis project under the guidance of a faculty research advisor. Restricted to students in the University Honors Program with permission of the program director and department chairperson. Students pursuing an interdisciplinary thesis topic may register for three semester hours each in two separate disciplines in consultation with the department chairpersons. Prerequisite(s): Approval of University Honors Program.

GEO 478. Honors Thesis Project. 3 Hours
Second of two courses leading to the selection, design, investigation, and completion of an independent, original Honors Thesis project under the guidance of a faculty research advisor. Restricted to students in the University Honors Program with permission of the program director and department chairperson. Students pursuing an interdisciplinary thesis topic may register for three semester hours each in two separate disciplines in consultation with the department chairpersons. Prerequisite(s): Approved 477; approval of University Honors Program.

GEO 479L. Environmental Instrumentation Laboratory. 3 Hours
This is a field-based course designed for students majoring in the sciences. A significant portion of this course focuses on experiential learning in the field and laboratory. Students will learn the use of field and laboratory-based equipment to study current environmental issues. Emphasis is placed on team-centered approaches to investigating environmental problems. Prerequisites: GEO 115 or SCI 210 or GEO 109 or GEO 208 or GEO 218 or by permission of instructor.

GEO 480. Senior Capstone Project & Presentation. 3 Hours
Project and presentation in the scholarship, activity and/or practice related to the major. Students will present their work in a forum appropriate to the major.

GEO 495. Geosciences Seminar. 1 Hour
This is a seminar course designed to develop students' ability to communicate and synthesize geoscience knowledge they learned from previous courses through specific topics of societal importance. Students will also be introduced to professional practices, and ready for a career in geosciences. Prerequisite(s): GEO 115 and GEO 116.

GEO 498. Geological Research and Thesis. 3 Hours
Research project within an area of the geological sciences, including, but not limited to, environmental geology, geochemistry, geomorphology, or paleontology. The results are to be presented in a written thesis. Prerequisite(s): Permission of Instructor.

Geology and Environmental Geosciences Courses

GIS 450. Applied Geographic Information Systems. 4 Hours
Introduction of concepts and implementation of analysis in geographic information systems (GIS).

GIS 451. Geographic Information Systems (GIS) for Human Rights. 4 Hours
This course introduces the concepts and implementation of analysis in geographic information systems (GIS), and applies the GIS tool to different human rights situations or investigations. This course is cross-listed with HRS 451 and GIS 551.

GIS 452. Geographic Information Systems Applications in Water Resources Planning & Management. 4 Hours
An introduction to GIS applications in water resource management. Following an introduction to GIS basics, this course focuses on GIS techniques in surface water modeling and floodplain delineation and management.

GIS 455. Environmental Remote Sensing. 4 Hours
Introduction to principles and concepts of remote sensing, a sophisticated technology of earth observation that provides fundamental data for global environmental investigation.

GIS 460. Advanced Geographic Information Systems. 4 Hours
Building upon GEO 450 / GEO 550, this course aims to broaden students' understanding of GIS theories and emphasize advanced spatial analysis, modeling and visualization methodologies. Based on an applied approach, this course will use a variety of projects to illustrate these techniques. This course is to be co-listed with GIS 560. Prerequisites: (GIS 450 or GIS 550) or (GIS 451 or GIS 551) or (GIS 452 or GIS 552) or (GEO 450 or GEO 550) or (GEO 451 or GEO 551) or (GEO 452 or GEO 552).