

# Earth Science

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In Earth Science, we use an integrated approach to understand the composition, structure, evolution, and dynamic of planet Earth. This covers processes ranging from the deep inner earth to those at the earth's surface to the outer limits of our atmosphere. The program combines geology, mathematics, physics, chemistry, and field studies to address how the earth works over various spatial and temporal scales. The main subject areas you will study include general and historical geology, properties of Earth materials, igneous petrology, sedimentology and stratigraphy, structural geology, field methods, and climate science. You will examine slow, long-term processes such as mantle convection, plate tectonics, and mountain building, as well as processes with short timescales including current, societally relevant problems such as the study of natural hazards, seismicity, volcanism, climate change, and mineral-, energy-, and water-resource exploitation.

Our curriculum offers wide a spectrum of methods and research topics drawn from the different research groups and expertise of faculty within the Department (biogeochemistry & water resources, climate & tectonics, igneous petrology & volcanism). Students are mentored in the lab and in outdoor field experiences in independent studies, capstone research projects, and/or internships. From satellite imagery and climate modeling to laboratory experiments and petrographic studies to field observations and biogeochemical analysis of water resources, we focus on techniques, skills, and knowledge that prepares you for a diversified job market in the twenty first century. Individual academic advising and personalized curricula provide a wide range of elective offerings that are best suited for your career interests.

Our highly interdisciplinary program in Earth Science can lead to your Bachelor of Science degree or an undergraduate minor. No matter what your interests are, you will leave the program with a better understanding of the forces and processes that shape our global environment and the world around you.

- Major in Earth Science (<http://catalog.neiu.edu/arts-sciences/earth-science/earth-science/>) (not currently accepting applications)
- Minor in Earth Science (<http://catalog.neiu.edu/arts-sciences/earth-science/minor-earth-science/>)

Kenneth T. Nicholson, Ph.D., Associate Professor, Professor of Chemistry, Chair  
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## **ESCI-109. First Year Experience: Chicago Rocks! Geology In The City. 3 Hours.**

Chicago has been at the bottom of the sea, buried under a mile of ice, and set in a warm, tropical paradise. Such diverse changes have shaped Chicago and the surrounding region, including the lake, the rivers, the ground we walk on (and build on), and the decisions we make about land use, resources, and waste management. Explore Chicago Rocks - as well as water, weather, and land forms - in the context of current issues related to resource use and the environment. Field trips and hands-on experiences highlight the extent to which geology influences the character of the Chicago area.

## **ESCI-109W. First Year Experience: Chicago's Muddy Waters- Environmental Geology. 3 Hours.**

Chicago's vital bodies of water - Lake Michigan, Chicago River, and others - interact with the urban landscape and the soils and rocks of the ground beneath. Such interactions influence environmental issues in everyday life, including "What happens when water goes down the drain?" and "Why do certain areas flood after it rains?" These questions are explored in the context of Chicago's geology, to evaluate the critical factors affecting soil and water contamination, flooding, and our drinking water. Laboratory analysis of water and soil, collected on local field trips, will clear the 'muddy water' about environmental geology impacts in local neighborhoods. (Lecture 2 hr., lab 2 hr.)

## **ESCI-121. Introduction To Earth Science. 3 Hours.**

Basic concepts of geology, meteorology, oceanography, and the solar system. Discussion of topics of current interest in the earth sciences. Laboratory involves the study of minerals, rocks, maps and weather instruments. Lecture 2 hours, lab 2 hours.

**Prerequisite:** (MATH-091 - 499 or MATH-091A - 499Z or NEIU Math Placement Result 02 - 45 or ACT Math 19 - 36 or Accuplacer Elementary Algebra 060 - 084 or Accuplacer College Level Math 020 - 120 or Accuplacer Adv. Algebra & Func 200 - 300 or SAT Math 500 - 800).

## **ESCI-123. Environmental Geology. 3 Hours.**

Earth, its structure, composition and resources. Mineral and energy resources, their formation and distribution, their supply and demand projections for the future. Water resources and water quality. Environmental impact of resources, nuclear and other waste disposal, geological aspects of earthquake and volcanic hazards. Lecture 3 hours.

**Prerequisite:** (MATH-091 - 499 or MATH-091A - 499Z or NEIU Math Placement Result 02 - 45 or ACT Math 19 - 36 or Accuplacer Elementary Algebra 060 - 084 or Accuplacer College Level Math 020 - 120 or Accuplacer Adv. Algebra & Func 200 - 300 or SAT Math 500 - 800).

## **ESCI-150. Water: Science And Society. 3 Hours.**

This course is designed as an introduction to the importance of water for society and its unique characteristics from an Earth Science perspective. The course will focus on the major earth processes that govern water systems and resources and will offer a basic scientific background for understanding water occurrence, movement, and behavior. Students from any background will be given opportunities to connect the earth science of water to society, arts, and humanities through a variety of interactive activities, virtual field trips, assigned readings, and online discussions.

**ESCI-180. Fundamentals Of Data Science. 4 Hours.**

Foundations of data science considers data from three perspectives: inferential thinking, computational thinking, and real-world relevance. Given data arising from some real-world phenomenon, how does one analyze that data to understand that phenomenon? The course teaches critical concepts and skills in computation and statistical inference, in conjunction with hands on analysis of real-world datasets, including economic data, document collections, geographical data, and data from social networks. It delves into social, ethical, and legal issues surrounding data analysis, including privacy and data ownership.

**Prerequisite:** MATH-173 with a minimum grade of C.

**ESCI-201. Exploring America's National Parks. 4 Hours.**

This course blends an overview of U.S. national parks with a general understanding of how the earth works. We will explore how geologic processes control the landscapes and features in U.S. national parks and along the way learn about the concepts of geologic time, plate tectonics, and how the rock record can be used to reconstruct the geological story of the parks. The course investigates geological hazards including volcanic eruptions, earthquakes, and landslides that pertain to various parks. Additionally, we will critically examine how the geology relates to cultural aspects and values, native stewardship, and environmental issues in these parks.

**ESCI-211. Physical Geology. 4 Hours.**

This course emphasizes basic geologic processes and concepts with a focus on understanding the Earth as a system. In this course we will study how the rock cycle, geotectonics, volcanoes, and earthquakes are interrelated, and examine the way internal and external processes interact at the Earth's surface to shape our landscape. Formation, relevance, and implication of water, mineral, and energy resources, as well as climate change, will be part of the fundamental intellectual inquiry into the past, present, and future of our planet.

**Prerequisite:** (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

**ESCI-303. Environmental Geology In The Field. 4 Hours.**

This course introduces students to standard approaches, equipment, and tools used in geological field investigations and lab-based methods in order to develop and test geological ideas and concepts. Special attention is given to the fundamental aspects of geologic mapping, field observations, data gathering, use of a geologic compass, topographic and geologic map use and interpretation, and the construction of geologic cross sections. A significant part of the course will involve case studies as well as hands-on field and laboratory analyses with a focus on Midwestern geological features and landforms. The course includes two mandatory weekend field trips.

**Prerequisite:** ESCI-121 with a minimum grade of C or ESCI-211 with a minimum grade of C.

**ESCI-306. Writing Intensive Program: Earth Materials. 4 Hours.**

This course focuses on identifying common rocks and minerals and understanding their association to plate tectonic settings and landscape dynamics. Observational skills and hand sample identification are emphasized.

**Prerequisite:** ESCI-211 with a minimum grade of C and ENGL-101 with a minimum grade of C.

**ESCI-307. Climate Change: Evidence, Causes, Effects. 4 Hours.**

This course will provide an integrative understanding of the components of the climate system, including the science behind climate change, the range of natural climate variability and external drivers of climate change, as well as impacts of a changing climate on multiple sectors. The course explores the basic science underpinning environmental dynamics and climate change, and the practical problem solving and communication skills to critically assess and discuss these topics. We will use case studies and media stories as backdrop to illustrate the many environmental and climate issues we face today.

**Prerequisite:** (MATH-092 - 499 or MATH-092A - 499Z or NEIU Math Placement Result 30 - 40 or ACT Math 22 - 36 or Accuplacer College Level Math 020 - 120 or SAT Math 530 - 800 or Accuplacer Adv. Algebra & Func 237 - 300).

**ESCI-308. Geology Of The National Parks. 3 Hours.**

Study of the geological processes producing and controlling the lands within the National Park System. Lecture 3 hours.

**Prerequisite:** ESCI-121 with a minimum grade of C or ESCI-211 with a minimum grade of C.

**ESCI-309. Geochemistry. 3 Hours.**

Chemical composition of the earth, element abundances, cosmochemistry, meteorites, origin of elements, geochronology, geothermometry, geobarometry, principles of trace element distribution. Igneous, metamorphic and sedimentary environments. Lecture 3 hours.

**Prerequisite:** CHEM-211 with a minimum grade of D and (ESCI-306 with a minimum grade of D or ESCI-206 with a minimum grade of D).

**ESCI-310. Geology Of The Chicago Region. 4 Hours.**

The geologic history of Chicago integrates the effects of changes in climate and sea level, varied sedimentary processes, and the influence of the tectonic framework of the Midwestern US region. This course explores the diversity in Chicago's geologic past and present, including the continuing evolution of a geologic landscape affected by glacial, stream, and coastal processes, and examines the impact of local geology on resources and land use, as well as the impact of human processes on the geologic environment. Interpretation of map evidence and real-time data, individual research, and local and regional field experiences supplement class discussion. Lecture 2 hours and Lab 3 hours.

**Prerequisite:** ESCI-211 with a minimum grade of C.

**ESCI-311. Mineralogy And Petrology I. 4 Hours.**

This course is an introduction to fundamental mineralogical and petrological principles. Igneous and metamorphic processes are explained using crystallization theory, phase diagrams, thermodynamics, and geochemistry. We survey the distribution, chemical composition, and mineral associations in rocks of the Earth's crust and upper mantle, and investigate the relationships between these and tectonic environments. Lab methods include studying physical and optical properties of rocks and minerals.

**Prerequisite:** CHEM-211 with a minimum grade of C and (ESCI-306 with a minimum grade of C or ESCI-206 with a minimum grade of C).

**ESCI-312. Historical Geology. 4 Hours.**

Evolution of the earth and its flora and fauna, paleoecology; principles of paleontological stratigraphy and techniques of relative and absolute age determination. Lecture 3 hours, lab 2 hours.

**Prerequisite:** ESCI-121 with a minimum grade of C or ESCI-211 with a minimum grade of C.

**ESCI-314. Paleontology. 4 Hours.**

Principles, study of invertebrate phyla, morphology, taxonomy, evolution and paleoecology as well as occurrence of various fossil types. Lecture 2 hours, lab 3 hours.

**Prerequisite:** ESCI-212 with a minimum grade of C or ESCI-312 with a minimum grade of C.

**ESCI-315. Glacial Geology. 4 Hours.**

This course focuses on interpreting glacial processes and glacial environments, both past and present. Applying techniques that include map interpretation and correlation, remote sensing, and comparison of sediment and topographic data, students will analyze glacier dynamics, the development of glacial landscapes, and the geologic record of glaciations and glacial processes. Lecture 2 hours, Lab 3 hours. Prereq: ESCI-121 or ESCI-211.

**Prerequisite:** ESCI-121 with a minimum grade of C or ESCI-211 with a minimum grade of C.

**ESCI-316. Volcanic Processes And Hazards. 4 Hours.**

This course will cover physical and chemical controls on the timing, style, and magnitude of volcanic eruptions, as well as the products (including natural resources) that form from volcanic activity. Data obtained from a variety of analytical techniques associated with physical and chemical processes at volcanoes will be evaluated and applied to solve volcanic problems. Impacts of volcanic eruptions on society and the strategies to reduce risk, such as volcanic monitoring, will be discussed.

**Prerequisite:** ESCI-211 with a minimum grade of C and CHEM-211 with a minimum grade of C.

**ESCI-317. Sedimentology And Stratigraphy. 4 Hours.**

This course introduces students to the basic principles used in the study of sedimentology and stratigraphy, including the knowledge and tools to investigate sediment formation, transportation, and deposition. Students learn the fundamentals of fluid flow, sediment transport, physical properties of sediments, and the formation of sedimentary structures, as well as how to connect these with the environments in which sedimentary rocks form. Special emphasis is placed on stratigraphic nomenclature and observation of thin sections in the lab, and the application of various concepts to stratigraphic columns in the field.

**Prerequisite:** ESCI-306 with a minimum grade of C or ESCI-206 with a minimum grade of C.

**ESCI-319. Petrology. 4 Hours.**

Classification of rocks. Study of mineralogical and textural relations of major rock groups in hand specimens and thin sections. Chemical composition of rocks. Chemical and petrographic data interpretation. Interrelation of petrological processes and plate tectonics. Description of selected and widely referred petrologic complexes. Lecture 2 hours, lab 3 hours.

**Prerequisite:** ESCI-311 with a minimum grade of C.

**ESCI-320. Limnology. 4 Hours.**

In this course, students will explore the geological aspects of freshwater systems, focusing on Lake Michigan. Topics that will be covered include the origin of Lake Michigan, tectonic and climatic settings of the Lake, physical sedimentary processes, sedimentary geochemistry, geochronology and paleolimnology. Students will also explore the multidisciplinary aspects of biogeochemical cycling of elements, the role of planktonic organisms in these cycles. Lecture 2 hours, Lab 3 hours.

**Prerequisite:** ESCI-211 with a minimum grade of C.

**ESCI-324. Oceanography I. 4 Hours.**

Ocean boundaries and bottom topography. Origin and evolution of ocean basins. Nature and characteristics of coastal and marine sediments. Gathering of oceanological data development of the marine sciences.

**Prerequisite:** ESCI-121 with a minimum grade of C and ESCI-207 with a minimum grade of C.

**ESCI-326. Independent Study In Earth Science. 3 Hours.**

Research in the geological sciences, oceanography, meteorology, or astronomy under the guidance of a faculty member. Independent Studies require the approval of the instructor, department chair and the appropriate College Dean.

**ESCI-327. Aqueous Environmental Geochemistry. 4 Hours.**

This course builds on students' fundamental knowledge of aqueous chemistry and highlights applications relevant to geological sciences. The course focuses on using chemical principles to study surface and near surface water and water-rock/water-soil interactions. Topics include basic thermodynamics, chemical speciation, mineral solubility, complexation, acid-base reactions, oxidation-reduction reactions, carbonate chemistry, and an introduction to geochemical modeling. The practical applications of these topics will develop quantitative skills required for addressing geological and environmental issues.

**Prerequisite:** ESCI-211 with a minimum grade of C and CHEM-212 with a minimum grade of C.

**ESCI-329. Soil Science. 4 Hours.**

Fundamentals of soil including origin, composition, and classification; physical, chemical and biological properties; significance of soil properties for evaluation of soil as a resource; soil fertility and amelioration, soil and watershed use and conservation, and environmental concerns, including soil contamination and remediation.

**Prerequisite:** ESCI-121 with a minimum grade of C or ESCI-211 with a minimum grade of C.

**ESCI-330. Structural Geology. 4 Hours.**

This course introduces the basic concepts of brittle and ductile deformation processes and how they control the strength, mechanical behavior and development of structures in the Earth's continental crust. The course provides a basic understanding of the forces driving deformation and associated displacements and strains. Emphasis is placed on (1) illustrating how deformation processes change under the influence of changing pressures and temperatures with increasing depth in the lithosphere, and (2) examining the types of structures produced by single episodes of deformation of crust, and how their styles and geometries vary as a function of depth in the continental crust.

**Prerequisite:** ESCI-303 with a minimum grade of C and ESCI-317 with a minimum grade of C.

**ESCI-331. Geological Structures And Map Interpretation. 4 Hours.**

Determination of the attitude and thickness of inclined strata and their bearing on outcrop patterns; preparation of geological maps from given field data; and interpretations of aerial photos, topographic maps, and geological maps depicting folds, faults, unconformities and intrusive bodies; preparation of geological cross sections. Lecture 2 hours, lab 3 hours.

**Prerequisite:** ESCI-211 with a minimum grade of C.

**ESCI-333. Internship In Earth Science. 3 Hours.**

Field experience at an off-campus site. Student will work a minimum of 150 hours with an earth science agency or organization. Evaluation will be based in part on the student's creation of a tangible product. Details of internship will be arranged by the student, faculty advisor and site supervisor.

**ESCI-335. Meteorology. 4 Hours.**

This course introduces the processes at work in the earth's atmosphere and the physical laws that control them; horizontal and vertical circulations, atmospheric stability, radiation balance, precipitation, air masses, frontogenesis, and severe weather. Laboratory work involves extensive use of maps and charts.

**Prerequisite:** PHYS-201L with a minimum grade of C or PHYS-206L with a minimum grade of C.

**ESCI-337. Principles Of Hydrogeology. 4 Hours.**

Introduction to the theory and principles of groundwater flow as well as streamflow. Topics include the hydrologic equation, evapo-transpiration, well drilling and testing, porosity and permeability, Darcy's law, confined and unconfined aquifers, flow-nets, geology of groundwater occurrence, water table maps, geophysical exploration methods, well logs, streamflow and hydrographs. Lecture 3 hours, Lab 2 hours.

**Prerequisites:** ESCI-211 and (MATH-185 or MATH-106 or NEIU Math Placement Result 35 - 45 or ACT Math 25 - 36 or Accuplacer College Level Math 031 - 120 or SAT Math 580 - 800 or Accuplacer Adv. Algebra & Func 250 - 300).

**ESCI-339. Field Hydrogeology. 4 Hours.**

Field techniques of measuring infiltration, soil moisture, aquifer permeability and hydraulic conductivity. Practice in conducting geophysical surveys and drilling, logging and developing ground water wells. Methods of sampling water for chemical analysis. Visits to drilling, monitoring and waste management sites. Methods of recording, analysing, mapping and reporting field data. Lecture 2 hours, lab 3 hours.

**Prerequisite:** ESCI-337 with a minimum grade of C.

**ESCI-340. Introduction To Geotechnical Engineering. 4 Hours.**

Introduction to basic concepts of design and engineering of earth materials. Geotechnical soil properties, engineering soil classification, site characterization, earthwork, interactions of water with Earth materials. Overview of engineering design of roadways, landfills, dams, levees, and tunnels. Especially useful for those interested in environmental aspects of geology. Lecture 2 hours, laboratory 3 hours.

**Prerequisite:** (MATH-104 or MATH-177 or MATH-185 or NEIU Math Placement Result 35 - 45 or ACT Math 25 - 36 or Accuplacer College Level Math 031 - 120 or SAT Math 580 - 800 or Accuplacer Adv. Algebra & Func 250 - 300) and.

**ESCI-341. Environmental Hydrology. 4 Hours.**

The course introduces surface water hydrology, emphasizing applications in urban and agricultural environments of the glaciated Midwest. The course includes basic principles of the processes, interrelationships, and measurement of precipitation, infiltration, evaporation, evapotranspiration, interflow, overland flow, stream flow, and ground water flow. Also covered are an introduction to quantification of watershed hydrologic budgets, hydrographs, flood routing, hydraulic drainage and control structures, and estimation of extreme events. Lecture 2 hrs., laboratory 3 hrs.

**Prerequisite:** ESCI-211 with a minimum grade of C and MATH-185 with a minimum grade of C.

**ESCI-347. Climate Change: Past, Present, Future. 4 Hours.**

This course investigates the characteristics and causes of short (1 year) to long-term (>1 million years) climate change over the past ~400 million years and ~100 years into the future. The course will present an overview of the methods and techniques used to reconstruct Earth's climate history in the past, and will investigate ongoing climate changes in the present, and those predicted for the future. Students will be introduced to an educational state-of-the-art climate model (EdGCM) to simulate, implement, and analyze the effects of climate change by using real-world data and scientific approaches.

**ESCI-350. Geotectonics. 4 Hours.**

Geotectonics is the study of large-scale motion and deformation of earth's crust and mantle, the relationship of geodynamics to volcanic activity, earthquakes, and surface features, as well as the deep structure and movement of the interior of the earth. Interdisciplinary instruction of geological, geophysical, and geochemical concepts will allow students to develop a broad working knowledge of classic and current plate tectonics. Historical and recent papers on plate tectonics will be read, discussed, summarized in written reports, and presented to the class. Laboratories will consist of analyzing geologic, geophysical, geochemical, and remotely sensed evidence of current and ancient geodynamics.

**Prerequisite:** ESCI-211 with a minimum grade of C.

**ESCI-356. Introduction To Geophysics. 4 Hours.**

This course is designed to be a survey of the various subdisciplines of geophysics. Students will be introduced to geophysical phenomena through the acquisition, reduction and interpretation of data from geophysical surveys and exercises. We will examine simple physics and processes that govern Earth's dynamic behavior and students will demonstrate their knowledge employing various survey methods including seismic refraction, ground penetrating radar (GPR), and electrical resistivity to address near surface environmental and geotechnical issues. <br />Lecture 2 hours, Lab 3 hours.

**Prerequisite:** MATH-187 with a minimum grade of C and (PHYS-202L with a minimum grade of C or PHYS-207L with a minimum grade of C).

**ESCI-370. Interdisciplinary Seminar On Climate Change. 2 Hours.**

This university-wide seminar provides important views on the critical issue of climate change, drawing from many perspectives and disciplines. Faculty from different NEIU departments and other institutions will present an overview of socio-economic, political, cultural, racial, gender, ethical, and scientific perspectives on the issue of climate change. The main objective of the seminar is to gain an understanding of the dynamic linkages and feedbacks between the climate system and society and to critically evaluate climate change solutions in the context of sustainability and social & environmental justice.

**ESCI-390. Field Geology. 5 Hours.**

This course introduces standard geologic field techniques and data analysis. It is a multiple-week intensive course in geologic mapping and field investigation that focuses on: (1) Collecting and recording data using common geologic field methods and tools; (2) Synthesizing geologic data collected in the field by producing geologic maps and cross-sections; (3) Developing a reasonable geologic history based on multiple lines of evidence. Students will be exposed to a spectacular landscape, where different geologic processes are present and well-exposed. Lecture 3 hours, Lab 3 hours.

**Prerequisite:** ESCI-330 with a minimum grade of C and ESCI-311 with a minimum grade of C.