

# GEOLOGY AND ENVIRONMENTAL GEOSCIENCES

## Majors:

- Bachelor of Science, Environmental (p. 1) Geosciences (p. 1)
- Bachelor of Science, Geology (p. 3)

## Minor:

- Geology (p. 4)

Geology is the study of the Earth, both past and present. It incorporates 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. Geology plays 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 geology department offers two programs leading to Bachelor of Science degrees in geology and environmental geosciences. The geology (GEO) major provides basic courses in the geological sciences as well as a range of advanced level classes that allow students to develop courses of study that complement particular interests within the field such as energy and mineral resources, plate tectonics or paleontology.

The environmental geosciences (EVG) program is broad in scope, providing a broad foundation in the fundamentals of earth and environmental science as well as an interdisciplinary curriculum that includes geology, biology, chemistry, and other allied science courses. The EVG curriculum stresses the interdisciplinary nature of modern environmental issues such as climate change and the development of alternative energy resources.

The geology department also offers a Geographic Information Systems (GIS) Certificate Program. GIS is used in a wide range of disciplines, and the certificate program is a great option for professionals, graduate students, and undergraduate students who are interested in becoming proficient at managing, analyzing, and displaying all forms of geographically referenced information.

The geology department aims to prepare students for both careers in the geological sciences, and for further academic studies. Hence, graduates of the department are also highly competitive for entry to graduate programs. Geology department majors pursue careers in a wide range of settings including:

- State and Federal Geological Agencies
- Geological Consulting Companies
- Natural Resource Exploration, Development and Management
- Museums
- Research Laboratories
- Education

Environmental geologists address critical needs of our society including global climate change, groundwater protection, energy resources, and the identification and assessment of natural hazards.

A minor in geology consists of 12 semester hours.

**FACULTY LISTINGS** (<https://udayton.edu/artsscience/academics/geology-environmental-geosciences/facstaff/>)

## Bachelor of Science, Environmental Geosciences (EVG) minimum 120 hours

The following program, leading to the Bachelor of Science with a major in environmental geosciences, is designed to present students with the basic courses in the geological sciences as well as provide specific environmental geology courses. The program also requires additional related science courses.

The Common Academic Program (CAP) is an innovative curriculum that is the foundation of a University of Dayton education. It is a learning experience that is shared in common among all undergraduate students, regardless of their major. Some CAP requirements must be fulfilled by courses taken at UD (e.g., Capstone and Diversity and Social Justice). Some major requirements must also be fulfilled by courses taken at UD. Students should consult with their advisor regarding applicability of transfer credit to fulfill CAP and major program requirements.

### Common Academic Program (CAP) <sup>1</sup>

First-Year Humanities Commons <sup>2</sup>	12 cr. hrs.
HST 103 Introduction to Global Historical Studies	
REL 103 Introduction to Religious and Theological Studies	
PHL 103 Introduction to Philosophy	
ENG 100 Writing Seminar I <sup>3</sup>	
Second-Year Writing Seminar <sup>4</sup>	0-3 cr. hrs.
ENG 200 Writing Seminar II	
Oral Communication	3 cr. hrs.
CMM 100 Principles of Oral Communication	
Mathematics	3 cr. hrs.
Social Science	3 cr. hrs.
Arts	3 cr. hrs.
Natural Sciences <sup>5</sup>	7 cr. hrs.
Crossing Boundaries	up to 12 cr. hrs.

Faith Traditions	
Practical Ethical Action	
Inquiry	
Integrative	
Advanced Study	
Philosophy and/or Religious Studies (6 cr. hrs.)	
Historical Studies (3 cr. hrs.) <sup>6</sup>	
Diversity and Social Justice <sup>7</sup>	3 cr. hrs.
Major Capstone <sup>8</sup>	0-6 cr. hrs.

<sup>1</sup> The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student's degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.

<sup>2</sup> May be completed with ASI 110 and ASI 120 through the Core Program.

<sup>3</sup> May be completed with ENG 100A and ENG 100B, by placement.

<sup>4</sup> May be completed with ENG 114 or ENG 198 or ASI 120.

<sup>5</sup> Must include two different disciplines and at least one accompanying lab.

<sup>6</sup> May be completed with ASI 110 and ASI 120 through the Core Program.

<sup>7</sup> May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, Arts, or Natural Sciences CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student's major.

<sup>8</sup> The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.

#### Science Breadth Requirements

(Satisfies CAP Mathematics and CAP Natural Science)

BIO 152	Concepts of Biology II: Evolution & Ecology	3
CHM 123 & 123L	General Chemistry and General Chemistry Laboratory	4
CHM 124 & 124L	General Chemistry and General Chemistry Laboratory	4
MTH 148 or MTH 168	Introductory Calculus I or Analytic Geometry & Calculus I	3
MTH 149 or MTH 169	Introductory Calculus II or Analytic Geometry & Calculus II	3
PHY 201	College Physics I	3
PHY 202	College Physics II	3
<b>Total Hours</b>		<b>23</b>

#### Major Requirements

GEO 115 & 115L	Physical Geology and Physical Geology Laboratory	4
or GEO 109 & 109L	Earth, Environment, and Society and Earth, Environment, and Society Lab	
or GEO 208 & 208L	Environmental Geology and Environmental Geology Laboratory	

or SCI 210 & 210L	The Dynamic Earth and The Dynamic Earth Laboratory	
GEO 201 & 201L	Mineralogy and Mineralogy Laboratory	4
GEO 303	Field Geology <sup>Satisfies CAP major's capstone requirement.</sup>	6
GEO 307 & 307L	Geomorphology and Geomorphology Laboratory	4
GEO 309 & 309L	Surface & Groundwater Hydrology and Surface and Groundwater Hydrology Laboratory	4
GEO 412 & 412L	Introductory Geochemistry and Introductory Geochemistry Laboratory	4
GEO 450	Applied Geographic Information Systems	4
GEO 479L	Environmental Instrumentation Laboratory	3

Select GEO electives from: 12

GEO 116 & 116L	Geological History of the Earth and Geological History of the Earth Laboratory	
GEO 202 & 202L	The Inner Earth and The Inner Earth Laboratory	
GEO 234	Energy Resources	
GEO 301 & 301L	Structural Geology and Structural Geology Laboratory	
GEO 302 & 302L	Glacial Geology and Glacial Geology Laboratory	
GEO 308 & 308L	Problems & Decisions in Environmental Geology and Problems & Decisions in Environmental Geology Laboratory	
GEO 310 & 310L	Stratigraphy and Sedimentology and Stratigraphy and Sedimentology Laboratory	
GEO 401 & 401L	Paleontology and Paleontology Laboratory	
GEO 404	Problems in Geology	
GEO 420	The Internet of Things	
GEO 455	Environmental Remote Sensing	
GEO 477	Honors Thesis Project	
GEO 495	Geology Seminar	
GEO 498	Geological Research and Thesis	
SEE 301	Earth Systems & Global Climate Change	

Select science electives from: 8

BIO 151 & 151L	Concepts of Biology I: Cellular & Molecular Biology and Concepts of Biology Laboratory I: Cellular & Molecular Biology	
BIO 310 & 310L	Ecology and Ecology Laboratory	
BIO 340 & 340L	Culture, Biodiversity & Resources Management and Culture, Biodiversity & Resources Management Laboratory	
BIO 359	Sustainability & the Biosphere	
BIO 407 & 407L	Plant Diversity & Ecology and Plant Diversity & Ecology Laboratory	
BIO 409 & 409L	Ecological Restoration and Ecological Restoration Laboratory	
BIO 439	Analysis & Interpretation of Biological Data	
BIO 441	Environmental Plant Biology	
BIO 452 & 452L	Biology of Rivers & Lakes and Biology of Rivers & Lakes Laboratory	

BIO 459 & 459L	Environmental Ecology and Environmental Ecology Laboratory
CEE 312 & 312L	Geotechnical Engineering and Geotechnical Engineering Laboratory
CEE 333	Water Resources Engineering
CEE 434 & 434L	Water & Wastewater Engineering and Water & Wastewater Engineering Laboratory
CHM 341 & 341L	Environmental Chemistry and Environmental Chemistry Laboratory
CPS 132	Computer Programming for Engineering & Science
CPS 144	Introduction to Computer Programming
CPS 150	Algorithms & Programming I
CPS 151	Algorithms & Programming II
MEE 473	Renewable Energy Systems
MTH 207	Introduction to Statistics
MTH 218	Analytic Geometry & Calculus III
MTH 219	Applied Differential Equations
MTH 367	Statistical Methods I
MTH 368	Statistical Methods II
PHY 220	Energy & Environmental Physics
SEE 435	System Modeling for Sustainability

**Total Hours** **53**

#### Breadth

ASI 150	Introduction to the University Experience	1
Social and Behavioral Sciences (Includes CAP Social Science)		6
Total Hours to total at least		120

## Bachelor of Science, Geology (GEO) minimum 120 hours

The Common Academic Program (CAP) is an innovative curriculum that is the foundation of a University of Dayton education. It is a learning experience that is shared in common among all undergraduate students, regardless of their major. Some CAP requirements must be fulfilled by courses taken at UD (e.g., Capstone and Diversity and Social Justice). Some major requirements must also be fulfilled by courses taken at UD. Students should consult with their advisor regarding applicability of transfer credit to fulfill CAP and major program requirements.

#### Common Academic Program (CAP) <sup>1</sup>

First-Year Humanities Commons <sup>2</sup>		12 cr. hrs.
HST 103	Introduction to Global Historical Studies	
REL 103	Introduction to Religious and Theological Studies	
PHL 103	Introduction to Philosophy	
ENG 100	Writing Seminar I <sup>3</sup>	
Second-Year Writing Seminar <sup>4</sup>		0-3 cr. hrs.
ENG 200	Writing Seminar II	
Oral Communication		3 cr. hrs.
CMM 100	Principles of Oral Communication	

Mathematics	3 cr. hrs.
Social Science	3 cr. hrs.
Arts	3 cr. hrs.
Natural Sciences <sup>5</sup>	7 cr. hrs.
Crossing Boundaries	up to 12 cr. hrs.
Faith Traditions	
Practical Ethical Action	
Inquiry	
Integrative	
Advanced Study	
Philosophy and/or Religious Studies (6 cr. hrs.)	
Historical Studies (3 cr. hrs.) <sup>6</sup>	
Diversity and Social Justice <sup>7</sup>	3 cr. hrs.
Major Capstone <sup>8</sup>	0-6 cr. hrs.

<sup>1</sup> The credit hours listed reflect what is needed to complete each CAP component. However, they should not be viewed as a cumulative addition to a student's degree requirements because many CAP courses are designed to satisfy more than one CAP component (e.g., Crossing Boundaries and Advanced Studies) and may also satisfy requirements in the student's major.

<sup>2</sup> May be completed with ASI 110 and ASI 120 through the Core Program.

<sup>3</sup> May be completed with ENG 100A and ENG 100B, by placement.

<sup>4</sup> May be completed with ENG 114 or ENG 198 or ASI 120.

<sup>5</sup> Must include two different disciplines and at least one accompanying lab.

<sup>6</sup> May be completed with ASI 110 and ASI 120 through the Core Program.

<sup>7</sup> May not double count with First-Year Humanities Commons, Second-Year Writing, Oral Communication, Social Science, Arts, or Natural Sciences CAP components, but may double count with courses taken to satisfy other CAP components and/or courses taken in the student's major.

<sup>8</sup> The course or experience is designed by faculty in each major; it may, or may not, be assigned credit hours.

#### Science Breadth Requirements

(Satisfies CAP Mathematics and CAP Natural Sciences)		
CHM 123 & 123L	General Chemistry and General Chemistry Laboratory	4
CHM 124 & 124L	General Chemistry and General Chemistry Laboratory	4
MTH 148	Introductory Calculus I	3

or MTH 168	Analytic Geometry & Calculus I	
MTH 149	Introductory Calculus II	3
or MTH 169	Analytic Geometry & Calculus II	
PHY 201	College Physics I	3
PHY 202	College Physics II	3
<b>Total Hours</b>		<b>20</b>

**Major Requirements**

GEO 115 & 115L	Physical Geology and Physical Geology Laboratory	4
or GEO 109 & 109L	Earth, Environment, and Society and Earth, Environment, and Society Lab	
or GEO 208 & 208L	Environmental Geology and Environmental Geology Laboratory	
or SCI 210 & 210L	The Dynamic Earth and The Dynamic Earth Laboratory	
GEO 116 & 116L	Geological History of the Earth and Geological History of the Earth Laboratory	4
GEO 201 & 201L	Mineralogy and Mineralogy Laboratory	4
GEO 202 & 202L	The Inner Earth and The Inner Earth Laboratory	4
GEO 301 & 301L	Structural Geology and Structural Geology Laboratory	4
GEO 303	Field Geology <sup>Satisfies CAP major's capstone requirement.</sup>	6
GEO 307 & 307L	Geomorphology and Geomorphology Laboratory	4
GEO 310 & 310L	Stratigraphy and Sedimentology and Stratigraphy and Sedimentology Laboratory	4
GEO 450	Applied Geographic Information Systems	4
Select GEO electives from:		12
GEO 302 & 302L	Glacial Geology and Glacial Geology Laboratory	
GEO 308 & 308L	Problems & Decisions in Environmental Geology and Problems & Decisions in Environmental Geology Laboratory	
GEO 309 & 309L	Surface & Groundwater Hydrology and Surface and Groundwater Hydrology Laboratory	
GEO 401 & 401L	Paleontology and Paleontology Laboratory	
GEO 404	Problems in Geology	
GEO 411	Petrology	
GEO 412 & 412L	Introductory Geochemistry and Introductory Geochemistry Laboratory	
GEO 420	The Internet of Things	
GEO 455	Environmental Remote Sensing	
GEO 477	Honors Thesis Project	
GEO 478	Honors Thesis Project	
GEO 479L	Environmental Instrumentation Laboratory	
GEO 495	Geology Seminar	
GEO 498	Geological Research and Thesis	
SEE 301	Earth Systems & Global Climate Change	
Science electives and laboratories where applicable from:		6

BIO, CHM, CPS, GEO, MTH, PHY, Engineering <sup>1</sup>	
<b>Total Hours</b>	<b>56</b>

**Breadth**

ASI 150	Introduction to the University Experience	1
Social and Behavioral Sciences (Includes CAP Social Science)		6
<b>Total Hours to total at least</b>		<b>120</b>

<sup>1</sup> With permission of department chairperson.

**Minor in Geology (GEO)****Geology**

Select four GEO courses (300/400 level) <sup>1</sup>	12
<b>Total Hours</b>	<b>12</b>

<sup>1</sup> Appropriate prerequisites must be completed.

- Bachelor of Science, Environmental Geology (p. 4)
- Bachelor of Science, Geology (p. 3)

**Environmental Geology**

First Year			
Fall	Hours	Spring	Hours
ASI 150		1 GEO 116 & 116L	4
GEO 115 & 115L (CAP Natural Science w/lab)		4 CHM 124 & 124L	4
CHM 123 & 123L		4 MTH 149	3
MTH 148		3 HST 103	3
ENG 100 (CAP Humanities Commons)		3 PHL 103	3
		<b>15</b>	<b>17</b>
Second Year			
Fall	Hours	Spring	Hours
GEO 201 & 201L		4 GEO 409	3
BIO 151 (CAP Natural Science)		3 GEO 409L	1
ENG 200 (CAP Writing Seminar)		3 BIO 152	3
PHY 201		3 PHY 202	3
REL 103, PHL 103, or HST 103 (CAP Humanities Commons)		3 CMM 100 (CAP Communication)	3
		CAP Arts	3
		<b>16</b>	<b>16</b>
Third Year			
Fall	Hours	Spring	Hours
GEO 407		3 GEO 412	3
GEO 407L		1 GEO 412L	1
GEO 450		4 GEO Elective + Lab	4
SSC 200 (CAP Social Science)		3 Social Science	3
CAP Adv REL/Faith		3 CAP Advanced Historical Studies	3
		<b>14</b>	<b>14</b>

Fourth Year			
Fall	Hours	Spring	Hours
GEO 479L		3 GEO Elective + Lab	4
GEO Elective + Lab		4 Science Elective	3
Science elective		3 CAP Diversity and Social Justice	3
CAP Integrative		3	
CAP Adv PHL/PEA		3	
		<b>16</b>	<b>10</b>

Total credit hours: 118

## Geology

First Year			
Fall	HourSpring	HourSummer	Hours
ASI 150	1 GEO 116 & 116L	4 GEO 303	6
GEO 115 & 115L (CAP Natural Science w/lab)	4 MTH 149	3	
ENG 100 (CAP Humanities Commons)	3 CHM 124	3	
MTH 148	3 CHM 124L	1	
CHM 123L	1 HST 103	3	
CHM 123	3 PHL 103	3	
		<b>15</b>	<b>17</b>
			<b>6</b>

Second Year			
Fall	HourSpring	Hours	
GEO 201	4 CMM 100 (CAP & 201L Communication)	3	
REL 103, PHL 103, or HST 103 (CAP Humanities Commons)	3 GEO 202	3	
GEO 450	4 GEO 202L	1	
PHY 201	3 PHY 202	3	
ENG 200	3 Science Elective 1 CAP Arts	3	
		<b>17</b>	<b>16</b>

Third Year			
Fall	HourSpring	Hours	
CAP Adv REL/Faith	3 CAP Adv HST/Inquiry	3	
GEO 301	3 Science Elective 2	3	
GEO 301L	1 Social Sciences 3	3	
SSC 200	3 GEO 410	3	
GEO 407	3 GEO 410L	1	
GEO 407L	1		
		<b>14</b>	<b>13</b>

Fourth Year			
Fall	HourSpring	Hours	
CAP Integrative	3 GEO Elective 3	4	
GEO Elective 1	4 CAP DSJ	3	
GEO Elective 2	4 GEO	4	
CAP Adv PHL/PEA	3		
		<b>14</b>	<b>11</b>

Total credit hours: 123

## 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 104. Biology-Geology Field Course. 3 Hours

Fundamental earth science topics with emphasis on direct field experience. One week on campus, three weeks in the Rocky Mountains near Denver, Colorado, and one week of travel. For all non-geology and non-biology majors. Corequisite(s): BIO 104; (BIO 104L or GEO 104L).

### GEO 104L. Biology-Geology Field Laboratory. 1 Hour

Course to accompany GEO 104.

### 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. Prerequisite(s): (GEO 109 or GEO 115 or GEO 208 or SCI 210 – 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 Pleistocene "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 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 204. Geology for Teachers. 4 Hours**

Introduction for preservice teachers to the Earth system and the processes that operate in the atmosphere, hydrosphere, biosphere, and solid Earth. Emphasis is on understanding how interactions among these fundamental Earth systems maintain our livable planet. Students will explore the Earth system through best practices in teaching and inquiry, and through field trips. For ECE, EMS, and EMM majors only. Students completing this course may not take SCI 210. Prerequisite(s): EDT 110; SCI 190.

**GEO 208. Environmental Geology. 3 Hours**

Environmental 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 SCI 210, 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 411. Petrology. 3 Hours**

Study of the formation of sedimentary, igneous, and metamorphic rocks.  
Prerequisite(s): GEO 201.

**GEO 411L. Petrology Laboratory. 1 Hour**

Course to accompany GEO 411. Two hours each week. Prerequisite(s): GEO 201.

**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 450. Applied Geographic Information Systems. 4 Hours**

Introduction of concepts and implementation of analysis in geographic information systems (GIS).

**GEO 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 GEO 551.

**GEO 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.

**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 485. 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.

**GEO 495. Geology Seminar. 1 Hour**

Introduction to professional practices in the geosciences. Students will attend seminar talks by guest speakers, research career options and graduate programs in the earth sciences, develop a professional resume, and participate in other profession-building activities. May be repeated. Prerequisite(s): Permission of instructor.

**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.