

**472. Urban Development Regulation**  
Winter. 3(3-0) Seniors.

Public and private regulations basic to regulations influencing urban development; state enabling legislation and regulations, local ordinances, especially for zoning and subdivision regulations.

**473. Urban Development Programs**  
Spring. 4(2-4) U P 461B, U P 472.

Current governmental programs affecting urban development and renewal, grants process, proposal preparation. Application of appropriate programs to laboratory community as parts of comprehensive planning implementation strategy.

**489. 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. Senior majors; approval of school.

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

**490. Independent Studies in Urban Planning**

Fall, Winter, Spring, Summer. 2 credits. May reenroll for a maximum of 4 credits. Senior majors, approval of school.

**800. Special Problems**  
Fall, Winter, Spring, Summer. 2 to 6 credits. May reenroll for maximum of 6 credits. Approval of school.

**803. Contemporary Urban Politics, Policy and Planning**  
Winter. 3(3-0) Approval of school.

The contemporary roles of public urban policy, and relationships among selected key areas of urban policy and urban planning.

**808. Background of Urban Development Planning**  
Fall. 3(3-0)

American urban development from 1620 to the present, including shifts in technology and social forces that influenced development patterns. Problems faced by the professional planner are emphasized.

**811. Advanced Quantitative Methods in Geography and Planning**

Spring. 4(4-0) Approval of department, GEO 427. Interdepartmental with and administered by the Department of Geography. Statistical and mathematical approaches to spatial distributions and areal data.

**814. Research Methods in Urban and Regional Analysis**

Winter. 3(3-0) U P 427 or approval of school. Interdepartmental with the Department of Geography.

Basic quantitative techniques used in urban and regional analysis and planning, including statistical, linear, and network methods. Introduction to computer use.

**815. Application of Research Methods to Planning and Analysis**

Spring. 3(3-0) U P 814. Interdepartmental with the Department of Geography.

Applied techniques used in planning research. Analysis and forecasting of urban population, economic activity, and land use. Analysis of transportation and other community facilities.

**816. The Planning Process**  
Fall. 3(3-0)

Basic research and survey methods, and procedures used by the professional planner in developing a comprehensive plan.

**818. Planning Process Theory**  
Winter. 3(3-0) Approval of school.

Planning as a decision-making process, methods for defining goals in public and private planning programs, role of planning in public policy, formulation, planning for positive human-environment relationships.

**819. Theories of Urban Forms and Structure**

Spring. 3(3-0) Approval of school. Interdepartmental with the Department of Geography.

Idealized urban forms, theories and models in urban form as it relates to function and location of urban activities.

**824. Legal Bases for Planning**  
Winter. 3(3-0) U P 473; approval of school.

Analysis of legislation pertinent to planning, emphasis upon legislation for city and regional planning bodies and creation of special authorities with general planning responsibilities.

**828. Planning Presentation Techniques**  
Fall. 3(1-4) Approval of school.

Communication skills utilized by planners to present policy proposals to governmental decision makers and citizens. Speaking, writing, and small group leadership is integrated with essential planning graphic skills.

**830. Development Project Evaluation**  
Spring. 3(2-2) Approval of school.

Planning evaluation methods and processes employed in the review of urban development proposals and projects, site plans, and public policies.

**834. Planning Practicum I: Field Studies**  
Fall. 3(0-6) Completion of the first year MUP Core Program or approval of school.

Field experience in the collection, analysis, and synthesis of information by individual students or student groups, to develop solutions to specific urban problems.

**835. Planning Practicum II: Plan Making and Implementation**  
Winter. 3(0-6) U P 834.

Based on study and research done in U P 834, the preparation of plans appropriate to the study area and subject. The design of statutory measures and administrative policies for implementation.

**836. Introduction to Design**  
Winter. 3(0-6) U P 828 or approval of school.

Studio course emphasizing the role of planning in shaping the process of urban growth and development, and the role of physical form and structure in influencing cultural patterns.

**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. 4(3-2) Not open to Geology majors. Credit will be given in only one of the following: GLG 200, GLG 201, GLG 306.

The scientific method in geological studies; its impact on social, philosophical and political decisions.

**Descriptions — Geological Sciences  
of  
Courses**

**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 or 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.

Approved through Fall 1988.

**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.

**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**

(GLC 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. 4(2-4) GLG 202, GLG 323, GLG 327; GLG 351 recommended.

Grain and aggregate properties of sediments; relationships of these properties to depositional processes in the environment and to the predepositional and post-depositional history. Two weekend field trips required.

**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.

Approved through Fall 1988.

- 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.
- 437A. Invertebrate Paleontology I**  
*(GLG 437.) Spring of even-numbered years. 4(2-4) GLG 338 or ZOL 306 or approval of department. Cannot receive credit in both GLG 437 and GLG 437A. Interdepartmental with the Department of Zoology.*  
 Systematics and paleobiology of Archaeocyatha, Porifera, Cnidaria, Brachiopods, Bryozoa, and Hemichordata. Laboratory exercises in their comparative and functional morphology. One weekend field trip required.
- 437B. Invertebrate Paleontology II**  
*Spring of odd-numbered years. 4(2-4) GLG 338 or ZOL 306 or approval of department. Cannot receive credit in both GLG 437 and GLG 437A. Interdepartmental with the Department of Zoology.*  
 Systematics and paleobiology of Annelida, Mollusca, Hyolitha, Arthropoda and Echinodermata. Laboratory exercises in their comparative and functional morphology. One weekend field trip required.
- 438. Evolutionary Paleoecology**  
*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.
- 801. Special Problems in Structural Geology**  
*Winter of odd-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.*  
 Individual study on problems in stress and strain as related to the natural deformation of rocks.
- 802. Special Problems in Igneous Petrology**  
*Spring of odd-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. GLG 462.*  
 Individual study on problems in igneous petrology.
- 803. Special Problems in Seismotectonics**  
*Spring of even-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. GLG 479, GLG 871.*  
 Individual study on analysis of the source processes and source parameters of selected earthquakes.
- 804. Special Problems in Carbonate Sedimentology**  
*Fall of odd-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.*  
 Individual study on problems in carbonate sedimentology.
- 805. Special Problems in Clastic Sedimentary Petrology**  
*Winter of even-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. GLG 491.*  
 Individual study on problems in recent developments in sandstone and/or mudrock petrology (including provenance and/or diagenesis).
- 806. Special Problems in Mineral/Water Reactions**  
*Spring of even-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. GLG 898.*  
 Individual study on problems in recent developments in mineral/water interactions.
- 807. Special Problems in Paleobiology**  
*Fall of even-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.*  
 Individual study on problems in paleobiology, including paleobotany, and invertebrate and vertebrate paleozoology.
- 808. Special Problems in Seismic Wave Propagation**  
*Fall of odd-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. GLG 474, GLG 478.*  
 Individual study on problems from the following areas: body waves, surface waves, source mechanisms, source-received arrays, seismic processing and filtering, seismic experimental design, processing of three component data.
- 809. Special Problems in Sedimentary and Aqueous Geochemistry**  
*Fall of odd-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.*  
 Individual study on problems in sedimentary and aqueous geochemistry.
- 810. Seminar**  
*Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 12 credits.*  
 Seminar relating to current research in geology.

**Descriptions — Geological Sciences  
of  
Courses**

**811. Seminar in Plate Tectonics**

Spring of odd-numbered years. 1 credit. May reenroll for a maximum of 2 credits. GLG 479 or approval of department.

Seminar relating to plate tectonic processes and the geodynamic evolution of plate margins, accreted terranes, ocean basins, and other areas of interest.

**812. Seminar in Computational Earthquake Seismology**

Winter of even-numbered years. 1 credit. May reenroll for a maximum of 2 credits. GLG 871, knowledge of fortran.

Seminar relating to methods of computational earthquake seismology including algorithms for focal mechanisms and source parameter determinations, seismic wave propagation, and earth structure inversions.

**813. Seminar in Arctic Geology**

Fall of even-numbered years. 1 credit. May reenroll for a maximum of 2 credits. Approval of department.

Seminar relating to the geology and geophysics of the Arctic regions including Arctic Canada, Alaska, the Bering Sea, Northeast Siberia, Greenland, and the Arctic Ocean.

**814. Seminar in Strain Analysis**

Winter of even-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.

Seminar relating to finite and incremental strain analysis in rocks.

**815. Seminar in Seismology**

Winter of odd-numbered years. 1 to 2 credits. May reenroll for a maximum of 4 credits. GLG 474.

Seminar relating to seismology focusing on one or more of the following: propagation in anisotropic media, surface wave analysis, radiation patterns, travel time inversion, source parameters, fundamental earth vibrational modes.

**816. Seminar in Paleobiology**

Fall of odd-numbered years. 1 credit. May reenroll for a maximum of 6 credits. Approval of department.

Seminar relating to invertebrate and vertebrate paleozoology and paleobotany.

**817. Seminar in Tectonics and Sedimentation**

Spring of odd-numbered years. 1 credit. May reenroll for a maximum of 3 credits. GLG 491.

Seminar relating to recent developments in tectonics and sedimentation.

**818. Seminar in Clastic Sedimentary Petrology**

Fall of even-numbered years. 1 credit. May reenroll for a maximum of 3 credits. GLG 491.

Seminar relating to recent developments in sandstone and/or mudrock petrology (including provenance and/or diagenesis).

**819. Seminar in Mineral/Water Interactions**

Winter of odd-numbered years. 1 credit. May reenroll for a maximum of 3 credits. GLG 898.

Seminar relating to recent developments in mineral/water interactions.

**820. Seminar in Chemical Sedimentology**

Spring of odd-numbered years. 1 credit. May reenroll for a maximum of 3 credits. Approval of department.

Seminar relating to the investigation into the chemistry of the earth's surface as revealed through major element, trace element and isotopic compositions.

**821. Seminar in Carbonate Sedimentology**

Spring of even-numbered years. 1 credit. May reenroll for a maximum of 3 credits. Approval of department.

Seminar relating to recent and ancient carbonate sediments, their depositional environments and diagenetic history. Relationship of carbonate sediments to tectonic and geochemical cycles.

**822. Seminar in Structural Geology**

Winter of odd-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.

Seminar relating to current topics in structural geology and stress and strain as related to the natural deformation of rocks.

**823. Seminar in Igneous Petrology**

Fall of odd-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.

Seminar relating to current topics in igneous petrology.

**824. Seminar in Sedimentary and Aqueous Geochemistry**

Winter of odd-numbered years. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.

Seminar relating to recent developments in sedimentary and aqueous geochemistry.

**825. Clay Mineralogy**

Winter. 4(3-4) CSS 840, CSS 850 or approval of department. Interdepartmental with and administered by 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.

**826. Seminar in Basalt Petrogenesis**

Spring of odd-numbered years. 1 or 2 credits. May reenroll for a maximum of 2 credits. GLG 462 or GLG 862.

Current topics in basalt genesis, sources, secular variations, classification, tectonic discrimination schemes, and computer modelling.

**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.

**841. Isotope Hydrology**

Fall. 3(3-0) GLG 411 or approval of department.

Isotopic systems in hydrology and the application of isotopes for investigating origin, movement and fate of groundwater in the environment.

**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—Igneous**

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.

**Health Education, Counseling Psychology and Human Performance — Descriptions  
of  
Courses**

**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.

Approved through Fall 1988.

**894. Aqueous Geochemistry**

Fall. 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.

**898. Petrology of Mineral-Water Interactions**

Winter. 4(3-3) GLG 462 or GLG 491; GLG 894.

Mineralogy, petrology, and geochemistry of fluid-rock reactions in the geologic cycle, including rock and mineral weathering; genesis and burial diagenesis of sediments and sedimentary rocks; and metamorphism.

**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**

**ES**

**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.

**HEALTH EDUCATION,  
COUNSELING PSYCHOLOGY  
AND HUMAN  
PERFORMANCE**

**HCP**

(Name change effective July 1, 1985. Formerly the Department of Health and Physical Education.)

**College of Education  
College of Human Medicine  
College of Osteopathic Medicine**

**Instructional Courses**

Physical Education instructional courses are offered every term to give students an opportunity to become involved in physical activities that will benefit them, not only in attaining physical well being, but in acquiring a measure of carry-over skill which will promote a healthful way of life through continued participation. The areas of selection are: HPE 104-105, Individual Sports (Golf, Bowling, etc.); HPE 106-107, Dual Sports (Tennis, Racquetball, etc.); HPE 108, Team Sports (Soccer, Softball, etc.); HPE 109, Aquatics (Beginning Swimming, Life Saving, etc.); HPE 110, Gymnastics (Floor Exercises, Apparatus, etc.); HPE 111, Dance (Social, Dancercise, etc.); HPE 211, Dance (Modern, Ballet, etc.); and HPE 270, The Healthy Lifestyle.

**104. Individual Sports I**

Fall, Winter, Spring, Summer. 1(0-3) May reenroll for a maximum of 12 credits if different activities or the same activities at higher levels are involved. Students are limited to a combined total of 12 credits in HCP 104 through HCP 111.

Development of sports skills and physical fitness through participation in individual sports activities.

**105. Individual Sports II**

(HPE 105.) Fall, Winter, Spring, Summer. 1(0-3) May reenroll for a maximum of 12 credits if different activities or the same activities at higher levels are involved. Students are limited to a combined total of 12 credits in HCP 104 through HCP 111.

Development of sports skills and physical fitness through participation in individual sports activities.

**106. Dual Sports I**

(HPE 106.) Fall, Winter, Spring, Summer. 1(0-3) May reenroll for a maximum of 12 credits if different activities or the same activities at higher levels are involved. Students are limited to a combined total of 12 credits in HCP 104 through HCP 111.

Development of sports skills and physical fitness through participation in dual sports activities.

**107. Dual Sports II**

Fall, Winter, Spring, Summer. 1(0-3) May reenroll for a maximum of 12 credits if different activities or the same activities at higher levels are involved. Students are limited to a combined total of 12 credits in HCP 104 through HCP 111.

Development of sports skills and physical fitness through participation in dual sports activities.

**108. Team Sports**

Fall, Winter, Spring. 1(0-3) May reenroll for a maximum of 12 credits if different activities or the same activities at higher levels are involved. Students are limited to a combined total of 12 credits in HCP 104 through HCP 111.

Team sports skills and physical fitness through participation in group activities.

**109. Aquatics**

Fall, Winter, Spring, Summer. 1(0-3) May reenroll for a maximum of 12 credits if different activities or the same activities at higher levels are involved. Students are limited to a combined total of 12 credits in HCP 104 through HCP 111.

Aquatics skills, physical fitness, and water safety.

**110. Gymnastics**

Fall, Winter, Spring. 1(0-3) May reenroll for a maximum of 12 credits if different activities or the same activities at higher levels are involved. Students are limited to a combined total of 12 credits in HCP 104 through HCP 111.

Gymnastics skills and physical fitness through tumbling and apparatus.

**111. Dance**

Fall, Winter, Spring. 1(0-3) May reenroll for a maximum of 12 credits if different activities or the same activities at higher levels are involved. Students are limited to a combined total of 12 credits in HCP 104 through HCP 111.

Beginning and intermediate folk dance, social dance, square dance, and dancercise.