

**842 Population Genetics, Genealogy and Genomics**  
Fall. 3(3-0) Interdepartmental with Forestry; Animal Science; Crop and Soil Sciences; Fisheries and Wildlife; Horticulture. Administered by Department of Forestry. RB: Pre-calculus, basic genetics

Population genetic processes underlying patterns of molecular genetic variation. Genealogical approaches to the study of genomic diversity, phylogenetic reconstruction, and molecular ecology.

**851 Molecular Entomology**  
Fall of odd years. 3(3-0) Interdepartmental with Entomology. Administered by Department of Entomology.

Analysis of molecular processes unique to insects, and their potentials for genetic engineering.

**880 Laboratory Rotation**

Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to Ph.D. majors in Genetics.

Participation in research with faculty members.

**999 Doctoral Dissertation Research**

Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to Ph.D. students in Genetics.

Doctoral dissertation research.

## GEOGRAPHY

## GEO

### Department of Geography College of Social Science

**113 Introduction to Economic Geography**  
Fall, Spring. 3(3-0)

Spatial distribution of resources, population, enterprise, trade, consumption, and production. Interaction of those distributions at local to global scales.

**151 Cultural Geography**  
Fall. 3(3-0)

Systematic approach to the spatial distribution of cultural features, processes, and relationships.

**203 Introduction to Meteorology**  
Fall. 3(3-0)

Fundamentals of meteorology. Energy balance, adiabatic processes, horizontal motion, cyclogenesis, and severe weather.

**204 World Regional Geography**  
Fall. 3(3-0)

In a time of increasing globalization of economic, political and technological processes, different societies on different continents are responding in various ways. This course explores the conditions that contribute to diversity in different world regions including economic, social, political and environmental processes.

**206 Physical Geography**  
Fall, Spring. 3(3-0)

Geographic and functional interrelationships within the physical environment: Earth-sun relationships, weather, climate, soils, vegetation and landforms (terrain characteristics).

**206L Physical Geography Laboratory**  
Fall, Spring. 1(0-2) P:M: (GEO 206 or concurrently)

Geographic aspects of weather, climate, soil, vegetation, and terrain. Interpretation and application of maps and remotely sensed imagery.

**221 Introduction to Geographic Information**  
Fall, Spring. 3(2-2) SA: GEO 223, GEO 225

Principles and methods of spatial data collection, handling, analysis, and display. Introduction to remote sensing, geographic information systems, and cartography.

**259 Geography of Recreation and Tourism**  
Fall of even years. 3(3-0)

Cultural, physical, and biotic factors affecting the distribution of recreation and tourism resources and participation. U.S. and international examples and case studies.

**306 Environmental Geomorphology**  
Spring. 3(3-0) Interdepartmental with Geological Sciences. P:M: (CSS 210 or GEO 203 or GEO 206 or GEO 330 or GEO 333 or GEO 259 or GLG 201 or GLG 304 or ISP 201 or ISP 203 or ISS 310 or RD 201) and completion of Tier I writing requirement.

Relationships of running water, weathering, gravity, ice, waves, wind, and biota (including humans) to terrain and soils. Evolution of landscapes. Classical and modern interpretations.

**313 Introduction to Data Analysis for Urban and Regional Planners**  
Fall. 3(2-2) Interdepartmental with Urban Planning. Administered by Department of Geography. P:NM: (CPS 101 or CPS 131) and (UP 201)

Data gathering analysis, information presentation, and basic techniques of urban planning. Application of related computer programs and software.

**314 Methods for Investigation of Urban Systems**  
Spring. 4(3-2) Interdepartmental with Urban Planning. Administered by Department of Geography. P:M: (STT 201 and CSE 101) RB: (UP 201)

Models, approaches, and techniques for urban and regional problem analysis, research, program evaluation, and project management. Application of related computer software.

**324 Remote Sensing of the Environment**  
Fall, Spring. 4(2-4) SA: GEO 224

Features and interpretation methods of remotely sensed imagery, especially black-and-white and color infrared airphotos. Basic features of radar, thermal, and multispectral imagery. Interpretation for agriculture, archaeology, fisheries, forestry, geography, landscape architecture, planning, and wildlife management.

**326 Thematic Cartography**  
Fall. 4(2-4) P:M: (GEO 221) SA: GEO 223  
Principles and techniques of map making. Decision making in designing thematic maps.

**330 Geography of the United States and Canada**

Fall, Spring, Summer. 3(3-0)

Regional analysis. Evolution and status of environmental, demographic, economic, and sociocultural patterns and processes.

**333 Geography of Michigan and the Great Lakes Region**  
Fall of odd years. 3(3-0)

Michigan's physical, historical, and economic geography. Interrelationships between the physical environment (rocks, landforms, soils, climate, vegetation, hydrology) and historical and contemporary land uses. Demographic and agricultural patterns. Human history and settlement patterns contemporary recreational opportunities.

**335 Geography of Latin America**  
Fall. 3(3-0) P:M: Completion of Tier I writing requirement. R: Not open to freshmen.

Physical and human geography of Latin America. Current development issues, especially people-environment interaction in urban and rural areas. Topics include migration, urbanization, and industrialization.

**336 Geography of Europe**  
Fall of odd years. 3(3-0) P:M: Completion of Tier I writing requirement. R: Not open to freshmen.

Major regions and nations, including their physical resources, peoples, political structures, and economies.

**337 Geography of East Asia**  
Spring. 3(3-0) P:M: Completion of Tier I writing requirement. R: Not open to freshmen.

Spatial patterns and processes of physical and human geography in China, Japan, Korea, and Taiwan. Emphasis on development problems, especially since 1950.

**338 Geography of Africa**  
Fall. 3(3-0) P:M: Completion of Tier I writing requirement. R: Not open to freshmen.

Physical and human geography of Africa. Current development issues, especially people-environment interaction in urban and rural areas. Topics include drought, agricultural patterns, hunger, rural development, migration, and urbanization.

**401 Geography of Plants of North America**  
Spring of even years. 3(3-0) R: Not open to freshmen or sophomores.

Geography of Plants in North America with emphasis on the East. Related ecological principles, soils, and post-Cretaceous geologic history. Some field instruction.

**402 Agricultural Climatology**  
Fall of even years. 3(3-0) Interdepartmental with Biosystems Engineering. P:M: (MTH 104 or MTH 110 or MTH 116) R: Not open to freshmen or sophomores. SA: AE 402

Relationships between climate and agriculture in resource assessment, water budget analysis, meteorological hazards, pests, crop-yield modeling, and impacts of global climate change.

**403 Microclimate and Its Measurement**  
Fall of odd years. 4(3-3) Interdepartmental with Biosystems Engineering. Administered by Department of Agricultural Engineering. P:M: (MTH 116 or MTH 124 or MTH 132 or LBS 118)

Climate near the earth's surface. Energy balance, thermal radiation exchange, heat fluxes, temperature sensors, wind speed and direction, humidity and evapotranspiration and their measurement.

## Geography—GEO

- 404 Synoptic Climatology**  
Fall. 4(4-0) P:M: (GEO 203)  
Global climate patterns and their controls. Relationship between upper air flow and weather in the northern hemisphere westerlies.
- 405 Applied Synoptic Climatology: Principles and Methods**  
Spring of odd years. 4(3-2) P:M: (GEO 203) and (MTH 104 or MTH 110 or MTH 116)  
Dynamic and thermodynamic principles of atmospheric science applied to the development and evolution of extratropical cyclones. Laboratory sessions include analysis of current observations and satellite imagery.
- 407 Regional Geomorphology of the United States**  
Fall of odd years. 3(3-0) P:M: (GEO 306 or GLG 201 or GLG 412 or ISP 203)  
Geomorphic characteristics of physiographic regions of the United States.
- 408 Soil Geomorphology Field Study**  
Fall. 4(2-4) P:M: (CSS 210 or GEO 306 or GLG 201 or GLG 412 or ISP 203) R: Not open to freshmen or sophomores.  
Common geographic relationships among soils, landforms, and vegetation in lower Michigan. Description, analysis, and genesis of soils and landscapes. Surficial processes. Field trips required.
- 412 Glacial and Quaternary Geology**  
Spring. 4(3-2) Interdepartmental with Geological Sciences. Administered by Department of Geological Sciences. P:NM: (GLG 201 or GLG 301 or GEO 306 or GEO 408) R: Not open to freshmen or sophomores.  
Glacial and Quaternary geology with emphasis on North America and Europe. Laboratory focuses on glacial processes. One weekend field trip required.
- 413 Urban Geography**  
Fall. 3(3-0) Interdepartmental with Urban Planning. R: Not open to freshmen or sophomores.  
Theories and models of urban spatial form. Underlying structures and processes. Socio-spatial dimensions of modern urbanism. Differentiation and locational conflict in residential, commercial, and industrial space.
- 414 Geography of Transportation**  
Fall of odd years. 3(3-0) Interdepartmental with Urban Planning. P:M: (GEO 113) R: Not open to freshmen.  
Spatial principles of transportation. Theories of interaction, network structures, and location-allocation models. Role of transport and transport planning.
- 415 Location Theory and Land Use Analysis**  
Fall. 3(3-0) Interdepartmental with Urban Planning. P:M: (GEO 113 or UP 201) RB: One of the prerequisites or an introductory ECON course. R: Not open to freshmen or sophomores.  
Classical and neoclassical, static and dynamic models of industrial location and spatial organization. Land rent theory. Central place theory. Multi-locational organization. Growth transmission.
- 418 The Ghetto**  
Fall of odd years. 3(3-0) Interdepartmental with Urban Planning. R: Not open to freshmen or sophomores.  
Analysis of the ghetto including its spatial organization and structure. Distribution of racial and ethnic populations. Emphasis on U.S. cities.
- 419 Applications of Geographic Information Systems to Natural Resources Management**  
Spring. 4(2-4) Interdepartmental with Fisheries and Wildlife; Forestry; Park, Recreation and Tourism Resources; Resource Development; Biosystems Engineering. Administered by Department of Fisheries and Wildlife. P:NM: (GEO 221)  
The application of geographic information systems, remote sensing, and global positioning systems to integrated planning and management for fish, wildlife, and related resources.
- 423 Map Production and Design**  
Spring. 4(2-4) P:M: (GEO 221)  
Manual and automated techniques. Design solutions, map planning, overlay construction, user issues, typography, color theory, and color selection.
- 424 Advanced Remote Sensing**  
Fall. 4(3-2) RB: (GEO 324)  
Interaction of solar radiation with the atmosphere, lithosphere, hydrosphere, and biosphere. Introductory digital image processing. Earth-resources satellite sensors, data products, and applications. Radar and thermal remote sensing.
- 425 Geographic Information Systems**  
Spring. 4(3-2) Interdepartmental with Urban Planning. P:M: (GEO 221)  
Technical and theoretical issues in the design, evaluation, and implementation of geographic information systems for research and application.
- 428 Digital Terrain Analysis**  
Fall of even years. 4(3-2) P:M: (GEO 221) R: Open only to juniors or seniors.  
Theoretical and technical issues of collection, management, analysis, and display of terrain data. Application of photogrammetry, geographic information systems, and cartography.
- 432 Environmental Ethics in Geography(W)**  
Fall. 3(3-0) P:M: Completion of Tier I writing requirement. R: Open only to juniors or seniors.  
Ethical dimensions and scientific bases of environmental and spatial controversies arising from landscape valuation, control, and alteration.
- 435 Geography of Health and Disease**  
Fall. 3(3-0) R: Not open to freshmen or sophomores.  
Spatio-environmental concepts and techniques applied to health problems. Disease transmission cycles, community nutrition, and health-care planning.
- 454 Spatial Aspects of Regional Development**  
Spring of odd years. 3(3-0) P:M: (GEO 113 or GEO 151 or GEO 330 or GEO 333 or GEO 335 or GEO 336 or GEO 337 or GEO 338)  
Spatial patterns and processes associated with regional development in selected world areas.
- 459 Tourism in Regional Development**  
Spring of odd years. 3(3-0) P:NM: (GEO 259 or PRR 213)  
The role of tourism in regional development. Examples from Michigan, and the United States and other nations. Environmental considerations.
- 463 Introduction to Quantitative Methods for Geographers and Planners**  
Fall. 3(3-0) Interdepartmental with Urban Planning. P:NM: Completion of University mathematics requirement. R: Open only to majors in Geography, Urban Planning, and Landscape Architecture.  
Quantitative techniques in the analysis and classification of spatial data.
- 480 Senior Seminar (W)**  
Fall. 3(3-0) P:M: Completion of Tier I writing requirement. R: Open only to seniors in Geography.  
History, philosophy, and methodology of the geographic discipline as it has evolved within academic and social contexts.
- 485 Senior Seminar in Geography Education**  
Spring of even years. 3(3-0) P:M: (GEO 113 or GEO 151) and (GEO 204 and GEO 206 and GEO 221 and GEO 330 or concurrently and GEO 333 or concurrently) R: Open only to Geography minors.  
Geography educational standards will guide the development of knowledge and technical expertise of future K-12 teachers. Emphasis will be on continued learning of geography, integration of physical and human concepts, the role of representation (maps, etc.), and the use of current events, local observations, and technology to integrate geography into the K-12 curriculum.
- 490 Independent Study**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.  
Supervised individual study in an area supplementary to regular courses.
- 492 Geographic Research Problems**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Not open to freshmen or sophomores. Approval of department.  
Supervised original research on selected aspects of geography.
- 495 Field Study**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course.  
Supervised field study in geography.
- 498 Internship in Geography**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course.  
Individual experience in geography in an approved organization.
- 806 Advanced Geomorphology**  
Spring of even years. 3(3-0)  
Advanced study in geomorphology, surficial processes and soils.
- 809 Seminar in Physical Geography**  
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.  
Review of research on topics in physical geography such as climatology, geomorphology, soils, or plant geography.

**GEOLOGICAL  
SCIENCES****GLG****Department of Geological Sciences  
College of Natural Science****201 The Dynamic Earth**  
Fall, Spring. 4(3-2) Not open to students with credit in GLG 301.

Physical and chemical processes related to the past, present and future behavior of the earth system, and the energy systems that drive these processes. A study of the earth's materials, the earth's surface and the earth's interior.

**302 Geology of Michigan**  
Spring. 3(3-0) P:M: (GLG 201 or GLG 301 or ISP 203)

Integration of the geological evolution of Michigan with its social and economic development.

**303 Oceanography**  
Fall. 4(4-0) P:NM: (CEM 141 or CEM 142 or CEM 151 or CEM 152 or CEM 181H or CEM 182H or LBS 165) and (PHY 183 or PHY 183B or PHY 193H or PHY 231 or PHY 231B or PHY 231C or LBS 164)

Physical, chemical, biological, and geological aspects of oceanography: ocean circulation, waves, tides, air-sea interactions, chemical properties of ocean water, ocean productivity, shoreline processes, and sediments.

**304 Physical and Biological History of the Earth**  
Fall, Spring. 4(3-2) P:M: (GLG 201 or ISP 203) SA: GLG 202

Origin of the Earth. Differentiation of the Earth's core, mantle and crust. Lithospheric tectonics over geologic time. Origin and evolution of the Earth's hydrosphere, atmosphere and climate. Origin and evolutionary history of biological life. Interactions of life with the Earth's endogenic and exogenic systems.

**306 Environmental Geomorphology**  
Spring. 3(3-0) Interdepartmental with Geography. Administered by Department of Geography. P:M: (CSS 210 or GEO 203 or GEO 206 or GEO 330 or GEO 333 or GEO 259 or GLG 201 or GLG 304 or ISP 201 or ISP 203 or ISS 310 or RD 201) and completion of Tier I writing requirement.

Relationships of running water, weathering, gravity, ice, waves, wind, and biota (including humans) to terrain and soils. Evolution of landscapes. Classical and modern interpretations.

**319 Introduction to Earth System Science**  
Fall. 3(3-0) Interdepartmental with Entomology; Botany and Plant Pathology; Zoology; Sociology. Administered by Department of Entomology. RB: Completion of one course in biological or physical science.

Systems approach to Earth as an integration of geochemical, geophysical, biological and social components. Global dynamics at a variety of spatio-temporal scales. Sustainability of the Earth system.

**813 Seminar in Urban and Economic Geography**  
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. P:NM: Two of GEO 413, GEO 414, GEO 415, GEO 416, GEO 417, GEO 418.

Review of research on selected topics in urban and economic geography.

**814 Applied Research Methods for Planning and Development**  
Spring. 3(2-2) Interdepartmental with Urban Planning. Administered by Department of Geography. P:NM: (UP 813) R: Open only to graduate students in Urban and Regional Planning, Public Administration, and Geography.

Techniques in urban and regional planning analysis. Forecasting models. Methods of urban project evaluation.

**819 Spatial Epidemiology and Medical Geography**

Summer of even years. 3(3-0) Interdepartmental with Epidemiology. Administered by Epidemiology. P:NM: (EPI 810) R: Open only to master's students in the Epidemiology major or approval of department. SA: HM 819

Concepts, techniques, and utilization of spatio-epidemiologic analyses for human health.

**823 Map Automation**  
Fall of even years. 3(2-2)

Use of computers in cartography. Cartographic algorithms, interpolation, and line generalization. Program intelligence. Cartographic data bases.

**825 Geoprocessing**  
Fall of odd years. 4(4-0)

Integration of digital remote sensing data, geographic information systems, spatial analysis, and expert systems in solving research problems. Class research project.

**826 Seminar in Cartography and Geoprocessing**  
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.

Review of research in cartography, geographic information systems, and remote sensing.

**832 Environmental and Natural Resource Law**  
Fall. 3(3-0) Interdepartmental with Resource Development; Agricultural Economics; Crop and Soil Sciences; Forestry. Administered by Department of Resource Development. P:NM: (RD 430)

Origin and development of environmental law. Theories of power, jurisdiction, sovereignty, property interests, pollution, and other bases for legal controls of natural resources. Common law and constitutional limitations on governmental power.

**835 Biogeography**  
Spring of odd years. 3(3-0) Interdepartmental with Fisheries and Wildlife; Zoology; Botany and Plant Pathology. Administered by Department of Fisheries and Wildlife. RB: Courses in evolution and ecology at undergraduate level.

Geographical distributions of plants and animals; biogeographic realms. Ecological and evolutionary mechanisms determining distributional patterns. Application of biogeography to conservation problems.

**850 Seminar in Regional Geography**  
Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.

Review of research on contemporary geographic issues in different world regions.

**854 Economics of Planning and Development**  
Spring. 3(3-0) Interdepartmental with Urban Planning. Administered by Department of Geography. P:NM: (UP 801)

The physical urban environment and local economic development.

**865 Advanced Quantitative Methods in Geography**  
Spring. 4(4-0) P:NM: (GEO 465)

Statistical and mathematical approaches. Multiple regression, principal components and factor analysis, discriminant analysis. Related taxonomic methods.

**867 Methods and Modeling in Regional Science**  
Spring of even years. 3(3-0) Interdepartmental with Resource Development; Urban Planning. P:NM: (EC 820 and GEO 865) and (GEO 415 or RD 461)

Techniques for regional research: economic base analysis, input-output analysis, mathematical programming, and econometric and simulation analysis.

**886 Research Design in Geography**  
Spring. 3(3-0)

Research and writing in geography. Identification of geographic problems and their relative importance. Structuring and stating hypotheses. Data acquisition and tests for validity.

**890 Advanced Readings in Geography**  
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Approval of department.

Advanced independent readings.

**892 Advanced Research in Geography**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course.

Advanced independent research.

**899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 12 credits. A student may earn a maximum of 30 credits in all enrollments for this course. R: Open only to graduate students in Geography.

Master's thesis research.

**986 Theory and Methods in Geography**  
Spring. 3(3-0) R: Open only to Ph.D. students in Geography.

Historical development of the discipline within social and intellectual contexts. Current methodological and philosophical approaches to geographic research.

**999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 36 credits in all enrollments for this course.

Doctoral dissertation research.