

Geology (GEOL)

Courses

GEOL 101. Introduction to Geology. 3 Credits.

Introduction to the dynamics of the Earth -- volcanoes, earthquakes, plate tectonics, streams, groundwater, glaciers, waves, wind, and landslides, with emphasis on the environmental applications of these processes. Introduction to the tools of the geologist -- minerals, rocks, maps, and aerial photographs. GEOL 101L may be taken concurrently. F,S,SS.

GEOL 101L. Introduction to Geology Laboratory. 1 Credit.

An introductory laboratory to complement GEOL 101. Prerequisite or Corequisite: GEOL 101. F,S,SS.

GEOL 102. The Earth Through Time. 3 Credits.

In this course we examine the history of Earth, from its formation to today, as it is recorded in the geological record. With an emphasis on geologic time, this course follows the evolution of Earth and the fascinating organisms that have inhabited our planet, from the origin of life to the animals and plants we see today. We explore connections between the fundamental processes that have shaped the Earth and its lifeforms which created our world today. It is recommended to take GEOL 102L concurrently. F,S.

GEOL 102L. The Earth Through Time Laboratory. 1 Credit.

An introductory laboratory to complement GEOL 102 designed to provide additional hands-on and applied learning opportunities. This includes exploring fundamental geological concepts with mineral, rock, and fossil specimens. Prerequisite or Corequisite: GEOL 102. F,S.

GEOL 103. Introduction to Environmental Issues. 3 Credits.

Introduction to Environmental Issues. A survey of environmental issues concerning society's interaction with Earth's natural systems and exploitation of Earth's resources. F,S.

GEOL 104. Geology of National Parks. 3 Credits.

An overview of the geology of U.S. National Parks. Unifying geological principles are emphasized. Major topics: sandstone parks, volcanic parks, hot springs and geothermal areas, caves and limestone parks, reefs and fossilized reefs, rivers and erosion, ice and glaciers, mountain building and mountain ranges. S.

GEOL 105. Selected Topics. 1-4 Credits.

A special topic course intended for non-geology majors. Subjects will include many issues of interest to non-geologists and non-scientists, such as earthquakes, evolution, gems, and the geology of National Parks. Repeatable when topics vary. Repeatable. On demand.

GEOL 106. Global Warming: The Facts and Myths. 3 Credits.

Global warming is the most debated current challenge to humans. A large, multifaceted and technically challenging topic, it has been diluted to popular slogans that at best capture some aspects of the issue and at the worst are over simplifications. Most of us who are directly affected by global warming do not understand the background, do not know what the assertions are based on, and can not evaluate the correctness of the arguments propagated in mass media such as newspapers and talk-radio. This class will provide students with a clear grasp of the science behind global warming discussion, the typical strategies (pros/cons) that are used in the popular media, and a good understanding of the science-based predictions of upcoming changes in the climate and environment. In addition to providing general scientific background to understand global warming and the science behind it, the class will visit the arguments that are used both for and against global warming. The graded written tests require students to address typical misinformation about global warming, show general knowledge of the scientific background, and recognize typical means to distort science in the mass media.

GEOL 111. Introduction to Planetary Geology. 3 Credits.

An introduction to Earth and the Solar System. Coverage includes: the planets and their moons, comets, asteroids, impact craters, meteorites, the sun, the solar system's origin, planetary atmospheres, the living Earth, and the question of life elsewhere. F,S.

GEOL 111L. Introduction to Planetary Geology Laboratory. 1 Credit.

Laboratory to complement GEOL 111 Introduction to Planetary Geology. Corequisite: GEOL 111. S.

GEOL 112. Discovering Dinosaurs!. 3 Credits.

This course provides an introduction to the "terrible lizards" that ruled our planet for over 150 million years. Dinosaurs capture human imagination, and their existence and demise allows us to explore evolution and extinction on geologic timescales. Emphasis will be placed on the scientific method and its applications to the study of dinosaurs. Topics will include dinosaur evolution, interrelationships, extinction, and the evolution of those dinosaurs still among us (birds). We will also explore current debates within the field of dinosaur paleontology and the evidence supporting the hypothesis that their extinction was due to a meteorite impact. Suitable for all majors. F,S.

GEOL 115. Motion of Life. 3 Credits.

Explore introductory concepts and principles of evolution through the study of motion, including major evolutionary transitions such as the development of limbs, wings, and the upright posture of humans. This course connects the evolutionary history of organisms with their unique biomechanical traits, locomotor capabilities, and influences on human engineering and design. Topics covered will include the relationship of form and function in extinct and modern organisms, how their evolutionary history influences this relationship, and its connection to human designs. Suitable for all majors. S.

GEOL 205. Surviving on Planet Earth. 3 Credits.

This Essential Studies course stresses critical thinking in covering the basic strategies about humans succeeding on our planet including Earth's hazards (our restless Earth); the balance of life on Earth (evolution and extinction); water in our lives (too much and too little); energy (use and population demands); and global change (Earth as a unique, ongoing experiment). S.

GEOL 215. Introduction to Paleontology. 3 Credits.

This course provides an overview of the foundational principles of paleontology. Topics covered include the fundamentals of evolution, phylogenetics, fossilization, paleoecology, and fossil identification. Students also explore the critical importance of fossils to geology, industry, and other related geoscience careers. The separate laboratory portion of the course emphasizes practical application via identification and interpretation of fossils, especially invertebrates as they are common in the fossil record. Prerequisite: GEOL 102 and GEOL 102L. Corequisite: GEOL 215L. F.

GEOL 215L. Introduction to Paleontology Lab. 1 Credit.

This course provides an overview of the foundational principles of paleontology. Topics covered include the fundamentals of evolution, phylogenetics, fossilization, paleoecology, and fossil identification. Students also explore the critical importance of fossils to geology, industry, and other related geoscience careers. The laboratory emphasizes practical application via identification and interpretation of fossils, especially invertebrates as they are common in the fossil record. Prerequisite: GEOL 102 and GEOL 102L. Prerequisite or Corequisite: GEOL 215. F.

GEOL 218. Mineralogy. 2 Credits.

Survey of the origin, distribution and uses of rock-forming minerals. Introduction to mineral structures, crystal chemistry, and crystallography. Prerequisite: GEOL 101 or GEOE 203, and CHEM 121 or consent of instructor. Corequisite: GEOL 218L. S.

GEOL 218L. Mineralogy Lab. 1 Credit.

Hands-on laboratory activities relating to GEOL 218. Prerequisite: GEOL 101 or GEOE 203, and CHEM 121 or consent of instructor. Corequisite: GEOL 218. S.

GEOL 219. Petrology. 2 Credits.

Description, classification and origin of igneous, metamorphic, and sedimentary rocks. Field and laboratory study of rocks. Engineering properties of Earth materials. Advanced aspects of optical mineralogy. Prerequisite: GEOL 218. Corequisite: GEOL 219L. F.

GEOL 219L. Petrology Lab. 1 Credit.

Hands-on laboratory activities relating to GEOL 219. Prerequisite: GEOL 218. Corequisite: GEOL 219. F.

GEOL 220. Computer Applications in Geology and Environmental Science. 2 Credits.

Introduction to the application of computers, software, and digital processing in the geological and environmental sciences. F.

GEOL 256. Critical Thinking in the Geosciences. 2 Credits.

An introduction to the study of geoscience and skills needed to successfully complete a geoscience degree. F.

GEOL 303. Selected Topics in Geology. 1-4 Credits.

Each topic is concerned with a special aspect of geology. May be repeated up to a maximum of 8 hours. Prerequisite: Consent of the instructor. Repeatable to 8.00 credits. On demand.

GEOL 311. Geomorphology. 4 Credits.

In this course you will learn about the Earth's surface: what processes created the landforms we see today and how those landforms are evolving through time. The topics include: rivers, glaciers, wind, weathering, soils, groundwater, slope processes, dating of the surface deposits, and current and past climate change. The course objective is to provide students with a good understanding of the processes and materials that shape the Earth's surface. Includes field trip and hands on laboratory. Prerequisite: GEOL 101 or GEOE 203 or consent of instructor. F.

GEOL 312. Sedimentology and Stratigraphy. 3 Credits.

Describe and classify siliciclastic and carbonate sedimentary rocks; interpret sedimentary structures in ancient sedimentary rocks in terms of depositional, erosional or deformational processes, interpret ancient depositional environments of siliciclastic and carbonate sedimentary rocks; understand and appreciate the difference between rock and time units in sedimentary successions; recognize and appreciate the importance of unconformities in sedimentary successions and for the formation of hydrocarbons; discuss mechanisms responsible for sedimentary basin formation, and describe and classify sedimentary basins. This course is also designed to teach you how to reference adequately in the text and how to make a reference list (plus what should be in there). Prerequisite: GEOL 219. Corequisite: GEOL 312L. S.

GEOL 312L. Sedimentology and Stratigraphy Lab. 1 Credit.

Describe and classify siliciclastic and carbonate sedimentary rocks and know how to put a name to a sedimentary rock sample. You will learn to interpret sedimentary structures based on hand samples in ancient sedimentary rocks in terms of depositional, erosional or deformational processes, and interpret ancient depositional environments of siliciclastic and carbonate sedimentary rocks based on core description; you will learn to recognize the importance of surfaces in sedimentary successions; this course will also briefly discuss mechanisms responsible for sedimentary basin formation, and describe and classify sedimentary basins. Prerequisite: GEOL 219. Prerequisite or Corequisite: GEOL 312. S.

GEOL 316. Earth Materials. 3 Credits.

This course has three components. We start by considering the context in which Earth materials are studied and some fundamental concepts about the Earth system. Then we undertake a systematic look at the most important materials that make up our planet and how they occur in different settings. Included are elements, minerals, rocks of all sorts, soils, and water. We will examine their properties, their distribution and occurrences, the processes that form them, and how scientists use these materials to interpret Earth. The third, and perhaps most important focus of the class is on the importance of Earth materials in our society and lives. This includes consideration of mineral and energy resources, hazards, and engineering. Class time has both a lecture and a laboratory component. Prerequisite: CHEM 121 or equivalent knowledge of chemistry. S.

GEOL 321. Geochemistry. 3 Credits.

Application of the principles of chemistry to geologic and hydrogeologic problems. Origin and distribution of the chemical elements. Introduction to radiochemistry, isotopic geochronology, and stable-isotope geochemistry. Prerequisite: GEOL 218 or GEOE 301; CHEM 122; MATH 165; or consent of instructor. S.

GEOL 322. Geology, Society, and the Environment. 3 Credits.

Relationship of geology to society; natural hazards; protection, reclamation, and restoration of our natural environment; application of geology to engineering, land planning, and resource management. Prerequisite: One introductory geology course or upper division standing; MATH 103 is recommended. S, even years.

GEOL 330. Structural Geology. 3 Credits.

Mechanics of rock deformation, analysis of rock structures, preparation and interpretation of geologic maps and cross sections showing structural and tectonic features. Prerequisite: GEOL 219 or GEOE 301 and PHYS 211 or PHYS 251. Corequisite: GEOL 330L. S.

GEOL 330L. Structural Geology Laboratory. 1 Credit.

Hands-on laboratory activities relating to GEOL 330. Corequisite: GEOL 330. S.

GEOL 340. Digital Mapping Methods. 3 Credits.

This course integrates "hands-on" data acquisitions and map generation with an overview of the technology (GPS, lasers, and data management). Field projects focus on mapping methodology and laboratory projects focus on analysis and presentation. It is assumed that students have an undergraduate geology background and a basic knowledge of computer applications. Prerequisite: Junior Standing in geology.

GEOL 342. Conservation and Environmental Hydrology. 3 Credits.

Topics relating hydrology to the environment and water conservation, including the global and local hydrological cycle, flood occurrence and prediction, water pollution, erosion and sedimentation, wetlands, and water management. Prerequisite: Introductory geology course or upper division standing; MATH 103. S, odd years.

GEOL 355. Economic Geology and Ore Deposits. 3 Credits.

Our world requires mineral resources to support our lifestyles. And when we confront resource supply and development issues, people are often faced with uncomfortable choices. For example, where do we want our resources to come from? And how much environmental degradation is acceptable? These and related questions are not only fascinating but critically important to maintaining modern society. This course explores the origins, types, extraction procedures, and legal and political aspects behind the collection of geologic resources. The class has a seminar format, focusing on student presentations and discussion of topics vital to your (and everyone's) future. Prerequisite: GEOL 218, or permission of the instructor. F.

GEOL 356. Geoscience Lectures. 1 Credit.

Students attend and evaluate departmental lectures given by visiting scientists and engineers, faculty, and students. May be repeated once. May not be taken concurrently with GEOL 422. S/U grading. F,S.

GEOL 407. Petroleum Geology. 3 Credits.

This course is designed to provide students with an introduction to the application of geological principles in the exploration and production of oil and gas. Prerequisite: GEOL 101 or GEOE 203 or GEOE 210. S.

GEOL 410. Site Characterization. 3 Credits.

Purposes, techniques, and tools of site investigation. Covers geologic, hydrologic, and ecologic concerns. Hands-on application of principles, tools and techniques at real sites. Prerequisite: GEOL 220, GEOL 311, GEOL 414; BIOL 332, BIOL 332L. F.

GEOL 414. Applied Geophysics. 3 Credits.

Principles of various geophysical methods and their application to geologic problems. Prerequisite: GEOL 101 or GEOE 203; MATH 165; and PHYS 211 or 251. F.

GEOL 416. Vertebrate Paleontology. 4 Credits.

This course examines the evolutionary history of vertebrates, ranging from the origin of chordates in the Cambrian to the rise of dinosaurs, mammals, and hominids. Emphases are placed on the anatomical diagnoses of vertebrate clades and their phylogenetic relationships, as well as major milestones in vertebrate evolution, such as the origins of terrestrial locomotion and flight. Lab exercises examine skeletal anatomy of vertebrates, functional adaptations, and the role of skeletons in discerning phylogenetic interrelationships of vertebrates. Prerequisite: GEOL 102 and GEOL 102L. F, odd years.

GEOL 417. Dinosaur Paleontology. 4 Credits.

This course examines the origin and evolutionary history of non-avian dinosaurs, including their extinction. Emphases are placed on the anatomical diagnoses of dinosaur clades and their phylogenetic relationships, the origin of birds, and functional adaptations exhibited by dinosaurs. Lab exercises will examine the anatomy of dinosaur bones, adaptations exhibited by dinosaurs, and the role of their skeletons in discerning their phylogenetic interrelationships. Prerequisite: GEOL 102 and GEOL 102L. S, odd years.

GEOL 418. Taphonomy and Fossilization Processes. 4 Credits.

All living organisms eventually succumb to the same end: death. Taphonomy is the study of everything that happens to an organism from the time of its death until its discovery as a fossil. This course explores the varied environmental, geologic, and biologic processes that act on organic remains after death, including how these processes can bias the fossil record or yield information about past ecosystems. The laboratory involves experiments and activities which provide opportunities to explore the lecture topics in further detail. Prerequisite: GEOL 102 and GEOL 102L. S, even years.

GEOL 420. Geology Capstone. 3 Credits.

Geology capstone entailing information literacy and communication about Earth materials, processes and history. The course checks retention of earlier learning and insures review and significant addition to that learning. Prerequisite: GEOL 312 or consent of advisor. F,S.

GEOL 421. Seminar. 1 Credit.

Instruction and practice of oral and visual presentation in science and engineering. Includes preparation and delivery of artifact talks, chalk talks, and slide talks. Involves critical review of student presentations and departmental guest lectures. Prerequisite: GEOL 312. F,S.

GEOL 422. Seminar II. 1 Credit.

Continuation of GEOL 421 experience. Preparation and delivery of oral presentations in science and engineering, culminating in oral presentation of senior thesis (Geol 490) or Engineering Design (485). Includes critical review of student presentations and departmental guest lectures. Prerequisite: GEOL 421, senior or graduate status in departmental major. F,S.

GEOL 450. Advanced Planetary Geology. 3 Credits.

This course leads students deeper into Solar System processes. The topics covered include planetary properties, system dynamics, energy transport, planetary atmospheres and interiors, laws of physics that govern planetary bodies, exoplanets and other star systems, and the possibility of life elsewhere in the universe. Prerequisite: GEOL 111. S.

GEOL 487. Undergraduate Research. 1 Credit.

Identification and proposal of research project. Includes literature review, feasibility review, and formal project identification and written proposal. Selection of faculty research adviser within first month of semester. Prerequisite or Corequisite: GEOL 421. F,S.

GEOL 488. Research II. 2 Credits.

Execution of research plan developed in GEOL 487. Prerequisite: GEOL 487.

GEOL 491. Geologic Problems. 1-4 Credits.

Individualized or group study on selected geoscience topics. May be taken more than one semester to maximum of 8 hours. Prerequisite: Consent of instructor. Repeatable to 8.00 credits. F,S,SS.

GEOL 494. Senior Thesis. 1 Credit.

Written results of research conducted in GEOL 487 or GEOL 488. The thesis document should conform to the format guidelines of a major English-language journal in which the thesis could be published. A copy is to be provided to the F.D. Holland Jr. Geology Library. Prerequisite or Corequisite: GEOL 487. F,S.

GEOL 500. Sedimentary Geology. 1-4 Credits.

Selected topics in sedimentary geology, such as sedimentary processes, carbonate petrology, clastic petrology, and basin analysis. May be repeated up to 12 credits. Prerequisite: Consent of instructor. Repeatable to 12.00 credits. F.

GEOL 505. Isotope Geochemistry. 3 Credits.

Geochemistry and cosmochemistry of radioactive and stable isotopes; isotope equilibria; applications in paleoclimatology, environmental isotope geochemistry, igneous, metamorphic, and sedimentary petrology. Prerequisite: GEOL 321 or permission of instructor.

GEOL 506. Glacial Geology. 4 Credits.

Origin, growth, and movement of glaciers; landforms and deposits incident to glaciation. 3 hours lecture, 2 hours laboratory time per week. Prerequisite: GEOL 311.

GEOL 509. Advanced Mineralogy. 1-4 Credits.

Advanced study of specific mineral groups or selected topics in mineralogy. Prerequisite: Demonstrable knowledge in petrology and geochemistry. On demand.

GEOL 511. Advanced Structural Geology. 4 Credits.

Reading and research in special topics in structural geology and geotectonics.

GEOL 512. Advanced Petrology. 1-4 Credits.

Selected topics in petrology taught using conventional lecture and laboratory/field approach. Prerequisite: Demonstrable knowledge in petrology. On demand.

GEOL 515. Advanced Paleontology. 3 Credits.

Selected topics include (but not limited to): Invertebrate paleontology; vertebrate paleontology; paleoecology; taxonomy; museum studies; western continental stratigraphy; critical boundaries. May be repeated. Prerequisite: Demonstrable knowledge in invertebrate and/or vertebrate paleontology and organismal biology. Repeatable to 40.00 credits. On demand.

GEOL 516. Earth Materials: Components of a Diverse Planet. 3 Credits.

This course has three components. (1) We examine the context in which Earth materials are studied and some fundamental concepts about the Earth system. (2) We undertake a systematic look at the most important materials that make up our planet (elements, minerals, rocks of all sorts, soils, and water). We will examine their properties, their distribution and occurrences, the processes that form them, and how scientists use these materials to interpret Earth. The third, and perhaps most important focus of the class is on the importance of Earth materials in our society and lives. This includes consideration of mineral and energy resources, hazards, and engineering. Class time has both a lecture and a laboratory component. Students will be required to give class presentations and complete writing assignments. Students who have taken GEOL 316 cannot subsequently take GEOL 516 as an undergraduate or graduate student at UND. Prerequisite: CHEM 121 or equivalent. S.

GEOL 518. Topics in Advanced Stratigraphy. 2-4 Credits.

Selected topics in lithostratigraphy and biostratigraphy. Prerequisite: Demonstrable knowledge in sedimentology, stratigraphy, and the basics of paleontology. Repeatable to 4.00 credits. On demand.

GEOL 520. Statistical Applications in Geology. 3 Credits.

The application of statistical techniques to geologic data and problems, with emphasis on analysis of geologic sequences, map analysis, and multivariate analysis of geologic data. Prerequisite: An introductory statistics course, such as CTL 515 or PSYC 241, and consent of instructor.

GEOL 522. History and Philosophy of Geology. 3 Credits.

Historical and philosophical development of the science of geology. Prerequisite: Permission of instructor.

GEOL 523. Topics in Advanced Geomorphology. 1-4 Credits.

Selected topics in geomorphic processes and landforms. Prerequisite: GEOL 311. Repeatable to 4.00 credits.

GEOL 525. Weathering and Soils. 3 Credits.

Properties and classification of soils; the factors and processes of weathering and soil formation. Prerequisite: GEOL 311 and GEOL 411, or consent of instructor.

GEOL 530. Topics in Physical Hydrogeology. 2 Credits.

Selected topics in groundwater, vadose-zone hydrology, fracture flow, analytical/numerical modeling, GIS and hydrology, and wetland soils/hydrology. Repeatable when topics vary. Prerequisite: Consent of instructor. Repeatable to 8.00 credits. F,S.

GEOL 531. Hydrogeochemistry. 3 Credits.

The origin, characteristics and modeling of surface and ground water geochemistry. Prerequisite: GEOL 321 and MATH 166, or permission of instructor.

GEOL 532. Contaminant Hydrogeology. 3 Credits.

Chemical and physical processes affecting contaminant behavior in groundwater with analytical/numerical modeling and case studies. Prerequisite: GEOE 417 and GEOE 427 and MATH 265, or consent of instructor.

GEOL 540. Water Sampling and Analysis. 3 Credits.

Techniques of water and sediment sampling and analysis using equipment in the UND Water Quality Laboratory. Results are interpreted in the context of the natural systems from which the samples are taken. Enrollment is limited to eight students per section. A laboratory fee is required. Prerequisite: CHEM 121.

GEOL 551. Heat Flow. 3 Credits.

An exploration of Earth's thermal structure, thermal history and heat sources. The course begins with the theory of heat transfer within and through the surface of terrestrial planets. Methods of observation and modeling provide hands-on experience in field and laboratory activities. Applications of heat flow in tectonics, petrology, thermal maturity of kerogen, hydrogeology, geothermics and climate change are presented with current examples. Prerequisite: Graduate standing. Corequisite: Permission of instructor. On demand.

GEOL 555. Advanced Economic Geology and Ore Deposits. 3 Credits.

Our world requires mineral resources to support our lifestyles. And when we confront resource supply and development issues, people are often faced with uncomfortable choices. For example, where do we want our resources to come from? And how much environmental degradation is acceptable? These and related questions are not only fascinating but critically important to maintaining modern society. This course explores the origins, types, extraction procedures, and legal and political aspects behind the collection of geologic resources. The class has a seminar format, focusing on student presentations and discussion of topics vital to your (and everyone's) future. Additionally, students will write and present several short papers during the semester. Prerequisite: Demonstrable knowledge in mineralogy and/or petrology. F.

GEOL 560. Geothermics I. 3 Credits.

A survey of the methods of geothermal exploration, assessment and production. The course covers the various methods for discovery and characterization of geothermal resources. Methods for assessment of energy in place and determination of recoverable energy are covered in depth. Current technologies for energy extraction and power production are presented with current examples. Prerequisite: Graduate standing. Corequisite: Permission of instructor. On demand.

GEOL 561. Geothermics II. 3 Credits.

The course covers the historical development of geothermal policies, regulations and practices globally and in different states within the US. Matters of water usage, contamination and disposal are covered extensively. Current issues such as induced seismicity, hydrofracture, power plant size and location, electrical grid access and land use are critically examined. Prerequisite: Senior or Graduate Standing. Corequisite: Permission of Instructor. On demand.

GEOL 590. Research. 1-4 Credits.

Laboratory, field, or library research on problems of interest (may be repeated). Repeatable.

GEOL 591. Directed Studies. 1-4 Credits.

Directed advanced research in a specialized field of geologic study (may be repeated). Repeatable.

GEOL 996. Continuing Enrollment. 1-12 Credits.

Repeatable. S/U grading.

GEOL 997. Independent Study. 2 Credits.

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GEOL 998. Thesis. 1-9 Credits.

Repeatable to 9.00 credits.

GEOL 999. Dissertation. 2-12 Credits.

May be repeated up to 24 credits. Repeatable to 24.00 credits.