

GEOSCIENCE (GEOSCI)

GEOSCI 100 – INTRODUCTORY GEOLOGY: HOW THE EARTH WORKS

3 credits.

Geologic processes; structure and history of the earth; earthquakes, volcanos, glaciers, groundwater, minerals, rocks, deserts, fossils; topographic and geologic maps; climate change on geologic and human time scales.

Requisites: Not open to students with credit for GEOSCI/ENVIR ST 106

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/ATM OCN/ENVIR ST 102 – CLIMATE AND CLIMATE CHANGE

3 credits.

Describes the basic climate principles governing the climate system. It describes the climate and climate variability at present, climate evolution in the past, and the projected climate change into the future. The scientific principles underlying the natural and anthropogenic greenhouse effect and climate model forecasts are elucidated.

Requisites: None

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/ATM OCN 105 – SURVEY OF OCEANOGRAPHY

3-4 credits.

Nature and behavior of ocean water, interaction of oceans and atmosphere, structure of the ocean floor, life in the oceans, our relationship to the marine environment.

Requisites: None

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/ENVIR ST 106 – ENVIRONMENTAL GEOLOGY

3 credits.

Application of geology to problems resulting from the ever more intense use of the earth and its resources.

Requisites: Not open to students with credit for GEOSCI 100

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 109 – THREE BILLION YEARS BENEATH YOUR FEET: GEOLOGY OF THE NATIONAL PARKS

3 credits.

Famously called "America's best idea", the National Parks of the US record two-thirds of Earth's history, from the most ancient mountains to active volcanic eruptions. The geologic story of the National Parks is explored in the framework of physiography, tectonics, time, and fundamental geologic processes, highlighting the major parks from Hawaii, to Alaska, to the conterminous US. Provides a view of the geological evolution of the Earth using specific examples.

Requisites: None

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI 110 – EVOLUTION AND EXTINCTION

4 credits.

Contemporary views of the origin and diversification of life and evolutionary processes; crises in the history of life, with emphasis on controversies regarding evolution, mass extinctions, and the co-evolution of Earth and life.

Requisites: None

Course Designation: Breadth – Biological Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 111 – VOLCANOES AND CIVILIZATION

1 credit.

An introduction to the impact and influence volcanoes have had on the evolution of the Earth, life, human civilizations, and modern society.

Requisites: None

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2018

GEOSCI 112 – MOUNTAINS AND MOVING PLATES

1 credit.

An introduction to the Earth's great mountain ranges, the processes that lead to their births and deaths, and the reasons why continental mountain ranges differ dramatically from oceanic mountains and mountains on other planets.

Requisites: None

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2016

GEOSCI 115 – SCIENCE BEHIND THE NEWS - THE WORLD AROUND US

1-2 credits.

Examines the earth and environmental science behind the news with the goal of producing more informed and knowledgeable citizens.

Requisites: None**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2018**GEOSCI 117 – EX-FILES: LIFE IN THE EARTH'S EXTREME ENVIRONMENT**

2 credits.

Explores the diversity of microbial life forms in modern and ancient geological environments, with a focus on extreme environments of geological origin or relevance. Includes exploration of unusual aspects of microbial life in everyday settings.

Requisites: None**Course Designation:** Breadth – Biological Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Fall 2023**GEOSCI 118 – EYE IN THE SKY: MONITORING THE EARTH BY SATELLITE**

1 credit.

Fundamentals of satellite imagery applied to the earth sciences. Basics of image interpretation. Multitemporal data. Resolution and uncertainty. Existing and emerging technologies. Orbits, wavelengths, and satellites. Socio-economic impact of remotely-sensed data.

Requisites: None**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2024**GEOSCI/ATM OCN 140 – NATURAL HAZARDS AND DISASTERS**

3 credits.

An exploration of the science behind natural disasters including earthquakes, tsunamis, volcanic eruptions, landslides, tornadoes, hurricanes, and floods. Why, where, and when do these events occur, and why are some predictable but others are not? Addresses hazard assessment, forecasting, and mitigation to lessen their impact on society.

Requisites: None**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2024**GEOSCI/ASTRON 160 – LIFE IN THE UNIVERSE**

2 credits.

An examination of the origin and evolution of life in the universe based on our knowledge of astronomy, biology, and geology. Includes discussions on the search for extraterrestrial life and the history of life in our solar system.

Requisites: None**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2024**GEOSCI 198 – DIRECTED STUDY**

1-3 credits.

Independent study as arranged with a faculty member.

Requisites: Consent of instructor**Course Designation:** Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Spring 2012**GEOSCI 199 – DIRECTED STUDY**

1-3 credits.

Independent study as arranged with a faculty member.

Requisites: Consent of instructor**Course Designation:** Level – Elementary

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Fall 2023**GEOSCI 202 – INTRODUCTION TO GEOLOGIC STRUCTURES**

4 credits.

Introduction to recognition and mapping of geologic structures in the field. Landforms, folds, faults, tectonics, geologic maps, and field instrumentation.

Requisites: GEOSCI 100 or ENVIR ST/GEOSCI 106**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Fall 2023**GEOSCI 204 – GEOLOGIC EVOLUTION OF THE EARTH**

4 credits.

Physical evolution of the earth and its relationship to the development of life through geologic time. Includes field trip.

Requisites: GEOSCI 100 or ENVIR ST/GEOSCI 106**Course Designation:** Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No**Last Taught:** Spring 2024

GEOSCI 304 – GEOBIOLOGY

3 credits.

An integrative approach to studying the interaction between the atmosphere, hydrosphere, biosphere, and geosphere as they have evolved during earth history. Overarching theme includes ocean-climate system changes, biogeochemical cycles, evolution from microbes to mammals, and critical events in life history.

Requisites: GEOSCI 204 or graduate/professional standing

Course Designation: Breadth – Biological Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/GEOG 320 – GEOMORPHOLOGY

3 credits.

Principles and analysis of geomorphic processes and resulting land forms.

Requisites: GEOSCI/ENVIR ST 106, GEOSCI 100, 109, 204, ENVIR ST/GEOG 120, 127 or graduate/professional standing

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/GEOG 326 – LANDFORMS-TOPICS AND REGIONS

3 credits.

Emphasis on natural and human processes that control the morphology of the land and its waterways.

Requisites: GEOSCI/ENVIR ST 106, GEOSCI 100, 109, 204, ENVIR ST/GEOG 120, 127, GEOSCI/GEOG 320, or graduate/professional standing

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2016

GEOSCI 331 – GEMS: THE SCIENCE BEHIND THE SPARKLE

1-2 credits.

Explores the formation, collection, properties, and treatment of many popular gemstones.

Requisites: Junior standing

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/ATM OCN/ENVIR ST/GEOG 335 – CLIMATIC ENVIRONMENTS OF THE PAST

3 credits.

Climate change at timescales from the last several million years to the last 100 years, with emphasis on more recent timescales. Examines how climate variability arises from interplay between external forcings, feedbacks within the earth system, and (more recently) human activity.

Requisites: Sophomore standing

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/G L E 350 – INTRODUCTION TO GEOPHYSICS: THE DYNAMIC EARTH

3 credits.

Methods of geophysics applied to earth structure and plate tectonics. Principles of seismology, gravity, geodesy, magnetism and heat flow.

Requisites: MATH 217, 221, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/G L E 360 – PRINCIPLES OF MINERALOGY

3 credits.

Minerals, their physical and chemical properties, crystallography, and geologic significance.

Requisites: (GEOSCI 100 or ENVIR ST/GEOSCI 106) and (CHEM 103, 109, 115, or concurrent enrollment), graduate/professional standing, or member of Engineering Guest Students

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/G L E 370 – ELEMENTARY PETROLOGY

3 credits.

Igneous and metamorphic rocks, studied in hand sample and thin section.

Requisites: G L E/GEOSCI 360, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Breadth – Physical Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/ENVIR ST/F&W ECOL/G L E/GEOG/LAND ARC 371 – INTRODUCTION TO ENVIRONMENTAL REMOTE SENSING

3 credits.

Introduction to the Earth as viewed from above, focusing on use of aerial photography and satellite imagery to study the environment. Includes physical processes of electromagnetic radiation, data types and sensing capabilities, methods for interpretation, analysis and mapping, and applications.

Requisites: (Sophomore standing and MATH 113, 114, or 171), graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/ENVIR ST/F&W ECOL/G L E/GEOG/LAND ARC 372 – INTERMEDIATE ENVIRONMENTAL REMOTE SENSING

3 credits.

Examines intermediate-level concepts in information extraction, data processing and radiative transfer relevant to remote sensing of the environment. Includes transforms, image correction, classification algorithms and change detection, with emphasis on applications for land use planning and natural resource management.

Requisites: LAND ARC/ENVIR ST/F&W ECOL/G L E/GEOG/GEOSCI 371, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2015

GEOSCI 375 – PRINCIPLES OF GEOCHEMISTRY

3 credits.

Provides a chemical basis for understanding the origin, evolution, distribution and interactions of chemical elements and isotopes between the lithosphere, hydrosphere, biosphere, and atmosphere in geological and environmental processes.

Requisites: G L E/GEOSCI 360, (CHEM 109, 104, or 115) and G L E/GEOSCI 370 or concurrent enrollment in G L E/GEOSCI 370, or graduate/professional standing

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 376 – TOPICS IN GEOLOGY

1-3 credits.

Special topics or discussions of recent research in Geoscience.

Requisites: Consent of instructor

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2023

GEOSCI 402 – RESEARCH AND COMMUNICATION IN THE GEOLOGICAL SCIENCES

3 credits.

Skills and strategies to conduct research in the geological sciences, including collection of data, analysis of the data, generation of models to explain the data, and clear communication of both the research process and results. As part of the research process, find, evaluate, and utilize information in the existing scientific literature. Practice effective scientific communication skills, including writing, oral presentations, and producing effective visualizations.

Requisites: Senior standing and declared in Geology and Geophysics

Course Designation: Gen Ed - Communication Part B

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Fall 2023

Learning Outcomes: 1. Learn about how information is produced and disseminated in the geological sciences. Audience: Undergraduate

2. Effectively and efficiently read the scientific literature for content - a foundation for life-long learning that is key to a successful career. Audience: Undergraduate

3. Critically evaluate the primary literature including the nature of evidence, the logic of the approach, and appropriateness of the analyses to the addressed problem. This explicitly includes critical reading, logical thinking, quantitative analyses, and the use of evidence. Audience: Undergraduate

4. Develop skills and strategies needed to find, evaluate, and utilize information in the geological sciences. Audience: Undergraduate

5. Clearly communicate - both in writing and orally - the results of scientific investigation. Audience: Undergraduate

6. Effectively use diagrams and graphs to explain scientific data. Audience: Undergraduate

GEOSCI/ENVIR ST 411 – ENERGY RESOURCES

3 credits.

A critical examination of the full spectrum of renewable and nonrenewable energy options, from the unifying perspective of the Earth systems that govern their use. Energy conversion and efficiency, consumption patterns and trends, and environmental consequences of energy production and use.

Requisites: Sophomore standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/GEOG 420 – GLACIAL AND PLEISTOCENE GEOLOGY

3 credits.

Principles, characteristics and work of glaciers; events of the Pleistocene. Field trip.

Requisites: GEOSCI/ENVIR ST 106, GEOSCI 100, 109, ENVIR ST/GEOG 120, 127, or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

GEOSCI 430 – SEDIMENTOLOGY AND STRATIGRAPHY

3 credits.

Comprehensive survey of the processes and products of sedimentation, including depositional environments, sedimentary tectonics, sequence stratigraphic principles, and analytical methods.

Requisites: GEOSCI 204 and G L E/GEOSCI 370, or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/G L E 431 – SEDIMENTARY & STRATIGRAPHY LAB

1 credit.

Covers Sedimentology and Stratigraphy; emphasizes qualitative and quantitative description and interpretation of sediments and sedimentary deposits.

Requisites: GEOSCI 204 or G L E/GEOSCI 360, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/CIV ENGR/ENVIR ST/G L E 444 – PRACTICAL APPLICATIONS OF GPS SURVEYING

2 credits.

Global positioning system surveying for field applications. Signals. Coordinate systems. Datums. Cartographic projections. Satellite orbits. Choosing hardware. Strategies for data collection and analysis. Assessing uncertainty. Geocoding satellite images. Integrating data with Geographic Information Systems. Emerging technologies.

Requisites: MATH 211, 217, 221, or graduate/professional standing, or member of Engineering Guest Students

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2023

GEOSCI/G L E 455 – STRUCTURAL GEOLOGY

4 credits.

Principles of rock deformation, structures in layered rocks, structural analysis, intrusive structures. Lab: three-dimensional problems involving structural concepts; field trip.

Requisites: GEOSCI 202, 204, and (G L E/GEOSCI 370 or concurrent enrollment), graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 456 – GEOLOGIC FIELD METHODS

2 credits.

Theory and techniques of geologic mapping; field trips.

Requisites: G L E/GEOSCI 455 or concurrent enrollment

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2019

GEOSCI 457 – CONDUCTED FIELD TRIP

2 credits.

Study of the principles and methods of geologic mapping.

Requisites: G L E/GEOSCI 370 or concurrent enrollment

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 459 – FIELD GEOLOGY

6 credits.

Detailed geologic mapping and solution of related problems in the field.

Requisites: GEOSCI 202, G L E/GEOSCI 370, and 455

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Summer 2019

GEOSCI/CIV ENGR/G L E/M S & E 474 – ROCK MECHANICS

3 credits.

Classification of rock masses, stress and strain in rock, linear and non-linear behavior of rock, failure mechanisms, state of stress in rock masses, lab testing, geological and engineering applications.

Requisites: E M A 201, PHYSICS 201, 207, or 247, or graduate/professional standing, or member of Engineering Guest Students

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI/HIST SCI 514 – HISTORY OF GEOLOGIC THOUGHT

3 credits.

Major concepts from earliest to modern times.

Requisites: GEOSCI 204 or graduate/professional standing**Course Designation:** Breadth – Humanities

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No**Last Taught:** Spring 2024**GEOSCI 515 – PRINCIPLES OF ECONOMIC GEOLOGY**

4 credits.

Composition, structure, occurrence, origin, and economic investigation of important groups of mineral deposits; problems of mineral deposition.

Requisites: GEOSCI 204 and G L E/GEOSCI 370, or graduate/professional standing**Course Designation:** Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No**Last Taught:** Spring 2018**GEOSCI/G L E 537 – QUANTITATIVE METHODS FOR GEOSCIENCE**

3 credits.

MATLAB is a powerful, high-level programming language and integrated development environment (IDE) that is used across a broad variety of scientific disciplines for tasks including data visualization, modeling, and application development. Focus on the active use of MATLAB for developing practical programming and data analysis skills that can be applied across a range of geoscience- relevant problems. Applications will include: data visualization and publishable figure development; automation of data processing; statistical and time-series analysis; image processing and mapping; and optimization. Additional topics may be guided by student interest.

Requisites: MATH 222, graduate/professional standing, or member of Engineering Guest Students**Course Designation:** Level – Advanced

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No**Last Taught:** Fall 2023**GEOSCI/ZOOLOGY 541 – PALEOBIOLOGY**

3 credits.

The evolutionary process as interpreted from the fossil record. Topics include: the study of form; tempo and mode of evolution; levels and mechanisms of evolutionary change; extinction in the fossil record; trends and patterns in the history of life; macroevolution.

Requisites: GEOSCI 304, ZOOLOGY/BIOLOGY 101, ZOOLOGY/BIOLOGY/BOTANY 152, or graduate/professional standing**Course Designation:** Breadth – Biological Sci. Counts toward the Natural Sci req

Level – Advanced

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No**Last Taught:** Spring 2016**GEOSCI/ZOOLOGY 542 – INVERTEBRATE PALEONTOLOGY**

3 credits.

The evolutionary history, morphology, and ecology of fossil invertebrates.

Labs emphasize fossil identification and recognition of basic morphological features.

Requisites: (GEOSCI 110 or 204), (ZOOLOGY/BIOLOGY 101 and 102), ZOOLOGY/BIOLOGY/BOTANY 152, (BIOCORE 381 and 382), or graduate/professional standing.**Course Designation:** Breadth – Biological Sci. Counts toward the Natural Sci req

Level – Intermediate

L&S Credit – Counts as Liberal Arts and Science credit in L&S

Grad 50% – Counts toward 50% graduate coursework requirement

Repeatable for Credit: No**Last Taught:** Fall 2014

GEOSCI 551 – PALEOCEANOGRAPHY

3 credits.

Investigates the history of the Earth's oceans, focusing on the last 65 million years, with discussion of the chemical and physical methods through which oceans are studied and the role of oceans in the climate system.

Requisites: GEOSCI 100, 110, ATM OCN/GEOSCI 105, ENVIR ST/GEOSCI 106, or graduate/professional standing

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

Learning Outcomes: 1. Explain the major climatic and oceanographic events and trends during the Cretaceous through the Cenozoic, spanning timescales from the last 150,000,000 years to the last 1,000 years. For this class emphasis is placed on the global climate and oceanographic systems, with some attention to regional changes. Audience: Both Grad Undergrad

2. Explain the physical processes controlling the behavior of the earth system and its related components (atmosphere, oceans, cryosphere, biosphere, etc.), and to articulate how oceanic/climatic variability results from a combination of external forcings and internal dynamics within the earth system. Audience: Both Grad Undergrad

3. Understand how paleoceanographers collect, date, and analyze a staggering variety of deep-sea records, as well as other paleoclimate archives as they pertain to oceanic and climate processes including ocean and lake sediment cores, ice cores, and speleothems. Audience: Both Grad Undergrad

4. Develop skills in critical thinking and technical writing, with particular attention to critically reading the scientific literature and critically evaluating the climate proxies and model simulations used by paleoceanographers. Audience: Both Grad Undergrad

5. Both explain and critically evaluate the data on which the majority of our ocean/climate knowledge of the last 150,000,000 years is based. Audience: Graduate

6. Both explain and assess the external forcings and internal dynamics within the earth system and across the different earth spheres. Audience: Graduate

7. Critically evaluate the scientific literature and provide your own perspective on the literature discussion and conclusions. Audience: Graduate

GEOSCI 556 – MOUNTAIN BELTS

3 credits.

Examination of interaction of tectonic plates and the resulting structures.

Requisites: G L E/GEOSCI 455 or graduate/professional standing

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

GEOSCI 557 – STRUCTURAL PETROLOGY

3 credits.

Petrographic investigation of rock fabrics and deformation using thin sections. Use of petrographic microscopes and Scanning Electron Microscopes (SEMs).

Requisites: G L E/GEOSCI 370 and 455, or graduate/professional standing

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/G L E 594 – INTRODUCTION TO APPLIED GEOPHYSICS

3 credits.

Survey of applied geophysics, including seismic refraction, seismic reflection, electrical resistivity, gravity, and magnetism methods. Basic physics of each method and modeling techniques and field procedures.

Requisites: MATH 222 and (PHYSICS 202, 208, 248, or E M A 202), graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/G L E 595 – FIELD METHODS IN APPLIED AND ENGINEERING GEOPHYSICS

1 credit.

The application of geophysical field methods for delineating near-surface features and/or structures as applied to engineering, environmental and exploration problems.

Requisites: GEOSCI/G L E 594 or concurrent enrollment, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/G L E 596 – GEOMECHANICS

3 credits.

Observation, description, and prediction of deformation of geomechanical systems at depth, and the forces (stress) causing those deformations, relevant for petroleum/geothermal reservoirs and studies of earthquake mechanics. Emphasis on computational exercises using datasets from the petroleum industry and earthquake catalogues, as well as prediction of ground deformation.

Requisites: GEOSCI/CIV ENGR/G L E/M S & E 474, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req

Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

GEOSCI 610 – GEOCHRONOLOGY, TIMESCALES, AND RATES OF GEOLOGIC PROCESSES

3 credits.

Application of radioisotopic (Ar-Ar, U-Pb, U-Th, U-He) and cosmogenic (He, Ne, Cl, Be, C) dating methods. Status of geologic, astronomic and paleomagnetic timescales, Chronology of flood basalts, impacts, extinctions, glaciations. Constraints on rates of magmatism, mountain uplift, deformation, erosion, sedimentation.

Requisites: G L E/GEOSCI 370 or graduate/professional standing

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/G L E 627 – HYDROGEOLOGY

3-4 credits.

Mathematical treatment of the physical principles governing the flow of groundwater; emphasis on well hydraulics and flow system analysis.

Requisites: (GEOSCI 100, 109, 110, ATM OCN/GEOSCI 105, 140, ENVIR ST/GEOSCI 106, or ASTRON/GEOSCI 160) and (MATH 217 or 221), graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Intermediate

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2023

GEOSCI/G L E 629 – CONTAMINANT HYDROGEOLOGY

3 credits.

Physical and chemical processes governing the transport of solutes in groundwater; application of hydrogeologic and geochemical theory and practice to the protection of aquifers from contamination.

Requisites: G L E/GEOSCI 627 and MATH 222, graduate/professional standing, or member of Engineering Guest Students

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 681 – SENIOR HONORS THESIS

3 credits.

Individual mentored study for seniors completing theses for Honors in the Major as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Honors - Honors Only Courses (H)

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 682 – SENIOR HONORS THESIS

3 credits.

Individual mentored study for seniors completing theses for Honors in the Major as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Honors - Honors Only Courses (H)

Repeatable for Credit: No

Last Taught: Spring 2023

GEOSCI 691 – SENIOR THESIS

3-4 credits.

Mentored individual research and study for students completing a senior thesis.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 692 – SENIOR THESIS

3-4 credits.

Mentored individual research and study for students completing a senior thesis.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 698 – DIRECTED STUDY

1-6 credits.

Independent study as arranged with a faculty member.

Requisites: Consent of instructor

Course Designation: Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

GEOSCI 699 – DIRECTED STUDY

1-6 credits.

Independent study as arranged with a faculty member.

Requisites: Consent of instructor**Course Designation:** Level - Advanced

L&S Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions**Last Taught:** Spring 2024**GEOSCI 701 – QUANTITATIVE GEOMORPHOLOGY**

4 credits.

Quantitative study of processes that shape Earth's surface. Use theory and field observations to investigate major components of continental geomorphic systems, including hillslopes, rivers, and glaciers. Understand how the major factors that shape Earth's surface-tectonics, climate, and life-create the landscapes we observe.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2022

Learning Outcomes: 1. Demonstrate knowledge of the processes that shape Earth's topography over a range of time scales and spatial scales
Audience: Graduate

2. Construct conservation of mass and momentum frameworks for topographic evolution Audience: Graduate

3. Apply mathematical laws for mass transport that govern topographic evolution Audience: Graduate

4. Make field observations that can be used to constrain multiple geomorphic processes Audience: Graduate

5. Write scientific reports in the form of a short journal article Audience: Graduate

GEOSCI 720 – GLACIOLOGY

3 credits.

Addresses the fundamentals of glaciology and glacier landform mechanics: mass balance, ice deformation, basal slip, temperature structure, glacial hydrology, sediment deformation and deposition, and landform building processes. Emphasizes an understanding of the mathematical principles that dictate how glaciers function. Begins with a classical treatment of the mechanics of glaciers and moves onto fundamental advances in the field of glaciology.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2022**GEOSCI/G L E 724 – GROUNDWATER FLOW MODELING**

3 credits.

An introduction to the principles of modeling groundwater flow systems, with emphasis on regional flow system analysis. Conceptual understanding of governing equations, and the use of finite difference techniques to solve such equations are stressed. Develop codes and become introduced to packaged models, including those developed by the U. S. Geological Survey. Knowledge of hydrogeology [such as G L E/GEOSCI 627 or 629] required.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2023**GEOSCI 727 – ADVANCED HYDROGEOLOGY**

1-3 credits.

Advanced topics in Hydrogeology.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** Yes, unlimited number of completions**Last Taught:** Spring 2016**GEOSCI 729 – FIELD APPLICATIONS IN HYDROGEOLOGY**

2 credits.

Instruction and practice in instrumentation and techniques used in collection and interpretation of data. Includes field work in and around Madison.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Summer 2015**GEOSCI 731 – CARBONATE GEOLOGY**

2 credits.

Comprehensive survey of the processes and products of carbonate sedimentation.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Spring 2024**GEOSCI 732 – GEOCHEMISTRY OF SEDIMENTS**

3 credits.

Processes involved in the origin of chemical sediments; shales, carbonates, and evaporites.

Requisites: Graduate/professional standing**Course Designation:** Grad 50% - Counts toward 50% graduate coursework requirement**Repeatable for Credit:** No**Last Taught:** Fall 2021

GEOSCI/G L E 747 – TECTONOPHYSICS

3 credits.

Elasticity and flexure of the earth's lithosphere, heat conduction, mantle convection, earthquake mechanisms, rock rheology, and fluid migration in the earth's crust; integration of geophysical observations, laboratory experiments, and theoretical models.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

Learning Outcomes: 1. Demonstrate an understanding of the Scientific Theory of Plate Tectonics by writing, solving, illustrating, and exemplifying Euler's formula for rigid tectonic plates moving on a sphere. \n Audience: Graduate

2. Demonstrate an understanding of the earthquake deformation cycle in time and space by sketching a map over ~100 km and a time series over ~1000 years. \n Audience: Graduate

3. Demonstrate an understanding of the physical principles of crustal deformation by writing, applying, and solving the differential equations governing motion under the constitutive relations for rigid, elastic, and Maxwell visco-elastic rheologies. \n Audience: Graduate

4. Demonstrate an understanding of quantitative reasoning for testing geophysical hypotheses by comparing two competing models with appropriate statistical tests. \n Audience: Graduate

5. Visualize plate motions on a 3-dimensional sphere by writing, debugging, and writing computer applications. \n Audience: Graduate

6. Analyze geophysical data and interpret them by implementing simple models in the Matlab computer language. \n Audience: Graduate

GEOSCI/ATM OCN/ENVIR ST/ZOOLOGY 750 – PROBLEMS IN OCEANOGRAPHY

3 credits.

Introduction to techniques used in the study of the biology, chemistry, geology, and physics of the marine environment.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

GEOSCI 755 – ADVANCED STRUCTURAL GEOLOGY

3 credits.

Structures in layered, intrusive, and metamorphic rocks; structural analysis.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2021

GEOSCI/G L E 757 – ADVANCED ROCK MECHANICS

3 credits.

Experimental rock mechanics, rock mechanics apparatus design, static and dynamic rock friction, rate and state friction, crack phenomena and rock fracture mechanics, earthquake energy budget, elastic/viscoelastic/plastic behavior of rocks, engineering and geological applications. Knowledge of introductory rock mechanics [such as M S E/GEOSCI/CIV ENGR/G L E/ M S & E 474] required.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2021

GEOSCI 758 – MECHANICS OF EARTHQUAKES AND FAULTING

3 credits.

Addresses current topics and controversies on fault mechanics, earthquake physics, and the rock record of seismicity. Emphasizes critical reading and in-depth discussion of recent publications drawn from a variety of disciplines, including geophysical, geological, and geochemical studies and approaches.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 765 – CRYSTAL CHEMISTRY

3 credits.

Principles of crystal chemistry, emphasizing the structure and behavior of rock forming minerals.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2022

GEOSCI 771 – IGNEOUS PETROLOGY

3 credits.

Classification, characteristics, and petrogenesis of igneous rocks. Representative rock suites studied in lab.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Fall 2022

GEOSCI 777 – ELECTRON MICROPROBE ANALYSIS

3 credits.

Proper use and functioning of electron probe and SEM, their use in microanalysis (WDS, EDS), range of applications, and limitations.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 793 – GEOPHYSICAL INVERSE THEORY

3 credits.

Application of inverse methods to geophysical measurements of the structure of the earth.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 796 – PHYSICS OF THE EARTH II

3 credits.

Theory and observations of earthquakes, seismic waves and plate tectonics.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: No

Last Taught: Spring 2024

GEOSCI 875 – ADVANCED TOPICS IN GEOLOGY

1-3 credits.

Special topics in Geoscience.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

GEOSCI/ATM OCN/BOTANY/CIV ENGR/ENVIR ST/ZOOLOGY 911 – LIMNOLOGY AND MARINE SCIENCE SEMINAR

1 credit.

Sections in various fields of zoological research.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

GEOSCI 920 – SEMINAR IN GLACIAL AND PLEISTOCENE GEOLOGY

1-3 credits.

An exploration of modern glacial, glaciology, and Pleistocene geology literature. Includes a field trip to explore local glacial geology.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2023

GEOSCI 929 – SEMINAR-HYDROGEOLOGY

1-2 credits.

Special topics in Hydrogeology.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2022

GEOSCI 940 – SEMINAR IN PALEONTOLOGY

1 credit.

Review of published literature on how patterns of biotic evolution and extinction are preserved in the fossil record, with particular emphasis on mass extinction events and the biological consequences of abrupt climate change.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2015

GEOSCI 970 – SEMINAR-GEOCHEMISTRY

2 credits.

Exploration of topics in the field of Geochemistry with an emphasis on engagement with recent literature.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

GEOSCI/ATM OCN/BOTANY/ENVIR ST/F&W ECOL/GEOG/ZOOLOGY 980 – EARTH SYSTEM SCIENCE SEMINAR

1 credit.

Topics in earth system science. Emphasis on the coupling between atmospheric, oceanic and land surface systems, involving physical geochemical and biological processes, and including interactions with human systems.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

GEOSCI 990 – RESEARCH

1-12 credits.

Research supervised by individual faculty members.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Spring 2024

GEOSCI 991 – SEMINAR: GEOPHYSICS

1-3 credits.

Topics in geophysics, emphasizing current research comparing models, experiments, and data.

Requisites: Graduate/professional standing

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2017

GEOSCI 999 – ADVANCED INDEPENDENT READING

1-3 credits.

Advanced level mentored reading and research for students with dissertator status.

Requisites: Consent of instructor

Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement

Repeatable for Credit: Yes, unlimited number of completions

Last Taught: Fall 2017