

# Department of Geological Sciences

**FACULTY** Professors Foster (chair), Gorman; Associate Professor Helenek.

The primary objective of the geological sciences program is to develop an awareness of the earth as a dynamic and unified system in time and space. It is the study of the solid earth, its atmosphere and oceans, its life forms, and their dynamics through geologic time. Applied aspects include mineral and energy resource exploration and environmental evaluation.

The curriculum is preparatory for careers in geology, engineering geology, geophysics, hydrogeology, and oceanography, or secondary earth science teaching. Emphasis is placed upon understanding geoscience concepts through discussion, laboratory work, field observation and participation in independent research projects.

Several programs are available depending upon the interest of the student. Majors should consult with departmental advisors early in their undergraduate careers to insure for a properly planned program.

## Geological Sciences (Professional) Program

This program is designed for individuals preparing for post-graduate professional study, or seeking careers in industry or government as professional geologists. Students enrolled in the professional program must achieve a minimum grade of C in all required geology and supporting courses and have an overall GPA of at least 2.25 to meet departmental graduation requirements. Course requirements for the professional program are as follows:

GES 101, 102 Earth Science and GES 110, 111 Historical Geology .....	8
GES 201 Mineralogy and GES 202 Optical Crystallography .....	8
GES 302 Invertebrate Zoology .....	4
GES 305 Petrology and Petrography.....	4
GES 312 Structural Geology and Tectonics .....	4
GES 321 Paleontology .....	4
GES 407 Sedimentology and GES 421 Stratigraphy.....	8
Approved field mapping course.....	6

46 hrs.

Required supporting courses: MTH 121 and 122; CIS 102 or CS 104; CHM 161 and 166, or 162; PHY 110 and 201 with labs; or equivalent courses.

Majors with interests in specific areas of the geological sciences (geochemistry, mineralogy, petrology, paleontology, oceanography, structural geology) may take additional courses concentrating on these topics.

## Applied Geology and Hydrogeology Program

This is an applied geology program oriented toward hydrogeology, environmental geology, and geophysics. Students enrolled in this program must achieve a minimum grade of C in all required geology, civil engineering and supporting courses and have an overall GPA of at least 2.5 to meet departmental graduation requirements. Course requirements for the applied geology and hydrogeology program are as follows:

GES 150 Engineering Geology.....	3
GES 102 Earth Science Lab.....	1
GES 110, 111 Historical Geology .....	4
CE 150 Mechanics I and CE 250 Mechanics II.....	6
GES 201 Mineralogy.....	4
CE 301 Mechanics of Materials .....	3
CE 304 Fluid Mechanics and CE 308 Geotechnical Engineering .....	7
GES 312 Structural Geology and Tectonics .....	4
GES 450 Hydrogeology .....	4
GES 421 Stratigraphy.....	4
GES 461 Introductory Geophysics .....	3
Approved elective.....	3

46 hrs.

Required supporting courses: MTH 121, 122, 207, 223, and 224; CIS 102 or CS 104; CHM 161 and 166, or 162; PHY 110 and 201 with labs; or equivalent courses.

## Earth Sciences Program

This program is preparatory for a career in secondary earth science teaching and meets requirements for secondary education teacher certification. Certification requirements are listed under the Department of Teacher Education (Secondary Education). A second teaching field is required; general science is suggested as the second field. Students must consult with advisor for specific requirements for the second teaching field. A minimum of 38 semester hours in courses from the College of Education and Health Sciences must be completed in addition to the courses listed below:

GES 101, 102 Earth Science and GES 110, 111 Historical Geology .....	8
GES 201 Mineralogy.....	4
GES 302 Invertebrate Zoology .....	4
GES 300 Oceanography .....	3
AST 300 Astronomy <b>or</b> AST 310 Astronomy and Astrophysics.....	3
GES 311 Geomorphology.....	3
GES 312 Structural Geology and Tectonics .....	4
GES 321 Paleontology .....	4
GES 335 Weather Elements .....	3

36 hrs.

Required supporting courses: BIO 123 or 124, one year of college chemistry, math through trigonometry, PHY 100.

\*MTH 109-110 if not sufficiently prepared for calculus (MTH 121).

## Environmental Science Program

Details of this program are listed elsewhere in this catalog.

## Suggested Freshman Program

### Geological Sciences Professional

#### First Semester

ENG 101 or COM 103 .....	3
GES 101 and 102 .....	4
*MTH 121 .....	4
CHM 161 .....	4
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#### Second Semester

COM 103 or ENG 101 .....	3
GES 110 and 111 .....	4
MTH 122 .....	4
CHM 166 or 162 .....	5
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### Applied Geology and Hydrogeology

#### First Semester

ENG 101 .....	3
GES 110 and 111 .....	4
MTH 121 .....	4
CHM 161 .....	4
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#### Second Semester

COM 103 .....	3
GES 150 .....	3
GES 102 .....	1
MTH 122 .....	4
CHM 166 or 162 .....	5
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## Minor in Geological Sciences

Students desiring a minor in geological sciences must take a minimum of 22 hours in geological sciences and earn a grade of C or better in each course.

The 22 required hours must be distributed as follows:

1. Required courses - 8 hours: GES 101, 102, 110 and 111.
2. A minimum of 14 hours from one of the following options:
  - Option A (Oceanography - Paleontology):  
GES 302, 300, 321, 421
  - Option B (Engineering - Applied Geology):  
GES 201, 312, 421, 450
  - Option C (Business - International Affairs):  
GES 300, 311, 335 and 493 (World Mineral Resources)
  - Option D (Igneous - Metamorphic Geology):  
GES 201, 202, 305, 312
  - Option E (Sedimentary Geology):  
GES 201, 312, 407, 421

## Course Descriptions

### GES 101 Principles of Earth Science

**3 hrs. (Gen. Ed. FS)**

The earth in space; weather, earth materials, and geological processes that control development of the earth's surface.

### GES 102 Principles of Earth Science Laboratory

**1 hr.**

Laboratory related to GES 101. One two-hour laboratory per week. Prerequisite: GES 101 or equivalent, or concurrent enrollment.

### GES 110 Principles of Historical Geology

**3 hrs. (Gen. Ed. FS)**

Introduction to history of the earth and its life forms; methods used by geologists to decipher earth history using rocks and fossils. Theory of evolution, origins of life, fossilization, animal and plant extinctions, mountain building, plate tectonics, and the Ice Age.

### GES 111 Principles of Historical Geology Laboratory

**1 hr. (Gen. Ed. FS)**

Laboratory related to GES 110. Study and interpretation of topographic and geologic maps, earth history, and fossils. One two-hour laboratory per week. Prerequisite: GES 110 or equivalent, or concurrent enrollment.

### GES 150 Principles of Engineering Geology

**3 hrs.**

For science or engineering students interested in technical aspects of geology. Sediments, rocks, structures, and hydrologic processes in civil engineering practice. Prerequisite: MTH 109, 110; or equivalents.

### GES 201 Mineralogy

**4 hrs.**

The crystalline state: physical and chemical properties of minerals; occurrence, association, and origin of the silicate and more important non-silicate minerals. Lecture and laboratory. Prerequisites: GES 101; one semester of college chemistry, or consent of the instructor.

### GES 202 Optical Crystallography

**4 hrs.**

Determination of optical constants of crystals; systematic identification of minerals. Lecture and laboratory. Prerequisite: GES 201.

### GES 205 Directed Field Study

**1-2 hrs.**

Directed study of regional geologic structure, paleontology, lithology, topography, and stratigraphy. Emphasis on similarities and differences, and examination of processes responsible for their development. Structural framework of the continent: cratonic, shield, and geosynclinal elements. Prerequisite: GS major or consent of Department Chair.

### GES 300 Oceanography: The Human Perspective

**3 hrs. (Gen. Ed. TS)**

Introduction to scientific oceanography and its relationship to human life. History of oceanography and its technology; crustal movements; the ocean as a source of mineral resources; the variety of ocean life such as jellyfish and sharks, and their danger; whales and the human perspective of "lower" life; sound and submarine warfare, waves and their potential energy and destructive capacity; human pollution. Prerequisite: one college-level science course.

**GES 302 Invertebrate Zoology****4 hrs.**

Detailed biological survey of major groups of invertebrate animals. Emphasis on marine phyla with good fossil representation. Dissection of representative types. Lecture and laboratory. Cross listed as BIO 302. Prerequisite: elementary zoology or biology or historical geology with laboratory, or consent of instructor.

**GES 305 Petrology and Petrography****4 hrs.**

Origin of igneous and metamorphic rocks; processes responsible for their development. Microscopic and megascopic examination of textures and constituent minerals. Lecture and laboratory; field trip. Prerequisite: GES 201.

**GES 311 Geomorphology****3 hrs.**

Detailed analysis of the origin, control of development, evolution, and classification of landforms produced in various geologic materials and structures. Lecture and laboratory. Prerequisites: GES 101, 102; or consent of instructor.

**GES 312 Structural Geology and Tectonics****4 hrs.**

The earth's crust; emphasis on deformation in its upper part, and causes and effects of deformation as indicated in the rocks and rock units. Lecture and laboratory. Prerequisites: GES 101; trigonometry.

**GES 321 Paleontology****4 hrs.**

Life, from its earliest record to the present. Emphasis on large scale aspects of evolution. General survey of pertinent concepts in morphology, genetics, taxonomy, and ecology; introduction to elementary quantitative methods; megascopic and microscopic study of major types of fossils. Lectures, laboratory work, independent research, field trips. Prerequisite: GES 110, 111, 302; or consent of instructor.

**GES 335 Weather Elements****3 hrs.**

Analysis of fundamental physical processes of the atmosphere; their relationships to the daily weather pattern and weather forecasting in the U.S. Prerequisite: GES 101, or consent of the instructor.

**GES 407 Sedimentology****4 hrs.**

Geology of sedimentary deposits: sedimentary processes; genetic interpretation of sediments and sedimentary rocks. Lectures, laboratory, independent research, field trips. Prerequisite: GES 202.

**GES 410 Principles of Geochemistry****3 hrs.**

Origin and distribution of chemical elements in nature. Geochemical processes; their relationship to evolution of rock and mineral systems. Prerequisite: GES 202.

**GES 421 Stratigraphy****4 hrs.**

Concepts and methods in description, classification, correlation, and interpretation of stratified rocks. Field studies. Prerequisite: GES 321.

**GES 450 Hydrogeology****3 hrs.**

Introduction to geologic and hydrologic aspects of groundwater. Emphasis on hydrogeologic systems that may be impacted by pollutants: waste disposal, site exploration, site testing, and prediction of the fate of contaminants in the subsurface. Laboratory measurements of permeability, porosity, physical and chemical properties of soil, and hydrodynamic dispersion parameters. Prerequisites: PHY 201, MTH 122, and CS 104; or equivalents; or consent of instructor.

**GES 461 Introductory Geophysics****3 hrs.**

Introductory examination of the earth using principles of physics and applied mathematics. The earth's place in the Universe; the earth's structure, shape, heat flow, and magnetic and electric characteristics; processes responsible for these characteristics. Prerequisite: consent of instructor.

**GES 493, 494 Special Topics in Geological Sciences****1-4 hrs. each**

Topics of special interest which may vary each time course is offered. Topic stated in current Schedule of Classes. May be repeated under a different topic for a maximum of 8 hrs. credit per course.

**GES 505 Field Observation in Natural History****4 hrs.**

For non-majors: field oriented investigation of diverse topographic forms, mountain structures, and materials composing the earth. Develops understanding of rapidly deteriorating environment through observation of geophysical, astronomical, and biological variations. One week of classes; three week bus trip to marine station, and return. Not open to undergraduate geological sciences majors.

**GES 546 Groundwater Hydrology and Hydraulics****3 hrs.**

Groundwater in the hydrological cycle, fundamentals of groundwater flow; flow net analysis; steady-state and transient well testing techniques for parameter estimation; multiple well systems; leaky aquifers; sea water intrusion; groundwater investigation; artificial recharge of aquifers, design of wells; subsidence and lateral movement of land surface due to groundwater pumping. Design and computer applications. Cross listed as CE 546. Prerequisites: CE 202, 304, or consent of instructor.