

842. An International Comparative Study of Urban Planning
Winter of odd-numbered years. 3(3-0)

Urban growth patterns; types, roles and design theory of new cities; techniques and organization for urban growth; selection of subject areas will be made according to the class composition.

850. Housing Program Planning
Spring of even-numbered years. 4(2-4)
Approval of school.

Regulation, stimulation, salvage, and replacement of housing through public policy and administrative procedures. Increasing role of private initiative as partner to public action through conservation, rehabilitation, and redevelopment practices. Evaluation of trends and needs; analysis of case studies.

858. Urban Land Policy and Regulation
Spring of odd-numbered years. 4(2-4)
Approval of school.

Public land use policy and legislation, and implementing governmental actions. Land use controls exercised by several levels of government. Field work in development and application of land use control instruments.

862. Development Planning and Administration
Spring of odd-numbered years. 4(2-4)
Approval of school.

Measurement of urban obsolescence and deterioration with accompanying analysis of symptoms and causes for a selected community. Comprehensive plan for urban renewal and development objectives will be developed and one or more project areas will be studied and processed in accordance with most effective techniques and administrative procedures. Emphasis to be placed on the objective of unified, revitalized community development.

889. Internship in Urban Planning
Fall, Winter, Spring, Summer. 2(0-8) or 3(0-12) or 4(0-16) May reenroll for a maximum of 8 credits. Graduate students in Urban Planning; approval of school.

Individual experience in approved agencies and departments in the Lansing area.

897. Special Topics in Urban Planning
Fall, Spring. 2 to 4 credits. May reenroll for a maximum of 6 credits if different topic is taken.

Issues pertaining to urban planning as they arise out of current research, planning practice or the interplay of national issues and urban problems.

898. Master's Research
Fall, Winter, Spring, Summer. 2 or 3 credits. Approval of school.

The research component of the Plan B option for the MUP degree.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. May reenroll for a maximum of 15 credits. Approval of school.

GEOLOGICAL SCIENCES
College of Natural Science

Geology **GLG**

200. Geology of Human Environment (N)

Fall, Winter, Spring, Summer. 3(3-0)
Not open to Geology majors. Credit will be given in only one of the following: GLG 200, GLG 201, GLG 306.

An exploration of social philosophical and political events which require a geological viewpoint for resolution. The application of geologic and social/historical information will also reinforce the concept of the scientific method.

200L. Laboratory—Geology of Our Environment
Fall, Winter, Spring, Summer. 1(0-3)
GLG 200 or concurrently.

Laboratory study of geologic processes associated with environmental hazards. Emphasis placed on land-use planning, applying geologic criteria to evaluate land potentials.

201. Earth Processes
Fall, Winter, Spring. 4(4-2) Credit will be given for only one of the following: GLG 200, GLG 201, GLG 306.

Physical processes concerning evolution of Earth and its environments. Conservation and interaction of energy and matter through time. Laboratory stresses interpretation of process through studies of geologic data.

202. Evolution of the Earth
Fall, Winter, Spring. 4(4-2) GLG 200; or GLG 201; or GLG 306.

The history of the earth based on geological, chemical, and paleobiological evidence; the evolution of organic life.

205. Oceanology—The Marine Environment
Fall. 3(3-0)

Physical oceanography, including origin, hydrologic, chemical, geological properties; and environmental quality of the oceans. Human-sea interactions are emphasized including resource utilization and pollution.

282. Energy Resources of the Earth
Winter. 3(3-0)

World energy resources of petroleum, coal, and atomic fuel. Social, political, economic and environmental problems of fuels.

300. Solar System Geology
Winter. 4(4-0) AST 119 or AST 217 or AST 229; GLG 200 or GLG 201.

The origin, relationships, make-up and features of the bodies in the solar system emphasizing recent space exploration results and developing theories.

302. Vertebrate Life of the Past
Fall. 3(3-0) One course in a physical or biological science or Juniors. Interdepartmental with the Department of Zoology.

Fossil vertebrates from fish to humans.

304. Geology of Michigan
Fall. 3(3-0) GLG 200 or GLG 201 and/or GLG 202; or approval of department.

A historical accounting of the physical, historical and economic geology of Michigan and its environs; a course designed for students seeking an overall picture of the rather unique Michigan geological environment.

306. Engineering Geology
Fall, Spring. 3(3-2) Credit will be given for only one of the following: GLG 200, GLG 201, GLG 306. Sophomore Engineering students.

Fundamental principles of geology as applied to civil engineering practice. Minerals and rocks, aerial photographs, topographic and areal geologic maps and geologic cross sections studied in laboratory. Source of geologic literature and maps.

307. Geology Central Appalachians
Winter. 1(0-2) GLG 200, or GLG 201, or GLG 202, or concurrently.

General geology of the Central Appalachians. A preparatory course for GLG 308. Field excursions—Central Appalachians during spring vacation.

308. Field Excursion—Central Appalachians
Spring. 2 or 3 credits. GLG 307.

Training in stratigraphic, sedimentological, paleontologic, and structural principles as applied to field methods.

321. Mineralogy
Fall. 5(4-4) One term of chemistry.

Basics of crystallography, crystallography, and crystal chemistry. The classification, occurrence, composition and identification of minerals. Mineral genesis.

323. Introduction to Optical Mineralogy
Winter. 1(0-3) GLG 321.

Basic principles underlying the use of the polarizing microscope. Recognition and understanding fundamental optical properties. Identification of minerals and texture in thin sections of rocks.

327. Introduction to Geochemistry
Winter. 3(3-0) CEM 152, GLG 321.

Geochemical evolution of the universe, solar system, earth. Application of crystal field theory and thermodynamics to the solution of geological problems. Factors affecting the distribution of elements on earth. Principles of isotope geology.

335. Fossil Plants, Their History and Paleocology
Spring. 3(3-0) One course in geology or botany or biology or approval of department.

Interdepartmental with the Department of Botany and Plant Pathology.

History of plants through geologic time; their form and evolution; how and where found, identified and reconstructed; their use in determining ancient geographic patterns, paleoenvironments, paleoclimates and community structure. Field trip.

337. The Fossil Record of Organic Evolution
Spring. 3(3-0) One course in a natural science; Juniors. Interdepartmental with the Department of Zoology.

The direct evidence for organic evolution in the fossil record. Evolution of life from prebiological systems to humans. Impact of fossil discoveries on human thought.

338. Principles of Paleontology
Fall. 4(3-3) GLG 202.

Geological and biological principles of paleontology, and uses of paleontological data in historical geology, stratigraphy, evolutionary biology, and biogeography. One required weekend field trip.

**Description — Geological Sciences
of
Courses**

344. Field Geology—Summer Camp
Summer. 8 credits. GLG 351, GLG 363, GLG 392. GLG 338, GLG 346 recommended.

Methods and techniques of geological surveying and mapping. Field interpretation of geological phenomena in igneous, metamorphic and sedimentary rocks in northern Michigan and Wisconsin.

A. Field Techniques in Sedimentary Rocks

2 credits.

Field analysis of sedimentary rocks and fossils, emphasizing interpretation of ancient depositional environments, processes of sedimentation, and diagenesis. Measurement, detailed description, and synthesis of physically equivalent stratigraphic sections.

B. Methods of Geological Mapping

2 credits.

Plane table surveys, aerial photo and reconnaissance mapping. Examination and interpretation of structural and textural relationships in igneous and metamorphic rocks.

C. Geologic Interpretation of Selected Areas

4 credits.

Independent mapping and interpretation.

346. Principles of Stratigraphy
(GLG 446.) Spring. 4(3-3) GLG 338, GLG 392, or approval of department.

Dynamic and event stratigraphy, facies analysis and depositional environments, and chronostratigraphic correlation using organic, seismic and magnetic data. Laboratory exercises in stratigraphic techniques. One required weekend field trip.

351. Structural Geology
Winter. 4(4-3) GLG 202; MTH 111.

Description, classification, and origin of secondary structures such as folds, faults, joints, cleavages, foliations and lineations. Three-dimensional visualization stressed in economic laboratory problems involving descriptive geometry, stereographic projections, areal, and structural geologic maps.

363. Introduction to Igneous and Metamorphic Petrology
Spring. 4(3-4) GLG 321, GLG 323, GLG 327.

Processes that form igneous and metamorphic rocks, origin, distribution, variation and occurrence of rock. Study of rock properties in the field, in laboratory, and with the microscope. A 3-day field trip to the Grenville Province, Southeast Ontario, is required.

375. Introduction to Geophysics
Fall. 3(4-0) GLG 201; MTH 111; one year of physics.

Noncalculus introduction to the theory, terminology, and applications of geophysics to exploration, solid earth, and tectonic studies. Topics include reflection and refraction seismology, internal structure of the earth, gravity, paleomagnetism, lithospheric tectonics, global seismology, and planetary geology.

392. Sedimentology
Spring. 3(2-3) GLG 202, GLG 323, GLG 327; GLG 351 recommended.

Grain and aggregate properties of sediments; relationships of these properties to processes in the environment of deposition and to the pre-depositional and post-depositional history.

400H. Honors Work

Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 9 credits. Honors College student or 3.00 grade-point average, or approval of chairperson; written proposal approved by faculty sponsor and chairperson.

403. Fluvial Geomorphology
Fall. 4(3-4) Junior majors in GLG, C E, and CSS; one course in physical geology and junior standing in geology, civil engineering or soil science.

Quantitative analyses of the fluvial processes associated with the development of drainage basin morphology, with emphasis on stream bed erosion and sediment transport. Field trips are required.

411. Hydrogeology
Winter. 3(3-2) One term of geology and trigonometry.

Principles of the sources, occurrence, and movement of ground water. Surface and subsurface investigations of ground water and elementary ground water hydrology.

413. Glacial Geology
Spring. 4(3-4) GLG 201.

Geological aspects of glaciers and glaciation. Theories of ice ages through geologic time. Origin and development of glacial geomorphic features. Character and chronology of the Pleistocene. Laboratory techniques, with field trips to observe glacial materials and features of Michigan.

426. Optical and X-ray Mineralogy
Fall. 4(3-4) GLG 321, PHY 239 or PHY 289.

Theory, principle and application of the polarizing microscope and X-ray diffractometer in mineral analysis.

430. Vertebrate Paleontology
Winter. 4(3-3) ZOL 428 or approval of department. Interdepartmental with the Department of Zoology.

Fossil vertebrates with emphasis on the evolution of major groups. Laboratories on modern techniques and on the identification and interpretation of fossils.

437. Invertebrate Paleontology
Spring. 4(3-4) GLG 338 or ZOL 306 or approval of department. Interdepartmental with the Department of Zoology.

Systematics and paleobiology of the Porifera, Coelenterata, Bryozoa, Brachiopoda, Mollusca, Arthropoda, and Echinodermata. Laboratory exercises in their comparative and functional morphology. One required weekend field trip.

438. Evolutionary Paleocology
Winter. 4(3-4) GLG 338 or ZOL 389 or approval of department. Interdepartmental with the Department of Zoology.

Evolutionary consequences of the ecological properties of marine invertebrate populations, species, communities, and provinces. Discussion may include biogeography, diversity, and biotic interactions.

445. Field Studies
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Approval of department.

Advanced geologic or geophysical field studies.

462. Petrology
Winter. 4(3-4) GLG 363, GLG 426.

Introduction to the chemical and physical processes that are responsible for the origin and evolution of igneous and metamorphic rocks. Laboratory studies of rock suites that illustrate basic processes in petrology.

474. Exploration Geophysics
Fall. 4(3-2) GLG 375; MTH 214; PHY 239 or PHY 289.

Techniques used in geophysical exploration, with application in petroleum prospecting, minerals exploration, and engineering. Includes gravity, magnetic, seismic, electrical and other methods, and well logging. Interpretation of geophysical data.

478. Exploratory Seismology
Spring. 4(2-4) GLG 474.

Theory and technique of field seismic exploration methods. An associated geophysical survey will be conducted and a report prepared.

479. Tectonophysics
Winter. 3(3-0) GLG 351, GLG 375, MTH 113.

Plate tectonic processes including structure and evolution of plate margins, plate kinematics, geophysical and geologic evidence for plate motions, seismotectonics, paleocontinental reconstructions, and marine geology and geophysics.

482A. Mineral Resources
Spring of odd-numbered years. 4(4-0) GLG 321, GLG 351.

Genesis, distribution, and classification of ore deposits. Emphasis on metallic ores. Global patterns and tectonic relationships.

482B. Mineral Resources Evaluation
Spring of even-numbered years. 3(3-0) GLG 321, GLG 351, approval of department.

Emphasis on practical applications of geoscience to mineral resources and the extractive industries. Aspects of exploration and development of reserves including evaluation, grade estimation, drilling, recovery, and beneficiation.

483. Petroleum Geology
Fall. 4(3-2) Approval of department.

Fundamental principles of the origin, migration and accumulation of petroleum. Exploration techniques to include well drilling, electric and radioactivity well logging, surface and subsurface exploration methods, seismic surveys, land leasing and oil field development. Laboratory study of well log plotting and subsurface mapping technique.

491. Sandstone and Shale
Fall. 4(3-3) GLG 363, GLG 392.

Origin, deposition and diagenesis of sandstone. Study includes thin section, X-ray, and SEM analysis of sediments and shale. Field trips required.

493. Carbonate Environments
Fall. 3(2-2) GLG 392 or approval of department.

A field and laboratory examination of carbonate rocks and their depositional environments. Emphasis on ancient reef, tide flat and shelf deposits.

497. Geochemistry
Spring. 3(3-0) GLG 201; CEM 152 or approval of department.

Oxidation-reduction systems, chemical weathering, stable and unstable isotopes, the geochemistry of ore-forming solutions, and the behavior of trace components in silicate melts.

800. Special Problems
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Approval of department.
Special problems in geology.

810. Seminar
Fall, Winter, Spring. 1 to 3 credits.
May reenroll for a maximum of 12 credits.
Seminar relating to current research in geology.

825. Clay Mineralogy
Winter. 4(3-4) CSS 840, CSS 850 or approval of department. Interdepartmental with the Department of Crop and Soil Sciences. Structures and properties of clays; their origins, occurrence, and utilization. Methods of studying clays including x-ray diffraction, differential thermal analysis, infrared absorption and other chemical and physical techniques.

830. Paleobotany
Fall. 4(3-4) Approval of department. Interdepartmental with and administered by the Department of Botany and Plant Pathology. Survey of fossil plants: their preservation, occurrence, geology, paleogeography, paleoecology, evolutionary history, classification and representative types. One weekend field trip to fossil plant locality.

831. Palynology
Spring. 4(3-4) Approval of department. Interdepartmental with the Department of Botany and Plant Pathology. An introduction to the principles and techniques of spore and pollen analysis, both fossil and recent, and utilization of plant micro-fossils for stratigraphic determinations and paleoecologic interpretations of most sedimentary accumulations and rocks. Includes certain algae, protozoans, similar organisms of uncertain affinity and dissociated fragments of larger organisms.

836. Evolutionary Paleobiology
Fall, Spring. 3(3-0) May reenroll for a maximum of 12 credits. GLG 338 or ZOL 445 or approval of department. Interdepartmental with the Department of Zoology. Selected topics in paleobiology, such as macroevolution, the importance of size and shape, the role of development, morphometrics, phylogenetic systematics, paleoecology, or biogeography.

837. Advanced Invertebrate Paleontology
Fall, Spring. 3(3-0) May reenroll for a maximum of 12 credits. GLG 338 or ZOL 306 or approval of department. Interdepartmental with the Department of Zoology. Particular invertebrate phyla which are important in the fossil record including their functional morphology, systematics, taphonomy and evolutionary history.

838. Advanced Paleobotany
Winter. 3(2-4) Approval of department. Interdepartmental with and administered by the Department of Botany and Plant Pathology. Morphology, anatomy, phylogenetic relationships and classification of fossil plants. Microscopic analysis of tissues and organs prepared by thin section, transfers, peels, polished and etched surfaces, and macerations.

840. Patterns of Diversity in Fossil Groups
Fall, Spring. 3(3-0) May reenroll for a maximum of 12 credits. GLG 338 or ZOL 453 or approval of department. Interdepartmental with the Department of Zoology. Selected topics in the diversity of fossil organisms, for example, adaptive radiations, mass extinctions, patterns of clade replacement, biotic interactions and the dynamics of diversity.

846. Problems in Historical Geology and Stratigraphy
Fall, Spring. 3(3-0) May reenroll for a maximum of 12 credits. GLG 346 or approval of department. Important geological and paleontological events of a selected period of geologic time, or region of geologic interest, including history, stratigraphy, paleontology, climate and tectonics.

852. Structure of Ore Bodies
Winter of even-numbered years. 3(2-4) GLG 451, MTH 214. Mathematics and physics applied to problems in structural geology.

861. Evolution of the Earth's Crust and Mantle
Fall. 3(3-0) GLG 462. The composition, mineralogy and petrology of the Earth's mantle and crust. Plate tectonics and its relationship to earlier models of geosynclines, orogenic cycles, continental drift, etc.

862. Petrology—Igenous
Spring of even-numbered years. 2 to 4 credits. May reenroll for a maximum of 8 credits. GLG 462. Must enroll for laboratory with initial registration. Physical and chemical principles involved in the origin of igneous rocks. Application of experimental techniques in petrology.

870. Topics in Geophysics
Spring. 1 to 3 credits. May reenroll for a maximum of 12 credits. Approval of department. Topics and problems in geophysics, such as tectonophysics, terrestrial heat flow, processing and analysis of geophysical data, geomagnetism, paleomagnetism, high-pressure geophysics.

871. Theoretical Geophysics
Fall. 3(3-0) MTH 310, PHY 289 or approval of department. GLG 375 and/or GLG 474 recommended. Theoretical geophysics applied to determining the structure and evolution of the solid earth. Topics covered include geochronology, geothermics, gravity, magnetism, rheology, and seismology.

873. Seismology
Winter. 3(3-0) MTH 215 or concurrently; PHY 289 or concurrently. Theory and application of seismic wave propagation in earth materials.

877. Seismotectonics
Spring. 3(3-0) GLG 479, GLG 871 or approval of department. Analysis of the state of stress and relative motions of the lithosphere through the study of earthquakes. Focal mechanism determinations, plate kinematics, faulting source processes, earthquake prediction, quantification and earthquake locations, and relevant theory.

892. Carbonate Petrology
Spring. 4(3-2) GLG 392, GLG 497. Petrology, petrography, and geochemistry of carbonate sediments and rocks. Emphasis on diagenesis. Chemical and mineralogic trends through time. The role of diagenesis in petroleum reservoir potential.

893. Petrology of Weathering and Soil
Winter. 4(3-3) GLG 491 or GLG 497 or CSS 470 or CSS 480. Application of petrological and geochemical principles to rock and mineral weathering, soil formation, and landscape evolution. Weathering and soil through geologic time.

894. Aqueous Geochemistry
Spring. 3(3-0) GLG 497 or a course in physical chemistry or approval of department. Nature and regulation of electrolytes in solution (fresh water, seawater, brine); activity, complexation, and redox effects. Trace metals in solution. Carbonate, silica, alumina systems. Chemical weathering and mobility of elements.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

900. Special Problems
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 9 credits. Approval of department. Special problems in geology for doctoral students.

999. Doctoral Dissertation Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

Earth Science **E S**

445. Field Studies
Fall, Winter, Spring, Summer. 1 to 9 credits. May reenroll for a maximum of 15 credits. Approval of department. Experience and techniques in field investigation of the near surface layers of the earth.

446. Laboratory Investigations
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 15 credits. E S 445 or concurrently. Independent laboratory investigation of materials and phenomena obtained from field studies.

800. Problems in Earth Science
Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department. Independent study in topics related to earth science education.

GERMAN

See Linguistics and Germanic, Slavic, Asian and African Languages.

GERMAN AND RUSSIAN

See Linguistics and Germanic, Slavic, Asian and African Languages.

GREEK

See Romance and Classical Languages.