Geosciences (B.A., B.S.)

Attaining greater understanding of past and present Earth processes is the fundamental goal of geosciences. To achieve this goal the geoscientist studies the minerals, rocks, fluids, and fossils of the Earth and investigates the physical, chemical, and biological processes occurring on and in the Earth.

Professional opportunities in geology exist in the environmental, energy, and mineral resources industries and in government agencies concerned with these fields. In addition, many occupations concerned with law, management, economics, and the environment utilize a background in geosciences.

Specific degree plans will be formulated by the undergraduate advisor in Geosciences. Changing circumstances may require changes to the degree plans.

Bachelor of Science in Geosciences Degree Requirements (122 - 124 hours)

I. Core Curriculum Requirements1: 42 hours

A. Communication (6 hours)
   - 3 hours Communication (RHET 1302)
   - 3 hours Communication Elective (NATS 4310 Advanced Writing in the Natural Sciences and Mathematics)2

B. Social and Behavioral Sciences (15 hours)
   - 6 hours Government (GOVT 2305 and 2306)
   - 6 hours History (HST 1301 and 2301)
   - 3 hours Social and Behavioral Sciences Elective

C. Humanities and Fine Arts (6 hours)
   - 3 hours Fine Arts (AP 1301)
   - 3 hours Humanities (A&H 1301)

D. Mathematics and Quantitative Reasoning (6 hours; 2 hours extra may be counted as free electives)
   - Calculus (MATH 2417 and 2419)

E. Science (9 hours)
   - 8 hours Chemistry (CHM 1311, 1111, 1312, 1112)
   - 1 hour Physics (PHY 2125)

1 Curriculum Requirements can be fulfilled by other approved courses from accredited institutions of higher education. The courses listed in parenthesis are recommended as the most efficient way to satisfy both Core Curriculum and Major Requirements at U.T. Dallas.

2 A Major requirement that also fulfills a Core Curriculum requirement. If hours are counted in the Core Curriculum, students must complete additional coursework to meet the minimum requirements for graduation. Course selection assistance is available from the undergraduate advisor.

II. Major Requirements: 62-64 hours

Major Preparatory Courses (23 hours beyond Core Curriculum)
- PHYS 2325/2125 Mechanics and Heat with lab
- PHYS 2326/2126 Electromagnetism and Waves with lab
- GEOS 1303*/1103* Physical Geology with lab
- GEOS 1304*/1104* Introduction to Earth History with lab
- GEOS 2407* Field Geology I
- GEOS 2409* Rocks and Minerals

Major Core Courses (18 hours)
- GEOS 3421 Stratigraphy and Sedimentology
- GEOS 3470 Structural Geology
- GEOS 3480 Introduction to Geophysics
GEOS 4606 Field Geology II

Major Related Courses (21 to 23 hours)

**Geology Option** (21-22 hours)
- GEOS 3430 Invertebrate Paleontology
- GEOS 3461 Optical Mineralogy
- GEOS 3463 Petrology
- GEOS 4310 Fundamentals of Hydrogeology
- GEOS 4350 Principles of Geochemistry

One math course taken from
- MATH 2421 Multivariable Calculus
- MATH 2418 Linear Algebra
- MATH 4332 Mathematical Computing
- STAT 3360 Probability and Statistics for Management & Economics

**Geophysics Option** (23 hours)
- MATH 2421 Multivariable Calculus
- MATH 2420 Differential Equations
- MATH 4332 Mathematical Computing
- MATH 4362 Partial Differential Equations
- PHYS 3311 Mathematical Methods of Physics
- PHYS 3312 Classical Mechanics
- PHYS 3316 Electricity and Magnetism

*A prerequisite course to be completed before enrolling in upper-division GEOS courses.

III. Elective Requirements: 18 hours

Advanced Electives (6 hours)
- All students are required to take at least six hours of advanced electives outside their major field of study. These must be either upper-division classes or lower-division classes that have prerequisites.

Free Electives (12 hours)
- Both lower- and upper-division courses may count as electives, but students must complete at least 51 hours of upper-division credit to qualify for graduation.

Fast Track Baccalaureate/Master's Degrees

U.T. Dallas students with strong academic records who intend to pursue a master's degree in Geosciences may apply for a Fast Track baccalaureate/master's plan of study, an accelerated program which allows undergraduates, upon admission to the graduate program, to take selected graduate courses that may be applied toward the bachelor's degree and be used to satisfy requirements for the master's degree. Interested students should contact the Geosciences undergraduate advisor for more information.

Geosciences Minor

Students not majoring in Geosciences are encouraged to choose Geosciences as a minor.

Lower-division courses (8 hours):
- GEOS 1303 Physical Geology *
GEOS 1103 Physical Geology Lab. *
GEOS 1304 Introduction to Earth History*
GEOS 1104 Earth History Lab.
Upper-division courses (12 hours): To be selected in consultation with academic advisor

*A prerequisite course to be completed before enrolling in upper-division GEOS courses.

Specified Course Descriptions

A&H 1301 (HUMA 1301) Exploration of the Humanities (3 semester hours) An introduction to the concept of cultural tradition through the study of selected works of literature, philosophy, music, and visual art. Emphasis on the relations among various forms of cultural expression and developing students' ability to interpret complex artistic works in their historical, cultural, and intellectual contexts. General education core course. (3-0) S

AP 1301 (ARTS 1301) Exploration of the Arts (3 semester hours) This course introduces students to the physical and intellectual demands required of the author, the performer, and the visual artist. This introduction includes, but is not limited to, the student's production of a creative project as well as written assessments of art and performance. (3-0) Y

CHM 1111 (CHEM 1111) General Chemistry Laboratory I (1 semester hour) Introduction to the chemistry laboratory. Experiments are designed to demonstrate concepts covered in CHM 1311; including properties and reactions of inorganic substances, and elementary qualitative and quantitative analysis. (0-3) S

CHM 1112 General Chemistry Laboratory II (1 semester hour) A continuation of CHM 1111 demonstrating the concepts covered in CHM 1312, including acid-base chemistry, reaction kinetics, electrochemistry, polymers, and organic synthesis. Prerequisite: CHM 1111 or 1215. (0-3) S

CHM 1311 (CHEM 1311) General Chemistry I (3 semester hours) Introduction to elementary concepts of chemistry theory. The course emphasizes chemical reactions, the mole concept and its applications, and molecular structure and bonding. (3-0) S

CHM 1312 (CHEM 1312) General Chemistry II (3 semester hours) A continuation of CHM 1311 treating metals; solids, liquids, and intermolecular forces; chemical equilibrium; electrochemistry; organic chemistry; rates of reactions; and environmental, polymer, nuclear, and biochemistry. Prerequisite: CHM 1311 or 1315. (3-0) S

GEOS 1103 (GEOL 1103) Physical Geology Laboratory (1 semester hour) A laboratory to accompany GEOS 1303. The exercises include mineral and rock identification. Topographic maps, geologic maps, and aerial photographs are used to study surface landforms, geologic phenomena and tectonic processes. GEOS 1303 is a corequisite or prerequisite. (0-3) S

GEOS 1104 Earth History Laboratory (1 semester hour) A laboratory to accompany GEOS 1304. Exercises include: fossil identification, stratigraphy and correlation, the geologic time scale, age-determination techniques, and maps. (0-3) Y

GEOS 1303 (GEOL 1303) Physical Geology (3 semester hours) Introduction to the Earth as a unique planet. The course investigates minerals and rocks which make up the Earth. The structure of the Earth and dynamics of its internal mechanisms are explored. Plate tectonics and surface processes which sculpt the Earth are the topic of the second half of the course. Other planets and celestial bodies within the solar system are contrasted with Earth. Field trip. (3-0) Y

GEOS 1304 Introduction to Earth History (3 semester hours) Introduction to the history of the Earth. The history of life and an introduction to the principles of paleontology, stratigraphy and global change will be discussed. All topics will be discussed in the context of the tectonic evolution of North America. Field trip. Prerequisite: GEOS 1303 and GEOS 1103. (3-0) Y

GEOS 2407 Field Geology I (4 semester hours) Geologic field techniques. Field trips. Prerequisites: GEOS 1303 and 1103; GEOS 2409 recommended. (4-0) Y

GEOS 2409 (GEOL 2409) Rocks and Minerals (4 semester hours) Introduction to crystallography, mineralogy, and petrography. Laboratory course. Prerequisites: GEOS 1303 and 1103 (may be taken concurrently). (3-3) Y

GEOS 3421 Stratigraphy and Sedimentology (4 semester hours) Principles and evolution of modern stratigraphic nomenclature; concepts of space and time in the rock record and methods of stratigraphic correlation; factors controlling stratigraphic architecture of sedimentary basins; integrated stratigraphic techniques. Origin, transportation, and deposition of carbonate and siliciclastic sediments; weathering, textural analysis, and depositional environments. Laboratory course. Field
trips. Prerequisites GEOS 1304, 1104, and 2409 (3-3) Y

**GEOS 3430 Invertebrate Paleontology** (4 semester hours) Studies in the morphology, evolution, classification, and paleoecology of invertebrates important in the fossil record. Laboratory course. Field trip. GEOS 1304 and 1104 recommended (2-6) Y

**GEOS 3461 Optical Mineralogy** (4 semester hours) Principles of optical mineralogy and an introduction to the study of rocks in thin section. Laboratory course. Prerequisites: GEOS 2409; PHYS 2326 and 2126 strongly recommended. (2-6) Y

**GEOS 3463 Petrology** (4 semester hours) Study of the origin and composition of igneous, metamorphic, and sedimentary rocks, with an emphasis on microscopic description and interpretation. Laboratory course. Field Trips. Prerequisite: GEOS 3461 (2-6) Y

**GEOS 3470 Structural Geology** (4 semester hours) Modern tectonic concepts, survey of major structural provinces, examination of material behavior, stress-strain concepts, failure criteria, soil mechanics, fault analysis, rheology, fold analysis and applications of structural concepts to neotectonics and environmental problems. Training in graphical techniques, use of stereographic projections, and geological map interpretation. Laboratory course. Field trip. PHYS 2325 and 2125 strongly recommended (3-3) Y

**GEOS 3480 Introduction to Geophysics** (4 semester hours) Introduction to physics of the solid Earth. The nature of gravitational, magnetic, thermal and seismic phenomena and their application to our understanding of the internal structure, origin and dynamics of the planet, including plate tectonics. The principles of geophysical methods and data analysis will form the basis of small scale field exercises in the Dallas area. Laboratory course. Prerequisites: PHYS 2325, 2125, 2326, and 2126 or permission of instructor. (3-3) Y

**GEOS 4310 Fundamentals of Hydrogeology** (3 semester hours) Principles of fluid migration in the Earth's crust; groundwater flow, hydrologic models, single and multiphase contaminant migration, fracture system hydrology; training in data analysis, presentation and basic numerical modeling techniques. (3-0) R

**GEOS 4350 Principles of Geochemistry** (3 semester hours) Applications of chemistry to understanding the earth and geochemical cycles. Topics include composition of the earth and the solar system, evolution of the hydrosphere and behavior of low-temperature aqueous solutions, formation of hydrocarbons, chemical changes accompanying diagenesis and evolution of high temperature silicate melts. Introduction to isotope geochemistry. Prerequisite: CHEM 1311, 1111, 1312, and 1112. (3-0) R

**GEOS 4606 Field Geology II (Summer Field Camp)** (6 semester hours) A four-week summer camp designed to provide both practical geological and geophysical experience. Geology students emphasize mapping in sedimentary, igneous, and metamorphic terrains. Geophysics students utilize seismic, potential field, and electrical methods to analyze a field area. Reports in professional form are required. Prerequisites: GEOS 2407, 3421, 3470. NOTE: A field-trip fee is charged for this course. Students are responsible for all personal expenses related to camp. (6-0) Y

**GOVT 2305 (GOVT 2305) Constitutional Foundations and Political Behavior in the U.S. and Texas** (3 semester hours) This course examines the evolution and current state of political behavior and public policy making in the U.S. and Texas. Topics discussed will include the constitutions, federalism, intergovernmental relations, voting, elections, political parties, public opinion, and interest groups. (Fulfills one-half of the legislative requirement of 6 hours of American government.) (3-0) S

**GOVT 2306 (GOVT 2306) Political Institutions in the U.S. and Texas** (3 semester hours) This course explores the primary institutions of U.S. and Texas government. It examines the bureaucracy as well as the executive, legislative, and judicial branches of government at the state and federal level. (Fulfills one-half of the legislative requirement of 6 hours of American government.) (3-0) S

**HST 1301 Themes and Ideas in American History** (3 semester hours) An introduction to the methods of historical inquiry through the study of selected main themes in American history. A course designed to offer students an understanding of the historical and cultural context of America in the contemporary world. Fulfills one-half of the Texas legislative requirement for six hours in American history. (3-0) S

**HST 2301 Issues in American History** (3 semester hours) Readings, commentary, and discussion aimed at varying aspects of history and culture. Fulfills one-half of the Texas legislative requirement for six hours in American history. (3-0) Y

**MATH 2417 (MATH 2417) Calculus I** (4 semester hours) Functions, limits, continuity, differentiation; integration of function of one variable; logarithmic, exponential, and inverse trigonometric functions; techniques of integration, and applications. Three lecture hours and two discussion hours a week. Prerequisite: MATH 2312 or equivalent. (4-0) S
MATH 2418 Linear Algebra (4 semester hours) Systems of linear equations, determinants, vectors and vector spaces, linear transformations, eigenvalues and eigenvectors, quadratic forms. Three lecture hours and two discussion hours per week. Credit given for only one of MATH 2333 or 2418. Prerequisite: MATH 2419 or consent of instructor. (4-0) S

MATH 2419 Calculus II (MATH 2419) (4 semester hours) Continuation of MATH 2417. Improper integrals, sequences, infinite series, power series, parametric equations and polar coordinates, vectors, vector-valued functions, functions of several variables, partial derivatives and applications, multiple integration. Three lecture hours and two discussion hours per week. Prerequisite: MATH 2417. (4-0) S

MATH 2420 (MATH 2420) Differential Equations with Applications (4 semester hours) Topics covered will be drawn from the following list: First order differential equations, ordinary differential equations, system of linear differential equations, stability, series solutions, special functions, Sturm-Liouville problem, Laplace transforms and linear differential equations, numerical solutions and applications in physical sciences and engineering using computers. Three lecture hours and two discussion hours per week. Prerequisite: MATH 2419. (4-0) S

MATH 2421 Multivariable Calculus with Applications (4 semester hours) Vectors, matrices, vector functions, partial derivatives, divergence, curl, Laplacian, multiple integrals, line and surface integrals, Green's, Stoke's, and Gauss's theorems, and applications in physical sciences and engineering. Three lecture hours and two discussion hours per week. Prerequisite: MATH 2419. (4-0) S

MATH 4362 Partial Differential Equations (3 semester hours) This course presents a survey of classical and numerical methods for the solution of linear and nonlinear boundary value problems governed by partial differential equations. Modeling and application-related issues are included throughout. Prerequisites: MATH 2420, 2421, and knowledge of a high-level programming language. (3-0) T

NATS 4310 Advanced Writing in the Natural Sciences and Mathematics (3 semester hours) A writing-intensive course on questions or problems in natural sciences and mathematics; satisfies the advanced writing requirement for graduation. (3-0) S

PHYS 2125 (PHYS 2125) Physics Laboratory I (1 semester hour) Laboratory course to accompany PHYS 2325. Personal computer-based data presentation and curve fitting. Basic measurement concepts such as experimental uncertainty, mean, standard deviation, standard error, and error propagation will be covered. Corequisite: PHYS 2325. (0-3) Y

PHYS 2126 (PHYS 2126) Physics Laboratory II (1 semester hour) Laboratory course to accompany PHYS 2326. Builds on concepts of Physics Lab I. Will emphasize the use of an oscilloscope and measurements using simple circuits constructed in class. Corequisite: PHYS 2326. (0-3) Y

PHYS 2325 (PHYS 2325) Mechanics and Heat (3 semester hours) Calculus based. Basic physics including a study of space and time, kinematics, forces, energy and momentum, conservation laws, rotational motion, torques, harmonic oscillation, temperature and heat. Two lectures and one recitation session per week. Prerequisite: MATH 2417. Corequisite: PHYS 2125. (3-0) Y

PHYS 2326 (PHYS 2326) Electromagnetism and Waves (3 semester hours) Continuation of PHYS 2325. Topics include electrostatics and electromagnetics, electric field and potential, electric currents, magnetic fields, laws of Coulomb, Ampere, and Faraday, Maxwell's theory of propagation and optics. Two lectures and one recitation session per week. Prerequisites: PHYS 2325 and MATH 2419. Corequisite: PHYS 2126. (3-0) Y

PHYS 3311 Theoretical Physics I (3 semester hours) Vector spaces, linear operators, and eigenvectors; ordinary differential equations and eigenfunctions; complex functions and contour integration; Fourier series; integral transforms. Prerequisite: Ordinary Differential Equations (MATH 2420 or equivalent) and PHYS 2303 (3-0) Y

PHYS 3312 Theoretical Physics II (3 semester hours) Newton's laws and conservation of momentum; collisions; two body problems and trajectories; rotating coordinate systems; Lagrangian formulation; rotational dynamics and the inertia tensor; gravitation. Prerequisite: PHYS 3311 or equivalent. (3-0) Y

RHET 1302 (ENGL 1302) Rhetoric (3 semester hours) The course presents an integrated approach to writing, reading, and critical thinking by developing the grammatical, logical, and rhetorical skills necessary for university writing. All classes work in a computerized learning environment. Students are taught basic computer literacy and submit all work electronically and on paper. (3-0) S

STAT 3360 Probability and Statistics for Management and Economics (3 semester hours) Probability theory including independence, conditioning, density functions, frequently used families of distributions, random variables, expectation, moments, and the central limit theorem; statistical inference including sampling, estimation, hypothesis testing, and
regression. Cannot be used by mathematical sciences, engineering, or computer science majors to satisfy degree requirements. Prerequisite: MATH 1326. (3-0) S