

**Descriptions —Genetics
of
Courses**

835. Eukaryotic Molecular Genetics
Spring, 3(3-0) Interdepartmental with Microbiology. Administered by Microbiology.
P: BCH 462, ZOL 341. R: Open only to graduate students in the colleges of Agriculture and Natural Resources, Engineering, Human Medicine, Natural Science, Osteopathic Medicine, and Veterinary Medicine.

Gene structure and function in animals, plants, and fungi. Basic aspects of modern human genetics and the genetic basis for disease. Molecular genetic analyses. Eukaryotic modeling systems.

841. Chromosome Structure and Genetics
Spring of even-numbered years. 3(3-0) Interdepartmental with Zoology. Administered by Zoology.
R: Approval of department.

Classical and molecular genetics of chromosome structure and behavior in mitosis and meiosis. Synapsis and disjunction, exchange, centromeres, euchromatin, heterochromatin and transposable elements.

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

890. Selected Topics in Genetics

Fall, Spring, Summer. 2 to 5 credits. A student may earn a maximum of 9 credits in all enrollments for this course.

P: ZOL 341.
Topic selected from molecular genetics, physiological genetics, population genetics, quantitative genetics, microbial genetics, somatic cell genetics, behavioral genetics, human genetics, evolution, or radiology and mutagenesis.

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.

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, Spring of even-numbered years. 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.

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 credit.
P: 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)
Principles and methods of spatial data collection, handling, analysis, and display. Introduction to remote sensing, geographic information systems, and cartography.
SA: GEO 225

230. 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.

233. Geography of Michigan

Fall of odd-numbered years. 3(3-0)
Physical and cultural geography of Michigan.

259. Geography of Recreation and Tourism

Fall of even-numbered 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

Fall of even-numbered years, Spring. 3(3-0)
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 Urban Planning.
P: CPS 101 or CPS 131; 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. 3(2-2) Interdepartmental with Urban Planning. Administered by Urban Planning.
P: UP 313.
Models, approaches, and techniques for urban and regional problem analysis and plan formulation.

324. Remote Sensing of the Environment

Fall, Spring. 4(2-4)
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: GEO 221.
Principles and techniques of map making. Decision making in designing thematic maps.

335. Geography of Latin America

Fall. 3(3-0)
R: Not open to freshmen. Completion of Tier I writing requirement.
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-numbered years. 3(3-0)
R: Not open to freshmen. Completion of Tier I writing requirement.
Major regions and nations, including their physical resources, peoples, political structures, and economies.

337. Geography of East Asia

Spring. 3(3-0)
R: Not open to freshmen. Completion of Tier I writing requirement.
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)
R: Not open to freshmen. Completion of Tier I writing requirement.
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-numbered years. 3(3-0)
R: Not open to freshmen and 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-numbered years. 3(3-0) Interdepartmental with Biosystems Engineering.
P: MTH 116. R: Not open to freshmen and sophomores.
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-numbered years. 4 credits. Interdepartmental with Biosystems Engineering. Administered by Biosystems Engineering.
P: MTH 116. R: Not open to freshmen or sophomores.
The 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.
SA: ATM 836

404. Synoptic Climatology

Fall. 4(4-0)
P: 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-numbered years. 4(3-2)
P: GEO 404 or approval of department; 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-numbered years. 3(3-0)
P: 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: CSS 210 or GEO 306 or GLG 201 or GLG 412 or ISP 203. R: Not open to freshmen and 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 Geological Sciences.
P: GLG 201 or GLG 301 or GEO 306 or GEO 408. R: Not open to freshmen and 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.
P: GEO 113. R: Not open to freshmen and 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-numbered years. 3(3-0) Interdepartmental with Urban Planning.
P: 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: GEO 113. R: Not open to freshmen.
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-numbered years. 3(3-0) Interdepartmental with Urban Planning.
P: GEO 413 or SOC 375 or UP 201 or ISS 320 or MC 343 or MC 384 or approval of department. R: Not open to freshmen and sophomores.
Analysis of the ghetto including its spatial organization and structure. Distribution of racial and ethnic populations. Emphasis on U.S. cities.
- 419. Geographical Information Systems in Natural Resource Management**
Spring. 4 credits. Interdepartmental with Fisheries and Wildlife; Forestry; Resource Development; Agricultural Engineering; and Park, Recreation and Tourism Resources. Administered by Fisheries and Wildlife.
P: 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: 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)
P: GEO 324. R: Not open to freshmen and sophomores.
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: 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-numbered years. 4(3-2)
P: GEO 324 or GEO 424; 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.
- 435. Geography of Health and Disease**
Fall. 3(3-0)
R: Not open to freshmen, sophomores, juniors.
Spatio-environmental concepts and techniques applied to health problems. Disease transmission cycles, community nutrition, and health-care planning.
- 452. Population and Development**
Spring of odd-numbered years. 3(3-0)
P: GEO 113 or GEO 151 or GEO 230 or GEO 233 or GEO 335 or GEO 336 or GEO 337.
Demographic issues related to economic development and environmental sustainability in selected world regions.
- 454. Spatial Aspects of Regional Development**
Spring of odd-numbered years. 3(3-0)
P: GEO 113, or GEO 151, or GEO 230, or GEO 233, or GEO 335, or GEO 336, or 337.
Spatial patterns and processes associated with regional development in selected world areas.
- 459. Tourism in Regional Development**
Spring of odd-numbered years. 3(3-0)
P: 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: 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.
- 478. Urban Transportation Planning**
Spring. 3(3-0) Interdepartmental with Urban Planning. Administered by Urban Planning.
P: UP 201, UP 314. R: Open only to majors in Geography or Urban and Regional Planning or approval of department.
Principles of decision-making in urban transportation planning. Demand and supply analysis, social and environmental impacts, implementation programs. Use of computer models.
- 480. Senior Seminar (W)**
Fall. 3(3-0)
R: Open only to seniors in Geography. Completion of Tier I writing requirement.
History, philosophy, and methodology of the geographic discipline as it has evolved within academic and social contexts.
- 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 and 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.
R: Not open to freshmen and sophomores. Approval of department.
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.
R: Open only to juniors and seniors. Approval of department.
Individual experience in geography in an approved organization.
- 806. Advanced Geomorphology**
Spring of even-numbered 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.
- 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: 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 Urban Planning.
P: 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**
Spring of even-numbered years. 3(3-0) Interdepartmental with Human Medicine. Administered by Human Medicine.
P: HM 810. R: Open only to master's students in Epidemiology or approval of college.
Concepts, techniques, and utilization of spatio-epidemiologic analyses for human health.
- 823. Map Automation**
Fall of even-numbered 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-numbered 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.

Descriptions —Geography of Courses

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, Forestry, and Crop and Soil Sciences. Administered by Resource Development.
P: 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.

850. Seminar in Regional Geography
Fall of even-numbered years, 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 Urban Planning.
P: UP 801.

The physical urban environment and local economic development.

860. Methods and Modeling in Regional Science
Spring. 3(3-0) Interdepartmental with Resource Development. Administered by Resource Development.
P: RD 461.

Regional research techniques. Economic base analysis, input-output analysis, mathematical programming, and econometric and simulation analysis.

865. Advanced Quantitative Methods in Geography
Spring. 4(4-0)

P: 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-numbered years. 3(3-0) Interdepartmental with Resource Development and Urban Planning.
P: EC 820, GEO 865; 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.

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.

GEOLOGICAL SCIENCES GLG

Department of Geological Sciences College of Natural Science

201. The Dynamic Earth
Fall, Spring. 4(3-2)
R: 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.

202. Physical and Biological History of the Earth
Fall, Spring. 4(3-2)
P: GLG 201.
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 biological life with the Earth's endogenic and exogenic sy

301. Engineering Geology
Fall. 4(3-2)
R: Not open to freshmen. Open only to College of Engineering students. Not open to students with credit in GLG 201.
Principles of geology as applied to civil engineering practice. Minerals, rocks, surficial and internal processes, mitigation of destructive geological processes. Air photos, topographic-geologic maps, cross sections.

302. Geology of Michigan
Spring. 3(3-0)
P: 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: CEM 142 or CEM 152 or PHY 184 or PHY 232 or CEM 141, PHY 183 or CEM 141, PHY 231 or CEM 151, PHY 183 or CEM 151, PHY 231.
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.

319. Introduction to Earth System Science
Fall. 3 credits. Interdepartmental with Entomology, Botany and Plant Pathology, Zoology, and Sociology. Administered by Entomology.
P: 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.

321. Mineralogy and Geochemistry
Fall. 4(3-2)
P: GLG 201 or GLG 301 or concurrently; CEM 142 or CEM 152; MTH 124 or MTH 132.
Geochemical properties and processes in the origin, modification, structure, dynamics and history of Earth materials. Crystallography and crystal chemistry. Mineral classification and identification.

331. Vertebrate Life of the Past
Spring. 3(3-0) Interdepartmental with Zoology.
P: BS 110 or BS 111 or juniors and above. R: Not open Zoology majors. Not open to students with credit in GLG 433.
Evolution and diversity of fossil vertebrates from fish to humans with emphasis on dinosaurs and Pleistocene events.

332. Social Impact of Paleobiology
Spring. 3(3-0)
P: ISB 200 or ISP 203 or GLG 201 or BS 110; one ISS and one IAH course. R: Completion of Tier I Writing Requirement
Social impact and influence of paleobiological thought and discoveries, from early ideas on the origins of fossils to evolution as a dominant force shaping the design of organic life. Involvement of paleobiology in social Darwinism, evolutionary humanism, evolutionary mysticism, and conflicts with creationists.

335. Plants Through Time
Spring of odd-numbered years. 3(3-0) Interdepartmental with Botany and Plant Pathology. Administered by Botany and Plant Pathology.
P: BS 110 or BOT 105 or GLG 201 or LBS 144. R: Juniors and above.
Evolutionary history of plants, the development of ecosystems, and the use of plant fossils in the reconstruction of ancient environments and climate.

351. Structural Geology
Fall. 4(3-2)
P: GLG 361, MTH 116.
Structural geology. Mechanical behavior and kinematic history of the lithosphere. Stress and strain. Deformation features such as folds, faults and microstructure. Methods of analysis and interpretation. One weekend field trip required.

361. Petrology (W)
Spring. 4(3-2)
P: GLG 201, GLG 321. R: Completion of Tier I writing requirement.
Evolution, origin, occurrence and tectonic setting of igneous and metamorphic rocks. Phase relations of igneous and metamorphic systems. Studies of rocks in thin sections.
SA: GLG 461

371. Plate Tectonics (W)
Spring. 4(3-2)
P: MTH 116; PHY 183 or PHY 183B or PHY 231 or PHY 231B. R: Completion of Tier I writing requirement.
Geophysical methods of studying the structure and dynamics of the earth and planets. Plate kinematics and global geodynamic processes, plate margin processes and evolution, marine geology.

411. Hydrogeology
Fall. 4(3-2)
P: MTH 116. R: Not open to freshmen and sophomores.
Principles of the source, occurrence and movement of groundwater emphasizing geologic factors and controls.