

# GEOSCIENCES

Courses in geosciences leading to a bachelor of science degree provide opportunities for research and specialization (including surface and subsurface) in:

1. structural geology, structural petrology, and tectonics;
2. sedimentology, sedimentary petrology, environmental geochemistry, and diagenesis;
3. invertebrate paleontology, paleoecology, and modern carbonate environments;
4. petroleum geology and stratigraphy;
5. igneous petrology and volcanology;
6. hydrogeology and hydrology;
7. geophysics;
8. geomorphology, urban geology, G.I.S., environmental geology, and wetlands; and
9. geoarchaeology.

Geosciences students planning to specialize in paleontology should elect courses in biology; those planning to specialize in mineralogy and/or petrology should take more chemistry.

- Geosciences, B.S. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/geosciences/geology-bs/>)
- Geosciences - Secondary Major (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/geosciences/geology-secondary-major/>)
- Geosciences Minor (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/geosciences/geology-minor/>)
- Earth Science, B.A. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/geosciences/earth-science-ba/>)
- Earth Science (Double Major with Environmental Studies), B.A. (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/geosciences/earth-science-when-combined-major-environmental-studies/>)
- Earth Science Minor (<https://catalog.baylor.edu/undergraduate/college-arts-sciences/academic-departments/geosciences/earth-science-minor/>)

## Geology (GEO)

### GEO 1106 The Earth Through Time, Laboratory (1)

Pre-requisite(s): GEO 1306, 1307 or GEO 1309 or concurrent enrollment  
Counterpart lab to either GEO 1306, GEO 1307, or GEO 1309.

### GEO 1109 Origins of Habitable Worlds, Laboratory (3)

Pre-requisite(s): Credit or concurrent enrollment in GEO 1309  
Counterpart laboratory for GEO 1309.

### GEO 1306 The Earth Through Time (3)

In this course, students will gain an understanding of the relationship between the Earth's history and what that history suggests about both Earth's future and the present distribution of natural resources that support civilization.

### GEO 1307 Evolution and Extinction (3)

An examination of the fossil and geologic evidence of the history of life on Earth to help address that fundamental question. This course will emphasize what the fossil records tells us about evolutionary processes, major extinction events in Earth history, the relationship between the Earth's changing climates and environments and evolution, and the implications of future climate change for life on Earth.

### GEO 1308 Climate Change (3)

Climate science, emphasizing the physical, chemical, and biological processes and consequences of climate change of the past, present, and future.

### GEO 1309 Origins of Habitable Worlds (3)

This course asks "What makes a planet habitable?" by exploring the origins and inner workings of rocky planets and moons. This course will focus on the geologic processes that are endemic to Earth-like planets and will explore the ways in which NASA spacecraft missions illuminate these processes.

### GEO 1310 Water Today and Tomorrow (3)

Examines natural water processes, current human impacts on water systems, and future water needs challenged by a growing population and a changing climate. Discussion of issues and potential solutions from a variety of perspectives.

### GEO 1401 Earthquakes and Other Natural Disasters (4)

Survey of the natural disasters afflicting mankind. The course examines the causes and impact upon society of earthquakes, volcanoes, landslides, subsidence, and floods. Weekly laboratory. Students taking GEO 1401 cannot receive credit for GEO 1403 or GEO 1405.

### GEO 1402 World Oceans (4)

Introduction to oceanography emphasizing human interaction with the oceans: ocean resources, global environmental ethics, and conflicts resulting from ocean exploitation. One Saturday field trip required.

### GEO 1403 Environmental Geology (4)

A study of the interaction between people and the geologic environment. Emphasis will be placed on catastrophic geologic processes, earth resources, pollution, and regional planning. Students taking GEO 1403 cannot receive credit for GEO 1401 or GEO 1405.

### GEO 1405 The Dynamic Earth (4)

Survey of processes that have shaped the earth, including mountain building, volcanism, deposition of sediments, and landscape development. Plate tectonics integrates all the above into a dynamic theory of the deformation of the earth. Weekly laboratory. Students taking GEO 1405 cannot receive credit for Geo. 1401 or Geo. 1403.

### GEO 1408 Earth Science (4)

A descriptive survey of the earth sciences including astronomy, geology, meteorology, and oceanography. One Saturday field trip required.

### GEO 1410 Gems and Minerals (4)

Theory and application of gemology. Topics include crystallography, mineral optics, crystallization conditions, identification, and preparation of gemstones.

### GEO 1V90 Special Problems (1-3)

Pre-requisite(s): Consent of department chair

The current understanding of the earth as studied in a lab setting through group experimentation and projects. May be repeated with a change in content or topic.

**GEO 3319 Geophysics (3)**

Pre-requisite(s): GEO 1401, 1402, 1403, 1405, 1408 or 1109 and 1309  
Introduction to the study of the earth by quantitative physical methods, especially by seismic reflection and refraction, gravity, magnetic, electrical, and radiation methods.

**GEO 3329 Aqueous Geochemistry (3)**

Pre-requisite(s): GEO 1401, 1402, 1403, 1405 or 1408; or consent of instructor  
An introduction to the processes that control the chemical composition of surface and groundwater. Emphasis on the differentiation between natural geochemical processes and human perturbations of the environment.

**GEO 3341 Marine Field Studies (3)**

Cross-listed as BIO 3341  
Pre-requisite(s): Four semester hours of geology or biology, and consent of instructor  
Field examination of modern marine environments, including coral reefs, lagoons, deltas, and beaches. Individual research projects emphasize geology or biology of coral reefs. Offered during summer session.

**GEO 3344 Sedimentary Field Studies (3)**

Pre-requisite(s): GEO 1401, 1402, 1403, 1405, or 1408; and GEO 1106 with either 1306 or 1307  
Field study of modern sediments and ancient sedimentary rocks. Physical and biological features of modern sedimentary environments are examined to provide the basis for interpreting ancient environments in the rock record. Offered during summer session.

**GEO 3349 Hydrologic Processes (3)**

Pre-requisite(s): Upper-level standing  
Theory and principles of hydrology and hydrogeology focusing on the physical processes: the hydrologic cycle, definitions, equations, streams, flooding, erosion, sedimentation and transport, aquifers, groundwater flow and well hydraulics. One or more local field trips required.

**GEO 3365 Applied Petroleum Geoscience (3)**

Pre-requisite(s): Geo 1405 and 1406 or (1106 and 1306) or (1106 and 1307). Basic and intermediate concepts related to hydrocarbon origin, migration and accumulation. Review of the design and application of standard analytical techniques and technologies used in hydrocarbon exploration and production.

**GEO 3427 Mineralogy (4)**

Pre-requisite(s): GEO 1405 (or equivalent) and credit or concurrent enrollment in either CHE 1300 or CHE 1301  
Igneous, Sedimentary, and Metamorphic rocks in hand specimen; crystallography and systematic mineralogy. Occasional field trips.

**GEO 3430 Petrology (4)**

Pre-requisite(s): GEO 3427 and CHE 1302; or consent of instructor  
Origin and evolution of Igneous, Sedimentary, and Metamorphic rocks. Includes optical mineralogy of principal rock-forming minerals and thin section study of rocks. Required field trip.

**GEO 3435 Invertebrate Paleontology (4)**

Cross-listed as BIO 3435  
Prerequisite (s): Prerequisite (s): GEO 1406 or (1106 and 1306) or (1106 and 1307) or consent of instructor. Introduction to taxonomy, morphology, evolution, paleoecology and stratigraphic aspects of invertebrate fossils. Emphasis on biostratigraphic and time-stratigraphic concepts, evolutionary trends, speciation, biometrics, facies, faunas, zonation, and correlation. Independent field and lab problems.

**GEO 3442 Field Stratigraphy-Sedimentology (4)**

Prerequisite (s): GEO 3427 and 3435 or consent of instructor. Study of sediments and sedimentary rocks in the field. The interpretation of geologic history, based on outcrop investigation. Includes numerous written and oral reports, weekly field trips, and occasional weekend field trips. Recommended for junior year.

**GEO 3445 Structural Geology (4)**

Prerequisite (s): GEO 1406 or (1106 and 1306) or (1106 and 1307) and GEO 3430 or consent of instructor. The structures of the earth's crust; their classification, origin, and economic aspects; methods of discovery of structures; solution of structural problems; elementary field methods. Two field trips are required.

**GEO 3V9R Research (3)**

Pre-requisite(s): Consent of the instructor  
Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.

**GEO 4300 Senior Thesis (3)**

Pre-requisite(s): Requires a GPA of 3.25 overall or 3.5 in Geology and consent of the instructor  
Independent research problem. Result will be submitted in proper thesis format with an oral defense.

**GEO 4301 Senior Colloquium (3)**

Pre-requisite(s): Senior level standing  
Readings and presentations that emphasize integration of major core courses in the major

**GEO 4302 Mentored Research Experience (3)**

Pre-requisite(s): Prerequisite (s): Consent of instructor and Senior level standing  
Research in laboratory or field with faculty or graduate student under direction of faculty. Requires a written report to faculty mentor.

**GEO 4303 Internship (3)**

Pre-requisite(s): Consent of instructor and Senior level standing  
Supervised work experience in a geology-related position with an outside agency or company. This course will allow undergraduates the chance to experience work in an area of their career interest.

**GEO 4314 Meteorology (3)**

Pre-requisite(s): Upper-level standing or consent of instructor  
Composition of the atmosphere, atmospheric processes, weather disturbances, and climate elements and controls. Emphasis is placed on climate classification and measurements of human inputs into the atmosphere.

**GEO 4317 Sedimentary Geochemistry (3)**

Pre-requisite(s): Consent of instructor  
A chemical investigation of geological processes and materials in low temperature and pressure environments including important chemical reactions occurring at various stages of the surface cycle.

**GEO 4321 Isotope Geochemistry (3)**

Pre-requisite(s): Consent of instructor  
Theory and application of stable and radioactive isotopes in geology with particular emphasis on the use of stable isotopes in solving environmental, paleoclimate, and hydrogeologic problems.

**GEO 4322 Global Biogeochemical Cycles (3)**

Pre-requisite(s): CHE 1301, 1302, 1101, 1102; and BIO 1403; and GEO 1405 and 3427  
The chemistry of the earth's surface. Emphasis on the dynamic chemical and biological reactions on land, in the oceans, and in the atmosphere and their influence upon the global budgets and cycling of carbon, nitrogen, oxygen, and sulfur. Includes field trips.

**GEO 4323 Geodynamics (3)**

Pre-requisite(s): Consent of instructor  
Study of dynamic processes in solid planetary bodies using mathematical reasoning or MATLAB scripts.

**GEO 4324 Geomicrobiology (3)**

Pre-requisite(s): Consent of instructor  
Microbial metabolic processes that have coevolved with the Earth's surface environment including the changing composition of the upper lithosphere, hydrosphere, and atmosphere.

**GEO 4325 Economic Mineral Deposits (3)**

Pre-requisite(s): GEO 3427 and 3445  
Non-hydrocarbon economic mineral deposits. Origin and migration of ore-bearing fluids; mineralogy and geometry of ore bodies; relations of ore deposits to magnetism and tectonics. Field trip to Central Texas mining district.

**GEO 4328 Sedimentary Petrology (3)**

Pre-requisite(s): GEO 3427 and 3435 or consent of instructor  
Microscopic and field characteristics of sedimentary rocks. Emphasis on interpretation of depositional and diagenetic environments and relationships between geometry of rock bodies and sedimentary processes.

**GEO 4332 Science Leadership: Community Environmental Research (3)**

Cross-listed as ENV 4332  
See ENV 4332 for course information.

**GEO 4335 Volcanology (3)**

Pre-requisite(s): Consent of instructor  
Analysis of volcanic ejecta. Mechanisms of lava and pyroclastic eruptions. Geomorphological analysis of volcanic landforms. History of volcanological studies and case studies of well-known volcanoes. Field trips.

**GEO 4336 Analytical Techniques in Geochemistry (3)**

Pre-requisite(s): GEO 3427  
Principles and practice of X-ray fluorescence and electron probe analysis of geologic materials. Includes extensive laboratory work.

**GEO 4337 Paleocology (3)**

Pre-requisite(s): GEO 3435 or consent of instructor  
Relationship of fossil plants and animals to their physical and biological environment. Examination of principles of paleosynecology and paleoautecology; data gathering, analysis, and techniques of interpretation.

**GEO 4339 Advanced Marine Field Studies (3)**

Cross-listed as BIO 4339  
Pre-requisite(s): GEO 3341 or 5333 or BIO 3341  
Continuation of GEO 3341/5333. Field examination of marine environments. Individual research projects emphasize biology and geology of carbonate depositional regimes.

**GEO 4340 Geomorphology (3)**

Pre-requisite(s): Upper-level standing  
Development and modification of land-surface forms by atmospheric, fluvial, glacial, mass-wasting, volcanic, and tectonic agents. Emphasis is placed on the spatial aspects of landscape evolution.

**GEO 4341 Introduction to Hydrology (3)**

Pre-requisite(s): Consent of instructor  
Basic applied techniques in surface and ground water hydrology. Surface water hydrology will incorporate analysis of precipitation records, runoff processes, and calculation of flood hazard. Ground water hydrology will emphasize hydrogeology techniques, including simple models of ground water movement.

**GEO 4345 Water Management (3)**

Cross-listed as ENV 4345  
See ENV 4345 for course information.

**GEO 4346 Hydrogeology (3)**

Pre-requisite(s): GEO 3342 and 3445  
Hydrogeology (ground water hydrology) for geologists and engineers. Topics to be covered include evaporation and precipitation, soil moisture, principles of ground water flow, regional ground water flow, geology of ground water occurrence, flow to wells, ground water chemistry, and ground water development and management.

**GEO 4348 Geoarchaeology (3)**

Cross-listed as ANT 4348  
Pre-requisite(s): Upper-level standing or consent of instructor  
Concepts and methods of the geosciences applied to solving archaeological problems. Emphasis on stratigraphy, soils, climate, dating techniques, site formation, and site preservation related to both New World and Old World archaeology.

**GEO 4361 Petroleum Geoscience Concepts (3)**

Pre-requisite(s): Consent of instructor  
Geologic controls on the formation and accumulation of oil and gas, including concepts, equipment, data types and analytical procedures used in exploration and production.

**GEO 4371 Wetlands (3)**

Cross-listed as ENV 4371  
Pre-requisite(s): Upper-level standing or consent of instructor  
Theory and application of the wetland concepts: classification, hydrology, biochemistry, soils, vegetation, construction, regulation, and delineation. Field lab.

**GEO 4373 Global Soil Systems (3)**

Cross-listed as ENV 4374  
Fundamentals of soil genesis, classification, geomorphology, ecosystems, and environmental interpretation. Includes the role of soil biogeochemical cycles in past, current, and future global change issues. Field lab.

**GEO 4381 Paleoclimatology (3)**

Pre-requisite(s): Consent of instructor  
A survey of important changes in the Earth's climate using primary literature and the proxies and models used to determine and interpret the causes and effects of these changes.

**GEO 4383 Climate Change and Society I (3)**

Pre-requisite(s): GEO 1401, 1402, or 1405  
Details how humans have changed Earth's atmosphere, climate and environments which has challenged the sustainability of the planet. Earth systems models will be examined to highlight past and future climate changes.

**GEO 4384 Monsoon Climatology and Paleoclimatology (3)**

Pre-requisite(s): Senior level standing and GEO 4340  
A global view on monsoon climate dynamics and variability in the 21st century, the past 20,000 years and into the future.

**GEO 4386 Remote Sensing (3)**

Cross-listed as AVS 4386, BIO 4386, ENV 4386  
Pre-requisite(s): Consent of instructor  
Physical mechanisms of surface and atmospheric materials absorption, transmittance, reflection, and emittance of light measured by various remote sensing platforms. Survey various applications related to earth science, ecology, meteorology, and environmental science.

**GEO 4388 Earth System Science (3)**

Pre-requisite(s): Consent of instructor

The internal and external forcing factors that influence the Earth's four systems (atmosphere, hydrosphere, biosphere, and solid Earth), and how they affect the Earth's climate.

**GEO 4389 Quaternary Geology (3)**

Pre-requisite(s): GEOG 1404, GEO 1405, 1406 or (1106 and 1306) or (1106 and 1307), or 1408; or consent of instructor; and upper-level standing  
An examination through morphologic, stratigraphic, and biogeochemical proxy data of the nature of earth environments, focusing on the three most important components: Quaternary stratigraphies, Quaternary chronologies, and Quaternary environmental proxies and their interpretation.

**GEO 4429 Organic Geochemistry (4)**

Pre-requisite(s): CHE 1301/1101, CHE 1302/1102, PHY 1420 and CHE 3331 (or concurrent enrollment) or consent of instructor  
Investigate the chemical composition of organic matter in soils, sediments, and petroleum source rocks. The lab provides experience measuring and interpreting biomarkers and molecular proxies.

**GEO 4430 Vertebrate Paleontology (4)**

Cross-listed as BIO 4430

See BIO 4430 for course information.

**GEO 4431 Evolutionary History of Plants (4)**

Pre-requisite(s): GEO 1406 or (1106 and 1306) or (1106 and 1307)  
The evolutionary history of plants as studied through the fossil record, including preservation, plant morphology and anatomy, and techniques used to reconstruct paleoenvironment and paleoecology. Weekly labs, with one weekend field trip.

**GEO 4453 Advanced Three-Dimensional Seismic Interpretation (4)**

Pre-requisite(s): GEO 4458 or consent of instructor  
Techniques used to extract geological information from three-dimensional seismic reflection data. Laboratory emphasizing interpretation of real data sets, integration of other geologic and geophysical data, and construction of subsurface maps and sections.

**GEO 4455 Introduction to Seismology (4)**

Pre-requisite(s): PHY 1420, MTH 2321, and upper-level standing or consent of instructor  
Theory of wave propagation in the Earth, earthquake mechanics, Earth structure, interpretation of seismograms, faults, seismotectonics, earthquake locations, magnitudes, and focal mechanisms.

**GEO 4457 Geophysical Exploration I (4)**

Pre-requisite(s): GEO 3342 and 3445 and consent of instructor  
Exploration geophysics, using gravity, magnetics, heat flow, telluric currents, resistivity, and other methods of remote sensing of hidden geological phenomena exclusive of seismic exploration. Laboratory work will emphasize geological interpretation of geophysical data.

**GEO 4458 Geophysical Exploration II (4)**

Pre-requisite(s): GEO 3342 and 3445; and consent of instructor  
Exploration geophysics, using latest seismic techniques and well-log analyses, with emphasis on petroleum exploration.

**GEO 4485 Introduction to Geographic Information Systems (4)**

Cross-listed as AVS 4485, ENV 4485, GEO 4385  
The course covers the use of GIS to acquire primary geographic data, solve geographic problems, automate geographic analysis, and render explanations for geographic patterns and trends. Students will use the latest GIS software and data layers in a lab section.

**GEO 4487 Advanced GIS Analysis (4)**

Cross-listed as AVS 4487, ENV 4487, GEO 4387  
See ENV 4487 for course information.

**GEO 4656 Geophysical Field Training (6)**

Pre-requisite(s): GEO 4457 or 4458 or consent of instructor  
Practice in the efficient, accurate, and cost effective acquisition of geophysical data in the field. The course will involve field practice with gravimeters, magnetometers, borehole drilling and logging devices, exploration seismic gear, surface electrical prospecting equipment, physical laboratory models, and digital data processing equipment as specific equipment is available from summer to summer. Field work will be conducted on a weekly schedule of at least five half days, with data reduction taking up the remaining time.

**GEO 46C3 Capstone Field Experience (6)**

Pre-requisite(s): Consent of instructor  
Includes extended field trip, oral and written reports, sample identification, and design of field problems. Synthesis of undergraduate curriculum through geological mapping and interpretation of field processes.

**GEO 4V90 Special Problems (1-5)**

Pre-requisite(s): Consent of department chair  
Course may be repeated with a change in content or topic.

**GEO 4V9R Research (3)**

Pre-requisite(s): Consent of the instructor  
Undergraduate research undertaken with the supervision of a faculty member. May be taken for a maximum of 6 hours.