

Course Catalog - Fall 2008

Geology

100 **Planet Earth** credit: 3 hours.

Introduces non-science majors to physical aspects (earthquakes, volcanoes, floods, tsunamis, mountains, plate tectonics) and historical aspects (formation of earth and life, dinosaurs, ice age, evolution of climate) in earth science. Presents information on earth resources, natural hazards, and development of natural landscapes. Focuses on humanistic issues; provides context for understanding environmental change. Optional lab demonstrations and field trips with co-registration in GEOL 110. Credit is not given for both GEOL 100 and GEOL 101, GEOL 103, GEOL 107, or GEOL 111.

This course satisfies the General Education Criteria for a Physical Sciences course.

101 **Introductory Physical Geology** credit: 4 hours.

Focuses on physical features of our planet and their origin. Topics include: plate tectonics, mountain building, glaciers, earthquakes, volcanoes, coastlines, rivers, deserts, geologic structures, weathering, minerals, and rocks. Introduces fundamental methodology for observing and interpreting earth features. Intended for non-physical science majors. Credit is not given for both GEOL 101 and GEOL 100, GEOL 103, GEOL 107, or GEOL 111.

This course satisfies the General Education Criteria for a Physical Sciences course.

103 **Planet Earth QRII** credit: 3 hours.

Topics covered are very similar to those of GEOL 101. Emphasis is in the application of quantitative methods in deriving geological knowledge. A weekly computer laboratory is an essential component of the course. Credit is not given for both GEOL 103 and GEOL 100, GEOL 101, GEOL 107, or GEOL 111.

This course satisfies the General Education Criteria for a Physical Sciences, and Quant Reasoning II course.

104 **Geology of the National Parks** credit: 3 hours.

Develops geologic background, concepts, and principles through study of selected national parks and monuments. Examines the geologic framework and history, modern geologic processes, and factors influencing the present day landscape for each park area.

This course satisfies the General Education Criteria for a Physical Sciences course.

107 **Physical Geology** credit: 4 hours.

Introduces Earth phenomena and processes. Includes minerals and rocks, continental drift, plate tectonics, rock deformation, igneous and sedimentary processes, geologic time, landscape evolution, internal structure and composition of the earth, groundwater, seismology and earthquakes, and formation of natural resources. Emphasizes the chemical and physical aspects of the Earth, and the basis for geological inference. Field trip required for geology majors, optional for others. Intended for science and science-oriented students. Credit may not be received for both GEOL 107 and GEOL 100, GEOL 101, GEOL 103, or GEOL 111.

This course satisfies the General Education Criteria for a Physical Sciences course.

110 **Exploring Geology in the Field** credit: 1 hours.

Introduces practical techniques for identification of rocks, minerals, and fossils; interpretation of geologic maps and cross-sections; appreciation of Midwestern geologic history and geologic features and landforms in the field. Two field trips are required (a 1-day and a 3-day trip).

111 **The Dynamic Earth-Honors** credit: 4 hours.

Study of the geological history and evolution of the earth, the formation of mountains and ocean basins, the making of continents and earth environments and resources. Typically, a three to four-day field trip is required. Course in the Campus Honors Program. Credit may not be received for both GEOL 111 and GEOL 100, GEOL 101, GEOL 103, or GEOL 107.

This course satisfies the General Education Criteria for a Physical Sciences course.

116 **The Planets** credit: 3 hours.

Introduces non-science majors to important processes and their consequences on a planet-wide scale. Discusses system to tectonic, volcanic, chemical, and atmospheric cycles evolving through the past 4.5 billion years of the

planets and satellites; the interrelationship between deep-seated and surficial processes; processes common to terrestrial planets and unique to the Earth. Credit is not given for both GEOL 116 and ASTR 121.

This course satisfies the General Education Criteria for a Physical Sciences course.

117 ***The Oceans*** credit: 3 hours.

Integrated introduction to oceanography and marine geology and geophysics. Topics include ocean-basin formation and evolution (in the context of plate tectonics), ocean ecology, the hydrologic cycle, water chemistry, currents and waves, the interaction of oceans with climate, coastal hazards, resources, pollution, and the Law of the Sea. Course is oriented toward students not majoring in science.

This course satisfies the General Education Criteria for a Physical Sciences course.

118 ***Natural Disasters*** credit: 3 hours.

Introduces the nature, causes, risks, effects, and prediction of natural disasters including earthquakes, volcanoes, landslides, subsidence, global climate change, severe weather, coastal erosion, floods, mass extinctions, and meteorite impacts; covers geologic principles and case histories of natural disasters as well as human responses (societal impact, mitigation strategies, and public policy). Same as ENVS 180 and GLBL 118.

This course satisfies the General Education Criteria for a Physical Sciences course.

130 ***The Changing Earth System*** credit: 3 hours.

Same as ATMS 130 and GEOG 130. See ATMS 130.

This course satisfies the General Education Criteria for a Physical Sciences course.

143 ***History of Life*** credit: 3 hours.

Evolution of life from its beginning, illustrating changing faunas and floras through time; the invasion of land and of the skies; the effects of a changing atmosphere, changing climates, and continental drift. Emphasis on dinosaur evolution, ecology, and extinction; also other vertebrates, including mammal-like reptiles, mammals, and the emergence of humans, as well as plants and invertebrates.

This course satisfies the General Education Criteria for a Life Sciences course.

199 ***Undergraduate Open Seminar*** credit: 1 to 5 hours.

May be repeated.

208 ***History of the Earth System*** credit: 4 hours.

Presents systematic analysis of formation and evolution of the Earth and its dynamic systems (lithosphere, hydrosphere, atmosphere, and biosphere). Also introduces methods of reconstructing Earth's history through use of geochronology, paleontology, and the stratigraphic records. Introduces the geological history of life evolution, mountain belts and continents, geochemical systems, climate, sea level, and the Earth's interior. Field trip and field trip fee required. Prerequisite: GEOL 100, GEOL 101, GEOL 103, GEOL 104, GEOL 107, or GEOL 111 or consent of instructor.

This course satisfies the General Education Criteria for a Physical Sciences course.

333 ***Earth Materials and the Env*** credit: 4 hours.

Studies the origin, identification, and environmental significance of earth materials (minerals, rocks, and soil). Environmental topics include: mineral resources; acid mine drainage; volcanic hazards; swelling soils; engineering strength, porosity/permeability, and architectural uses of earth materials; and asbestos. Required 1- or 2-day field trip. Credit is not given for both GEOL 333 and GEOL 432. Prerequisite: GEOL 100 and GEOL 110; or GEOL 101, GEOL 103, GEOL 104, GEOL 107, GEOL 111, or GEOL 250; and CHEM 102 and CHEM 103; or consent of instructor.

380 ***Environmental Geology*** credit: 4 hours.

Increases student understanding of environmental issues of water supply and pollution, waste disposal, energy, environmental health, global change, and land evaluation and use by emphasizing the role of geology and its relationships to human activities. Course requires a one-day field trip. Same as ENVS 380. Prerequisite: CHEM 102 and CHEM 103; and GEOL 100 and GEOL 110, or GEOL 101, GEOL 103, GEOL 104, GEOL 107, GEOL 111, or GEOL 250; or consent of instructor.

390 ***Individual Study*** credit: 1 to 4 hours.

Research and individual study in geology. May be repeated. A maximum of 8 hours of GEOL 390 plus GEOL 391 may be counted toward graduation. Prerequisite: GEOL 208 or equivalent; consent of supervising faculty member.

391 **Individual Honors Study** credit: 1 to 4 hours.

Research and individual study in geology for honors credit. May be repeated. A maximum of 8 hours of GEOL 390 plus GEOL 391 may be counted toward graduation. Prerequisite: GEOL 208 or equivalent; consent of supervising faculty member and of departmental honors advisor.

401 **Geomorphology** credit: 4 hours.

History, origin, and characteristics of land forms produced by weathering, fluvial, glacial, wind, and wave processes or by a combination of these acting upon the major kinds of geologic materials and structures. Lectures, laboratory, and field trips. Prerequisite: GEOL 208 or consent of instructor.

404 **Soil Geomorphology** credit: 4 hours.

Same as GEOG 404. See GEOG 404.

406 **Fluvial Geomorphology** credit: 4 hours.

Same as GEOG 406 and NRES 406. See GEOG 406.

411 **Structural Geol and Tectonics** credit: 4 hours.

Introduction to principles of rock deformation, stress, and strain; description and interpretation of geologic structures; study of methods for structural analysis; outline of geotectonic processes; three hours of lecture and a three-hour lab per week. Required four-day field trip. Prerequisite: GEOL 107 or consent of instructor.

415 **Field Geology** credit: 2 to 8 hours.

Group field study in a prominent geologic locality; includes in-class meetings, student-led presentation, and field trip; trips run during spring break, winter break, in mid-end May or intercession; dates depend on location. May be repeated. Prerequisite: Consent of instructor.

417 **Geol Field Methods, Western US** credit: 6 hours.

Field course based in the mountains of the western United States. Provides intensive practical experience in geologic mapping, as well as instruction in field structural, stratigraphic, geomorphologic, and petrologic analysis. Offered during summer session only. Prerequisite: Eight hours of 400-level credit in geology, or consent of instructor; GEOL 411, GEOL 432, and GEOL 440 are recommended.

420 **Introduction to Paleontology** credit: 3 hours.

Surveys the major groups of fossil forming invertebrates, vertebrates and plants, their modes of preservation, and basics of taxonomy; also their use in the study of functional morphology, ecology, evolution, and biogeography. Prerequisite: GEOL 208, or IB 466, or consent of instructor.

432 **Mineralogy and Mineral Optics** credit: 4 hours.

Introduction to: crystallography; crystal optics; structure, composition, properties, stability and geological occurrences of minerals; and mineral identification. Credit is not given for both GEOL 333 and GEOL 432. Prerequisite: GEOL 208 and CHEM 104 and CHEM 105.

436 **Petrology and Petrography** credit: 4 hours.

Study of the minerals, compositions, textures, structures, classifications, and origins of igneous, and metamorphic rocks; lectures emphasize rock forming processes (petrology), and laboratories emphasize use of the petrographic microscope (petrography). Prerequisite: GEOL 432.

440 **Sedimentology and Stratigraphy** credit: 4 hours.

Introduces dynamics of sedimentation, geology of sedimentary basins, the distribution of geologic processes through time, definition and correlation of stratigraphic units, principles of paleogeography, stratigraphy and tectonics. Prerequisite: GEOL 208 or consent of instructor.

450 **Physics of the Earth** credit: 3 hours.

Survey of the physical and chemical principles used to delineate the physical state and evolution of the Earth including its internal structure, composition, and mineralogy. Topics include seismology, gravity, magnetics, heat flow, geophysical exploration, high-pressure mineralogy, and composition of the mantle and core. Students in geophysics, engineering, or physics should enroll in GEOL 452. Credit is not given for both GEOL 450 and GEOL 452. Prerequisite: PHYS 211, GEOL 432, credit or concurrent registration in GEOL 411, or consent of instructor.

451 **Methods in Applied Geophysics** credit: 4 hours.

Discusses nondestructive geophysical methods to reveal subsurface structures. Topics include seismic, gravity, magnetics, electrical methods, ground penetrating radar, borehole geophysics, and their applications to hydrocarbon and mineral exploration as well as engineering and environmental investigations. Several required local trips for field experiments. Prerequisite: MATH 241 and PHYS 212.

452 **Introduction to Geophysics** credit: 4 hours.

Introduces basic concepts related to the physics of the Earth's interior. Topics include formation of the Earth; its composition, gravity, shape, internal temperature, and magnetism; seismology; plate tectonics; and geodynamics. Same as ASTR 452. Credit is not given for both GEOL 452 and GEOL 450. Prerequisite: MATH 241 and PHYS 212.

454 **Introduction to Seismology** credit: 3 or 4 hours.

Introducing the basic theory of seismic wave generation and propagation and its application to Earth structure and earthquakes, including body waves, surface waves, inference of Earth structure, seismic prospecting, earthquake mechanisms, and strong ground motions. 3 or 4 undergraduate hours. Students participating in optional class projects receive an additional hour of credit. Prerequisite: MATH 285 or consent of instructor.

460 **Geochemistry** credit: 3 hours.

Fundamental chemical and physical concepts applied to geological processes; topics include: origin, distribution, and geochemical behavior of elements; chemical evolution of the Earth; geochemistry of natural waters and sedimentary rocks; isotope geochemistry, crystal chemistry, trace element geochemistry and organic geochemistry. Prerequisite: GEOL 101 or GEOL 107; CHEM 104; CHEM 105; MATH 220 or MATH 221; or consent of instructor.

470 **Introduction to Hydrogeology** credit: 4 hours.

Introduction to environmental and economic aspects of the occurrence and movement of groundwater through the earth's crust; topics include the hydrologic cycle, groundwater contamination, petroleum migration, formation of mineral resources, and groundwater chemistry. Prerequisite: MATH 220 or MATH 221; concurrent registration in either (i) CHEM 104 and CHEM 105 or (ii) CHEM 203 and CHEM 204; or consent of instructor.

481 **Earth Systems Modeling** credit: 4 hours.

Same as ATMS 421, GEOG 421, and NRES 422. See ATMS 421.

492 **Senior Thesis** credit: 2 to 8 hours.

Research in geology, with thesis; a thesis must be submitted for credit to be received. No graduate credit. May be repeated. A maximum of 10 hours of GEOL 492 plus GEOL 493 may be counted toward graduation. Prerequisite: Consent of supervising faculty member.

493 **Honors Senior Thesis** credit: 2 to 8 hours.

Research in geology with honors thesis; a thesis must be submitted for credit to be received. No graduate credit. May be repeated. A maximum of 10 hours of GEOL 492 plus GEOL 493 may be counted toward graduation. Prerequisite: Consent of supervising faculty member and of departmental honors advisor.

497 **Special Topics in Geology** credit: 1 to 4 hours.

Seminar or lectures in subjects not covered by regular course offerings; for advanced undergraduates and graduate students. 1 to 4 graduate hours. May be repeated. Prerequisite: Consent of instructor.

511 **Advanced Structural Geology** credit: 4 hours.

Study of selected topics concerning rock deformation processes and products. Course will introduce students to

current research literature and methods, and to the techniques of structural analysis. Prerequisite: GEOL 411 or equivalent; consent of instructor.

512 **Geotectonics** credit: 4 hours.

Discussion of plate tectonics theory, and nature and distribution of regional-scale earth structures, such as mountain belts; includes study of geological and geophysical evidence that led to modern interpretations of evolution of earth's lithosphere. Prerequisite: GEOL 411 or consent of instructor.

515 **Advanced Field Geology** credit: 2 to 4 hours.

Group field study in a prominent geologic locality; includes in-class meetings, student-led presentation, and field trip; trips run during spring break, winter break, mid-end May or intercession; dates depend on location. May be repeated. Prerequisite: Consent of instructor.

516 **Continental Lithosphere** credit: 3 hours.

Crustal composition and evolution, physical properties of the lithospheric mantle and effects of temperature, petrology and texture, the isopycnic (tectosphere) hypothesis, rock mechanics and rheology, seismic anisotropy and petro-fabrics, and mechanisms of uplift. Prerequisite: Equivalent of GEOL 411, GEOL 450 or GEOL 452, and GEOL 436 or GEOL 460, or consent of instructor.

521 **Topics in Paleontology** credit: 4 hours.

Selected topics in macro- and micropaleontology. Intensive study of a selected invertebrate or algal group; special problems in the taxonomy, evolution, skeletal diagenesis, ecology, biogeography, and biostratigraphy of selected fossil organisms. May be repeated. Prerequisite: GEOL 420, IB 466, or consent of instructor.

531 **Structural Mineralogy** credit: 4 hours.

Structure and crystal chemistry of minerals and survey of current knowledge of the properties and behavior of selected minerals and mineral groups. Prerequisite: GEOL 432 or consent of instructor.

540 **Petroleum Geology** credit: 4 hours.

Application of geoscience to understanding the nature and occurrence of hydrocarbon resources. Emphasizes: source-rock geology and geochemistry, process of petroleum migration, nature of reservoirs and traps, exploration and drilling procedures, interpretation of seismic-reflection profiles, cross-section and sub-surface map construction, classification and tectonics of petroleum-bearing sedimentary basins, application of sequence stratigraphy to exploration, and petroleum-related environmental issues. Prerequisite: GEOL 411 and GEOL 440, or equivalent.

552 **Geodynamics** credit: 4 hours.

Addresses dynamical characteristics of the solid earth. Mathematical theories will be developed that describe large scale deformation, both on the surface and within the interior of the earth. Theoretical predictions will be compared with observations to delineate: the internal properties of the earth; driving mechanism of plate tectonics and the origin of various geological processes such as volcanism, mountain building and basin formation. Prerequisite: MATH 285, PHYS 211, GEOL 452, or consent of instructor.

553 **Chemistry of Earth's Interior** credit: 4 hours.

The state of Earth's interior, emphasizing its chemical composition and mineralogy. Focuses on the interpretation of geochemical, petrologic, and laboratory geophysical data related to deep Earth composition, thermal state, structure, and evolution. Prerequisite: GEOL 450, GEOL 452, or consent of instructor.

554 **Physics of Earth's Interior** credit: 4 hours.

Study of the state of Earth's interior, including fundamental theories, geophysical methods, and recent discoveries. Emphasizes interpretation of observed seismic and other geophysical data related to the structure, composition, evolution, and dynamical processes of the Earth's mantle and core. prerequisite: GEOL 450, GEOL 452, or consent of instructor.

560 **Physical Geochemistry** credit: 4 hours.

Introduction to geochemical thermodynamics and kinetics providing the background needed for more advanced courses in geochemistry, petrology, and mineralogy. Prerequisite: CHEM 104; CHEM 105; MATH 241; or

equivalents; or consent of instructor.

562 **Isotope Geology** credit: 4 hours.

Introduction to the theoretical basis for isotopic fractionation in nature; survey of isotopic variations in natural materials; and application of isotopic variations to problems of geological and environmental significance. prerequisite: Consent of instructor.

563 **Analytical Geochemistry** credit: 4 hours.

Introduces principles and applications of chemical and isotopic analysis of geological materials, including x-ray spectroscopy, mass spectrometry and atomic spectroscopy. Lectures cover theory of analysis while practical laboratory based exercises focus on how instruments work and instrument operation. Individually tailored analysis project constitutes a major part of assessment. Prerequisite: Consent of instructor.

570 **Hydrogeology** credit: 4 hours.

The occurrence, storage, and movement of water within sediments and rocks, with emphasis on quantitative aspects of physical hydrologic theory; topics include flow modeling, heat transport and mass transfer, groundwater contamination, and the role of fluid migration within the earth's crust in geologic processes. Prerequisite: GEOL 470, CEE 454, or consent of instructor.

571 **Geochemical Reaction Analysis** credit: 4 hours.

Study of the chemical processes affecting fluids, sediments, and rocks of the earth's crust, with emphasis on the inorganic geochemistry of groundwater and the development and application of quantitative reaction models. Prerequisite: GEOL 460, GEOL 560, or GEOL 561, or CEE 443 or CEE 537, or consent of instructor.

579 **Isotope Hydrogeology** credit: 4 hours.

Application of isotope measurements in hydrogeology. Groundwater age dating, stable isotope ratios and anthropogenic radionuclides will be considered in the context of studying a broad range of hydrologic problems, from siting of nuclear waste disposal to understanding the migration of groundwater in sedimentary basins. Prerequisite: GEOL 470 or GEOL 562, CEE 454, or consent of instructor.

591 **Current Research in Geoscience** credit: 1 hours.

Brings students up-to-date with current research over a broad spectrum of geoscience; improves students' oral presentation skills by practice and example. Required for all graduate students in Geology. Approved for S/U grading only. May be repeated to a maximum of 12 hours. Prerequisite: Graduate standing in Department of Geology or consent of instructor.

593 **Advanced Studies in Geology** credit: 1 to 8 hours.

Work may be taken in the following fields: (a) general geology; (b) engineering geology; (c) geomorphology and glacial geology; (d) clay mineralogy; (e) ground-water geology; (f) geomicrobiology; (g) geological fluid dynamics; (h) mineralogy and crystallography; (i) paleontology; (j) geochemistry; (k) geophysics; (l) petrography and petrology; (m) sedimentology; (n) stratigraphy; (o) oceanography; (p) submarine geology; (q) structural geology and geotectonics; (r) mathematical geology; (s) sedimentary petrography; (t) petroleum geology; (u) coal geology; (v) isotope geology and geochronology; (w) electron beam analysis; (x) vulcanology; (y) environmental geology; and (z) planetology. Approved for S/U grading only. May be repeated.

599 **Thesis Research** credit: 0 to 16 hours.

Individual research under supervision of members of the faculty in their respective fields. Approved for S/U grading only. May be repeated.