DEPARTMENT OF GEOLOGY AND GEOPHYSICS

Geology

The field of geology includes the scientific study of all aspects of the solid Earth and the fluids within it, including the fundamental processes that shape it and the stewardship of its resources that benefits society. The undergraduate curricula in geology foster critical thinking, and the application of scientific skills to the study of Earth materials (rocks, minerals, fossils, structures, landforms and subsurface fluids) and geologic processes. Courses provide a broad background in geology, emphasize knowledge transfer from other sciences to geologic problems and emphasize hands-on application of knowledge through laboratories and field trips and promote application to practical problems in petroleum exploration, environmental management and civil engineering.

The Department of Geology and Geophysics offers two undergraduate programs in geology, the Bachelor of Arts and the Bachelor of Science. The BS program is appropriate for students seeking careers as geologists or preparing for graduate school in geology, whereas the BA program is designed for students wishing to combine geology with other disciplines. Details of the two programs are given below.

To remain in satisfactory academic standing, students must maintain a 2.0 or better GPR in all technical courses (geology, geophysics, chemistry, math and physics).

Geophysics

Geophysics includes all areas of scientific inquiry that deal with the physical state of Earth and other planets and the dynamic processes that act on and within planetary bodies. The Bachelor of Science in Geophysics is for students who wish to combine a proficiency in mathematics with an interest in Earth. The objective of this program is to develop a physically-motivated approach to the study of Earth phenomena, with an emphasis on collection and analysis of geophysical data for probing and imaging the Earth’s interior. Graduates will be well-prepared for careers in the energy and environmental industries, and for advanced study at top-ranked graduate programs.

Minors in Geology and Geophysics

The Department of Geology and Geophysics offers minors in two separate programs: Geology, Geophysics. Minors provide opportunities for broadening a student’s background and tailoring the curriculum to specific career goals. For example, a minor in Geology or Geophysics may be especially beneficial to students majoring in fields that deal directly or indirectly with geological processes. These include agriculture, anthropology, archaeology, architecture, business, education, engineering, and soil science, to name a few.

Faculty

Balta, Joseph B, Visiting Assistant Professor
Geology & Geophysics
PHD, California Institute of Technology, 2010

Bapst, David W, Lecturer
Geology & Geophysics
PHD, University of Chicago, 2013

Becker, Mauro R, Research Professor
Geology & Geophysics
PHD, University of Texas - Austin, 1996

Belanger, Christina L, Assistant Professor
Geology & Geophysics
PHD, University of Chicago, IL, 2011

Benavides-Iglesias, Alfonso, Lecturer
Geology & Geophysics
PHD, Texas A&M University, 2007

Bhatia, Mukul R, Executive Professor
Geology & Geophysics
PHD, The Australian National University, 1982

Chester, Frederick M, Professor
Geology & Geophysics
PHD, Texas A&M University, 1988

Chester, Judith S, Professor
Geology & Geophysics
PHD, Texas A&M University, 1992

Clement, Brad M, Professor
Geology & Geophysics
PHD, Columbia University, 1985

Datta, Saugata, Visiting Professor
Geology & Geophysics
PHD, University of Western Ontario, Canada, 2001

Donovan, Arthur D, Professor of the Practice
Geology & Geophysics
PHD, Colorado School of Mines, 1985

Duan, Benchun, Associate Professor
Geology & Geophysics
PHD, University of California, Riverside, 2006

Everett, Mark E, Professor
Geology & Geophysics
PHD, University of Toronto, 1991

Ewing, Ryan C, Associate Professor
Geology & Geophysics
PHD, The University of Texas - Austin, 2009

Fulton, Patrick M, Assistant Professor
Geology & Geophysics
PHD, Pennsylvania State University, 2008

Giardino, John R, Professor
Geology & Geophysics
PHD, University of Nebraska, Lincoln, 1979

Gibson Jr, Richard L, Professor
Geology & Geophysics
PHD, Massachusetts Institute of Technology, 1991

Grossman, Ethan L, Professor
Geology & Geophysics
PHD, University of Southern California, 1982
Kabir, Mian M, Lecturer
Geology & Geophysics
PHD, Delft University Of Technology, 1997

Kitajima, Hiroko, Assistant Professor
Geology & Geophysics
PHD, Texas A&M University, 2010

Knappett, Peter S, Assistant Professor
Geology & Geophysics
PHD, University of Tennessee at Knoxville, 2010

Kronenberg, Andreas K, Professor
Geology & Geophysics
PHD, Brown University, 1983

Lamb, William M, Associate Professor
Geology & Geophysics
PHD, University of Wisconsin - Madison, 1987

Laya Pereira, Juan Carlos, Assistant Professor
Geology & Geophysics
PHD, Durham University, United Kingdom, 2012

Marcantonio, Franco, Professor
Geology & Geophysics
PHD, Columbia University, 1994

Miceli Romero, Andrea A, Research Professor
Geology & Geophysics
PHD, The University of Oklahoma, 2014

Miller, Brent V, Associate Professor
Geology & Geophysics
PHD, Dalhousie University, Canada, 1997

Newman, Julie, Professor
Geology & Geophysics
PHD, University of Rochester, 1993

Perez, Nicholas D, Assistant Professor
Geology & Geophysics
PHD, University of Texas at Austin, 2015

Pope, Michael, Professor
Geology & Geophysics
PHD, Virginia Tech, 1995

Raymond, Anne L, Professor
Geology & Geophysics
PHD, University of Chicago, 1983

Reece, Julia S, Assistant Professor
Geology & Geophysics
PHD, University of Texas, 2011

Reece, Robert S, Assistant Professor
Geology & Geophysics
PHD, The University of Texas - Austin, 2012

Riggs, Eric A, Associate Professor
Geology & Geophysics
PHD, University of California-Riverside, 2000

Shebl, Mamdouh A, Research Professor
Geology & Geophysics
PHD, University of Wyoming, 1996

Sparks, David W, Professor
Geology & Geophysics
PHD, Brown University, 1992

Sun, Yuefeng, Professor
Geology & Geophysics
PHD, Columbia University, 1994

Tice, Michael M, Associate Research Scientist
Geology & Geophysics
PHD, Stanford University, 2006

Torrez, Betsy D, Lecturer
Geology & Geophysics
PHD, University of Alabama, 1994

Yancey, Thomas E, Professor
Geology & Geophysics
DOC, University of California, Berkeley, 1971

Zhan, Hongbin, Professor
Geology & Geophysics
PHD, University of Nevada, Reno, 1996

Majors
- Bachelor of Arts in Geology (http://catalog.tamu.edu/undergraduate/geosciences/geology-geophysics/geology-ba)
- Bachelor of Arts in Geology and Master of Ocean Science and Technology, 5-Year Degree Program (http://catalog.tamu.edu/undergraduate/geosciences/geology-geophysics/bs-geol-most)
- Bachelor of Science in Geology (http://catalog.tamu.edu/undergraduate/geosciences/geology-geophysics/geology-bs)
- Bachelor of Science in Geology and Master of Ocean Science and Technology, 5-Year Degree Program (http://catalog.tamu.edu/undergraduate/geosciences/geology-geophysics/bs-geol-most)
- Bachelor of Science in Geophysics (http://catalog.tamu.edu/undergraduate/geosciences/geology-geophysics/geophysics-bs)

Minors
- Geology Minor (http://catalog.tamu.edu/undergraduate/geosciences/geology-geophysics/geology-minor)
- Geophysics Minor (http://catalog.tamu.edu/undergraduate/geosciences/geology-geophysics/geophysics-minor)

Courses
GEOL 101 Principles of Geology
Credits 3. 3 Lecture Hours.
(GEOL 1303, GEOL 1403) Principles of Geology. Physical and chemical nature of the Earth and dynamic processes that shape it; plate tectonics, Earth's interior, materials it is made of, age and evolution, earthquakes, volcanism, erosion and deposition; introduces physical and chemical principles applied to the Earth. Not open to students who have taken GEOL 103 or GEOL 104.
GEOL 102 Principles of Geology Laboratory
Credit 1. 2 Lab Hours.
(GEOL 1103, GEOL 1403) Principles of Geology Laboratory. Laboratory exercise-based introduction to the physical and chemical nature of the Earth and dynamic process that shape it; rock and mineral types; topographic and geologic maps; complements GEOL 101 but may be taken independently.

GEOL 104 Physical Geology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Earth materials, structures, external and internal characteristics; physical processes at work upon or within the planet. A working knowledge of high school chemistry and mathematics is required.

GEOL 106 Historical Geology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
(GEOL 1104 and 1304, 1404) Historical Geology. Hypotheses of Earth’s origin; age dating of geologic materials; development and history of life; plate tectonic reconstructions, geologic history, and paleogeography, with emphasis on the North American plate.
Prerequisite: GEOL 101 or equivalent.

GEOL 108 Dinosaur Life and Times
Credit 1. 1 Lecture Hour.
Dinosaur paleobiology and paleoecology; terrestrial paleoclimate and paleoenvironments of the Mesozoic; dinosaur ancestors; appearance and radiation of dinosaurs; paleoecology and paleobiology of major dinosaur groups; extinction of large dinosaurs and the Cretaceous-Paleogene mass extinction; the appearance and ancestry of birds. Not open to students who have taken GEOL 307.

GEOL 150 Introduction to the Solid Earth
Credits 4. 3 Lecture Hours. 2 Lab Hours.
Introduction to the dynamic earth for careers in geosciences; origin and structure of the earth; earth materials and processes, particularly as they relate to plate tectonics; maps as a basic tool of geologists; not open to students who have taken GEOL 101 or GEOL 104.

GEOL 152 History of the Earth
Credits 4. 3 Lecture Hours. 2 Lab Hours.
Evolution of life, plate tectonics processes, geography and climate through earth’s history; the timing of major events in earth history; sedimentary environments and stratigraphy; fossils; biostratigraphic and radiometric dating of rocks; not open to students who have taken GEOL 106.
Prerequisites: GEOL 150, GEOL 101 and GEOL 102, or GEOL 104 or equivalent.

GEOL 180 Introduction to Geology and Geophysics
Credit 1. 1 Lecture Hour.
Introduction to careers in geology and geophysics; campus resources for academic and personal success; tools for developing study skills and navigating the university; use of reflection to assess personal strengths, weaknesses and responsibilities and to devise strategies for improvement.
Prerequisite: Approval of instructor.

GEOL 203 Mineralogy
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Crystallography, crystal chemistry, mineral chemistry, optical crystallography, physical properties, and geologic occurrence of rock-forming and economic minerals.
Prerequisites: MATH 151; CHEM 101 and CHEM 111, or CHEM 107 and CHEM 117; GEOL 150 or equivalent.

GEOL 207 Dinosaur World
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Survey of dinosaur paleobiology and paleoecology; terrestrial paleoclimate and paleoenvironments of the Mesozoic; dinosaur ancestors; appearance and radiation of dinosaurs; paleoecology and paleobiology of major dinosaur groups; extinction of large dinosaurs and the Cretaceous/Paleogene mass extinction; the appearance and ancestry of birds.

GEOL 210 Geologic Field Methods
Credits 3. 3 Lecture Hours.
Introduction to communicating as a scientist particularly in geological settings; using precise language, illuminating graphs and correct mathematical and chemical symbols to describe geological observations and concepts in writing; using basic statistics to describe geological data and uncertainty; recognizing scientific ethical dilemmas and plagiarism and interpretation.
Prerequisites: MATH 151, ENGL 104, GEOL 150 or equivalent.

GEOL 250 Geological Field Methods
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Fundamental aspects of geologic mapping; field observation, data gathering and recording, use of a Brunton compass, pace-and-compass mapping, measurement of stratigraphic sections; topographic map use and interpretation, interpretation of geologic map patterns, construction of geologic cross sections; Integrating field and remote data to address geologic problems using GIS software.
Prerequisites: GEOL 152 or equivalent.

GEOL 285 Directed Studies
Credits 1 to 4. 1 to 4 Other Hours.
Directed studies in specific problem areas of geology.
Prerequisite: Approval of instructor.

GEOL 289 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.
Selected topics in an identified area of geology. May be repeated for credit.
Prerequisite: Approval of instructor.

GEOL 291 Research
Credits 0 to 4. 0 to 4 Other Hours.
Research conducted under the direction of faculty member in geology. May be repeated 2 times for credit. Registration in multiple sections of this course is possible within a given semester provided that the per semester credit hour limit is not exceeded.
Prerequisites: Freshman or sophomore classification and approval of instructor.

GEOL 300 Field Geology
Credits 6. 6 Other Hours.
Basic concepts of field relationships and field techniques are used to develop geologic maps, stratigraphic columns, cross-sections and geologic interpretations for a variety of geologic provinces. Course conducted off-campus in a field camp for six weeks.
Prerequisites: GEOL 302, GEOL 306, GEOL 309, GEOL 312 or approval of instructor.

GEOL 301 Mineral Resources
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Origin, geologic relations and geographic distribution of mineral and energy resources; mineral economics, mining and reclamation and global economics in the resource industry; identification and classification of economic minerals including energy resources, base and precious metals, chemical industrial minerals and gemstones.
Prerequisites: GEOL 101 or GEOL 320; CHEM 106 or higher.
GEOL 302 Introduction to Petrology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Introduction to the origin and evolution of igneous, sedimentary, and metamorphic rocks; classification and petrographic analysis of major rock types; relationships to tectonic settings.
Prerequisites: GEOL 104 and GEOL 203 or approval of instructor.

GEOL 304 Igneous and Metamorphic Petrology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Origin and evolution of igneous and metamorphic rocks; identification, classification and petrographic analysis; relationships to tectonic settings; genetic processes inferred from laboratory studies and field occurrences.
Prerequisites: GEOL 203; CHEM 107 and CHEM 117 or CHEM 102 and 112.

GEOL 305 Paleobiology
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Principles of paleobiology; study of organisms important in the marine fossil record; application of paleontology to geologic problems.
Prerequisite: GEOL 106 or approval of instructor.

GEOL 306 Sedimentology and Stratigraphy
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Origin of sediments and sedimentary rocks; climate, weathering, and weathering products; transport, deposition, and depositional environments for sediments; field and laboratory studies in description and interpretation of genesis of sedimentary rocks; principles of stratigraphy and basin analysis; plate tectonics and the formation of sedimentary basins; stratigraphic nomenclature; geologic time and correlation; sequence stratigraphy and basin architecture.
Prerequisite: CHEM 101 and CHEM 111 or CHEM 107 and CHEM 117; PHYS 218; GEOL 152 or equivalent.

GEOL 307 Dinosaur World
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Evolutionary development of dinosaurs and Mesozoic geography, climate and terrestrial environments including dinosaur morphology; evolutionary relationships; dinosaur metabolism; and constraints imposed by gigantism; their latitudinal distribution; casual mechanism for dinosaur extinction.

GEOL 308 Integrated Earth Science
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Integrated processes shaping Earth’s crust, continents, ocean basins, atmosphere and biosphere; place of Earth in the universe; relationship between Earth and human society; related fundamental physical and biological science principles and processes within an integrated Earth science context. Not an elective for students pursuing degrees for careers as professional geologists.
Prerequisite: GEOL 101 or GEOG 203.

GEOL 309 Introduction to Geological Field Methods
Credits 3. 1 Lecture Hour. 6 Lab Hours.
Geological mapping methods, field observation procedures and data gathering and recording; use of Brunton compass; pace-and-compass mapping; topographic map use and interpretation; measurement of structural elements; interpretation of geologic map patterns; measurement of stratigraphic sections; construction of geologic cross sections; six day geologic mapping project during either spring break or two three-day weekends.
Prerequisites: GEOL 101 or GEOL 104; GEOL 106.

GEOL 310 Planetary Geology
Credits 3. 3 Lecture Hours.
Introduction to planetary science; organization and composition of the solar system, including the planets, satellites and asteroids; surface features and internal structures of the terrestrial planets and moons; the dynamic processes of planetary resurfacing, including volcanism, tectonism, weathering and impacts; the history and future of solar system exploration.
Prerequisites: GEOL 101 or 104; junior or senior classification or approval of instructor.

GEOL 311 Principles of Geological Writing
Credit 1. 1 Lecture Hour.
Principles of writing for geological reports; format and style for abstracts, grant proposals, journal manuscripts and industry reports; evaluating written reports for revision and editing; using proper referencing and citation style; methods of maintaining clarity in documents; using web tools for geological communication.

GEOL 312 Structural Geology and Tectonics
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Fundamentals of the deformation of the lithosphere ranging from plate to atomic scales; stress, strain, experimental rock deformation, microscopic mechanisms and mechanical behaviors; analysis of faults, folds, flow and rock fabrics; subsurface interpretation; regional tectonics of selected areas; practical experience in geometric and kinematic analysis, constructing balanced cross sections.
Prerequisites: GEOL 104 or GEOL 150 or equivalent; MATH 151, MATH 152 and PHYS 218.

GEOL 314 Paleontology and Geobiology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Biosphere-geosphere interactions, including procaryote controls on sedimentary geochemistry and organismal distributions, and fossil preservation; fossils in the context of evolutionary theory and global change; identification of important groups of marine fossils; use of fossils to determine the stratigraphic age of rocks and the history of life on Earth.
Prerequisites: CHEM 101 or CHEM 107, or GEOL 152 or equivalent; GEOL 306.

GEOL 316 Team Research in Geology and Geophysics
Credits 3. 0 Lecture Hours. 9 Lab Hours.
Team-based research in geology and geophysics; hypothesis development, data collection, data interpretation; communication of geological/geophysical interpretations and data. May be taken four times for credit.
Prerequisites: GEOL 203 or concurrent enrollment and approval of instructor.

GEOL 320 Geology for Civil Engineers
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Principles of physical and engineering geology; properties of minerals, rocks and soils; active surface and subsurface processes; applications to siting, design, construction, operation and maintenance of engineered works and the protection of the environment. A three-day field trip is required (a field trip fee is charged at registration).
Prerequisite: Sophomore classification.
GEOL 330 Geologic Field Trips
Credits 1 to 3. 1 to 3 Other Hours.
Field trips to observe, analyze and interpret the geology and geophysics of selected localities in Texas and adjacent regions; complements classroom experience. Trip frequencies, duration, dates and study localities vary with semester.
Prerequisite: GEOL 101 or GEOL 104 or approval of instructor. May be repeated for credit.

GEOL 350 Summer Field Geology
Credits 3. 3 Other Hours.
Intense immersive geologic mapping experience, integrating geological skills from throughout the curriculum; concepts of field relationships and field techniques are used to develop geologic maps, stratigraphic columns, cross-sections and geologic interpretations for a variety of geologic provinces; conduct off-campus in a field area or areas for three to four weeks.
Prerequisites: GEOL 304, GEOL 314, GEOL 306, GEOL 250 and GEOL 312.

GEOL 352/GEOG 352 GNSS in the Geosciences
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Fundamentals of Global Navigation Satellite Systems (GNSS); basic geodesy, figure of the earth; frames of reference, map projection, datums, ellipsoids; GPS accuracy and precision; applications in earth resource mapping and database creation; elementary GPS phase data processing.
Prerequisites: Junior or senior classification; approval of instructor.
Cross Listing: GEOG 352/GEOL 352.

GEOL 400 Reservoir Description
Credits 3. 2 Lecture Hours. 3 Lab Hours.
An integrated reservoir characterization and design experience for seniors in petroleum engineering, geology and geophysics; includes using geophysical, geological, petrophysical and engineering data; emphasis on reservoir description (reservoir and well data analysis and interpretation), reservoir modeling (simulation), reservoir management (production optimization) and economic analysis (property evaluation).
Prerequisite: Junior or senior classification or approval of instructor.

GEOL 404 Geology of Petroleum
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Origin, migration and accumulation of petroleum; typical U.S. oil and gas fluids; laboratory work in subsurface geology.
Prerequisites: GEOL 104 or GEOL 150.

GEOL 410 Hydrogeology
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Geologic conditions determining the distribution and movement of ground water and their effect on the hydrologic properties of aquifers.
Prerequisite: MATH 151 and MATH 152, or equivalent; junior or senior classification.

GEOL 420 Environmental Geology
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Geologic concepts of the nature of geologic environments and the dynamics of geologic processes needed to characterize and quantify human interactions with specific geologic systems including aquifers, watershed, coastlines and wetlands; specific techniques, including geophysical and geochemical techniques, field mapping, geographical information systems and remote sensing used to monitor human-geosphere interactions.
Prerequisites: GEOL 101 or GEOG 203; junior or senior classification or approval of instructor.

GEOL 440 Engineering Geology
Credits 3. 2 Lecture Hours. 3 Lab Hours.
Fundamentals of soil, rock and fluid mechanics and basic engineering practices as applied to the analysis of the geologic environment for engineering uses. Designed for geoscience majors who have not had engineering courses.
Prerequisites: GEOL 312 or approval of instructor; PHYS 218.

GEOL 450 Geology Senior Project
Credits 3. 3 Lecture Hours.
Conducting and communicating a team research project in geology and/or geophysics; formulating a research question and a plan to answer that question; synthesizing and interpreting the geological and geophysical literature; written and oral presentation of findings and critiquing those findings.
Prerequisites: GEOL 210 and GEOL 312, or approval of undergraduate advisor.

GEOL 451 Introduction to Geochemistry
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Chemical principles and processes responsible for the formation and cycling of earth materials, with emphasis on low temperature equilibria and kinetics in rockwater systems.
Prerequisite: GEOL 302 or approval of instructor.

GEOL 478 Earth Science Modeling
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Techniques for building, solving and analyzing numerical models applied to a wide variety of problems in geology, geochemistry, geobiology and geophysics; derivation and scaling of conservation laws; finite difference and finite element techniques; programming in MATLAB or a higher-level language.
Prerequisites: MATH 151; MATH 152; junior or senior classification.

GEOL 484 Internship
Credits 0. 0 Other Hours.
Directed internship in a private firm, government agency or non-governmental organization to provide work experience related to the student’s degree program and career objectives. May be taken two times.
Prerequisites: Junior or senior classification and approval of internship agency and approval of instructor.

GEOL 485 Directed Studies
Credits 1 to 12. 1 to 12 Other Hours.
Advanced problems in geology.

GEOL 489 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.
Selected topics in an identified area of geology. May be repeated for credit.
Prerequisite: Approval of instructor.

GEOL 491 Research
Credits 0 to 4. 0 to 4 Other Hours.
Research conducted under the direction of faculty member in geology. May be repeated 2 times for credit. Registration in multiple sections of this course is possible within a given semester provided that the per semester credit hour limit is not exceeded.
Prerequisites: Junior or senior classification and approval of instructor.