

GEOLOGY

Program Overview

The Geology major prepares students for meaningful and productive post-baccalaureate employment and/or admission to high-quality graduate programs. The Geology program incorporates a broad and challenging curriculum, which emphasizes and investigates many of the important geologic sub-disciplines including rock-forming mechanisms and controls, deformational and tectonic processes, the weathering and erosion of geologic materials, the transport and deposition of derived sediments and the physical and biological history of the Earth.

Curriculum Overview

The curriculum for this major focuses on the interdisciplinary nature of Geology by offering a broad and challenging selection of courses including geology, chemistry, and physics. Upper level courses address the essential sub-disciplines of geology to prepare students for graduate study as well as employment opportunities. All Geology students will participate in extensive laboratory and fieldwork in their courses, allowing students to apply their conceptual and technical skills learning. In the third or fourth year of study, all students attend an approved, senior-level geology field camp where they learn additional fundamental field, technical, and mapping skills, and how to professionally apply and integrate what they learn in their individual courses to complex, real-world geologic problems. Geology students are encouraged to take advantage of the many opportunities to engage in independent research in collaboration with the GEMS faculty.

Honors Program in Geology

Graduation with honors in Geology is awarded in recognition of majors who have demonstrated outstanding academic ability. Enrollment in the program is by invitation from the faculty of the Department of Geological, Environmental, and Marine Sciences (GEMS). Eligibility requirements include a minimum GPA of 3.5 in courses required for the major and the satisfactory completion of a senior thesis. In addition, an honors candidate must maintain an overall minimum GPA of 3.0.

Degree Offered

- B.S. in Geology

Contact

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Program Website: Geology (<https://www.rider.edu/academics/colleges-schools/college-liberal-arts-sciences/undergraduate/geosciences/>)

Associated Department: Department of Geological, Environmental, and Marine Sciences (GEMS) (<http://www.rider.edu/academics/colleges-schools/college-liberal-arts-education-sciences/science-programs/geological-environmental-marine-sciences/>)

Related Programs:

- Earth and Environmental Sciences (<http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/majors-minors-certificates/earth-environmental-sciences/>)

- Earth Sciences (<http://catalog.rider.edu/undergraduate/colleges-schools/education/majors-minors-certificates/secondary-education-ba/>) (for Secondary Education majors)
- Environmental Sciences (<http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/majors-minors-certificates/environmental-sciences/>)
- Environmental Studies (<http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/majors-minors-certificates/environmental-studies/>)
- Integrated Math and Sciences (<http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/majors-minors-certificates/integrated-sciences-math/>)
- Marine Sciences (<http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/majors-minors-certificates/marine-sciences/>)

Geology Major Requirements

(68-71 credits)

Geology Major Requirements

(68-71 credits)

| Code | Title | Credits |
|--|---|---------|
| CLAS General Education Curriculum | | |
| See CLAS General Education Curriculum Page (http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/general_education_requirements/) | | |
| Geological, Environmental, and Marine Sciences | | |
| ENV 200 | Statistical and Computer Applications in the Natural Sciences | 4 |
| ENV 205 | Introduction to Geographic Information Systems | 3 |
| GEO 100 | Earth Systems Science | 3 |
| GEO 102 | Earth Materials and Processes Lab | 1 |
| GEO 304 | Elements of Mineralogy | 4 |
| GEO 305 | Petrology and Petrography | 4 |
| GEO 306 | Sedimentology and Stratigraphy | 4 |
| GEO 310 | Structural Geology | 4 |
| GEO 350 | Soil and Surficial Processes | 4 |
| GEO 407 | Hydrology and Water Resources | 4 |
| MAR 120 | Oceanography | 3 |
| MAR 121 | Introductory Oceanography Lab | 1 |
| MAR 210 & 210L | Marine Life through Time and Marine Life through Time Lab | 4 |
| Attendance at an approved geology field camp | | 3-6 |
| Chemistry | | |
| CHE 120 | Principles of Chemistry | 3 |
| CHE 121 | Principles of Chemistry Lab | 1 |
| CHE 122 | Intro to Chemical Systems | 3 |
| CHE 123 | Quantitative Methods Lab | 1 |
| Physics | | |
| PHY 100 | Principles of Physics I | 3 |
| PHY 100L | Principles of Physics I Lab | 1 |
| Mathematics | | |
| Select one of the following: | | |
| MTH 105 | Algebra and Trigonometry | 4 |

| | | |
|------------------------------|--|-------|
| or MTH 210 | Calculus I | |
| Electives | | |
| Select two of the following: | | 6 |
| ENV 220 | Weather and Climate Change | |
| ENV 375 | Environmental Biogeochemistry | |
| GEO 168 | Mesozoic Ruling Reptiles | |
| MAR 340 | Marine Processes and Environments: Seminar | |
| Total Credits | | 68-71 |

Notes:

1. Majors will also take either MTH 105 or MTH 210 to fulfill their math core requirement.
2. A minor in chemistry, physics, or marine sciences is strongly recommended.

Academic Plan of Study

The following educational plan is provided as a sample only. Rider students who do not declare a major during their freshman year; who change their major; or those who transfer to Rider may follow a different plan to ensure a timely graduation. Each student, with guidance from his or her academic advisor, will develop a personalized educational plan.

| Course | Title | Credits |
|---------------------------|---|---------|
| Year 1 | | |
| Fall Semester | | |
| CMP 120 | Seminar in Writing and Rhetoric | 3 |
| MAR 120 | Oceanography | 3 |
| MAR 121 | Introductory Oceanography Lab | 1 |
| MTH 105 | Algebra and Trigonometry ¹ | 4 |
| HIS 150 | World History to 1500 | 3 |
| Semester Credit Hours | | 14 |
| Spring Semester | | |
| CMP 125 | Seminar in Writing and Research | 3 |
| GEO 100 | Earth Systems Science | 3 |
| GEO 102 | Earth Materials and Processes Lab | 1 |
| HIS 151 | World History Since 1500 | 3 |
| Social Perspective Course | | 3 |
| Foreign Language | | 3 |
| Semester Credit Hours | | 16 |
| Year 2 | | |
| Fall Semester | | |
| CHE 120 | Principles of Chemistry | 3 |
| CHE 121 | Principles of Chemistry Lab | 1 |
| ENV 200 & 200L | Statistical and Computer Applications in the Natural Sciences and Statistical and Computer Applications in the Natural Sciences Lab | 4 |
| MAR 210 & 210L | Marine Life through Time and Marine Life through Time Lab | 4 |
| Foreign Language | | 3 |
| Semester Credit Hours | | 15 |
| Spring Semester | | |
| CHE 122 | Intro to Chemical Systems | 3 |
| CHE 123 | Quantitative Methods Lab | 1 |

| | | |
|---|-------------------------------|----|
| Select one of the following: | | 3 |
| ENV 220 | Weather and Climate Change | |
| ENV 375 | Environmental Biogeochemistry | |
| GEO 168 | Mesozoic Ruling Reptiles | |
| Philosophical Perspectives Course | | 3 |
| Aesthetic Perspectives: Literature Course | | 3 |
| Aesthetic Perspectives: Fine Arts Course | | 3 |
| Semester Credit Hours | | 16 |

Year 3**Fall Semester**

| | | |
|----------|--|---|
| PHY 100 | Principles of Physics I | 3 |
| PHY 100L | Principles of Physics I Lab | 1 |
| ENV 205 | Introduction to Geographic Information Systems | 3 |

Select one of the following: 3

| | | |
|----------------------------------|--|----|
| MAR 340 | Marine Processes and Environments: Seminar | |
| GEO 168 | Mesozoic Ruling Reptiles | |
| Social Perspectives Course | | 3 |
| One Elective Course ² | | 3 |
| Semester Credit Hours | | 16 |

Spring Semester**Select one of the following:** 4

| | | |
|-----------------------|---|----|
| GEO 350 & 350L | Soil and Surficial Processes and Soil and Surficial Processes Lab | |
| GEO 310 & 310L | Structural Geology and Structural Geology Lab | |
| GEO 407 & 407L | Hydrology and Water Resources and Hydrology and Water Resources Lab | |
| HIS 151 | World History Since 1500 | 3 |
| One Elective Course | | 3 |
| Semester Credit Hours | | 10 |

Summer Semester

| | | |
|--|--|-----|
| Attendance at an approved Geology Field Camp | | 3-6 |
| Semester Credit Hours | | 3-6 |

Year 4**Fall Semester**

| | | |
|-----------------------------------|---|----|
| GEO 306 & 306L | Sedimentology and Stratigraphy and Sedimentology and Stratigraphy Lab | 4 |
| GEO 304 & 304L | Elements of Mineralogy and Mineralogy Lab | 4 |
| Two Elective Courses ² | | 6 |
| Semester Credit Hours | | 14 |

Spring Semester**Select one of the following:** 4

| | | |
|-----------------------------------|---|----|
| GEO 350 & 350L | Soil and Surficial Processes and Soil and Surficial Processes Lab | |
| GEO 407 & 407L | Hydrology and Water Resources and Hydrology and Water Resources Lab | |
| GEO 305 & 305L | Petrology and Petrography and Petrology and Petrography Lab | |
| Two Elective Courses ² | | 6 |
| Semester Credit Hours | | 10 |

| | |
|-----------------------------------|---------|
| Total Credit Hours for Graduation | 114-117 |
|-----------------------------------|---------|

Courses and Descriptions

CHE 120 Principles of Chemistry 3 Credits

For students who have successfully completed one year of high school chemistry. This systematic study of the fundamental principles and concepts of chemistry covers atomic structure, bonding, stoichiometric relationships, including solution and oxidation-reduction reactions, and molecular structure. Three hours of lecture per week. Prerequisite(s): High school chemistry or CHE 100 is recommended before taking this course.

Corequisite(s): CHE 121.

CHE 121 Principles of Chemistry Lab 1 Credits

For students concurrently taking CHE 120. Experiments involve gravimetric, volumetric, and spectrophotometric quantitative analysis. One three-hour lab per week. Fall.

CHE 122 Intro to Chemical Systems 3 Credits

A continuation of CHE 120. For students majoring in the sciences but may be taken by others. Chemical systems in which the study of kinetics, thermodynamics, equilibrium, and radiochemistry are emphasized. Three hours of lecture per week. Prerequisite(s): CHE 120, MTH 105 or higher.

Corequisite(s): CHE 123.

CHE 123 Quantitative Methods Lab 1 Credits

Usually taken concurrently with CHE 122. Primarily for students majoring in the sciences. A number of quantitative classical and instrumental methods of analysis are used to determine thermodynamic properties and reaction mechanisms. One three-hour lab per week. Prerequisite(s): CHE 121.

Corequisite(s): CHE 122.

ENV 200 Statistical and Computer Applications in the Natural Sciences 4 Credits

This course introduces important statistical concepts, their application, and the usage of computer technology relevant to biological, environmental, geological, and marine problems. Students will learn various graphical and statistical techniques and how to execute them on personal computers. The curriculum emphasizes the integrated nature of these techniques and their importance to meaningful data evaluation and representation. Laboratory exercises are designed to emphasize useful solutions to problems found in many scientific disciplines using computer-based methodologies. Three hours of lecture and one three-hour lab per week.

Corequisite(s): ENV 200L.

ENV 200L Statistical and Computer Applications in the Natural Sciences Lab 0 Credits

This lab is a co-requisite and must be taken with the corresponding course.

Corequisite(s): ENV 200.

ENV 205 Introduction to Geographic Information Systems 3 Credits

This course introduces the computer-based concepts and skills of Geographic Information Systems (GIS). It covers the basic GIS concepts, such as map characteristics and projections, spatial data models and analysis, and relational databases. It explores data sources, data quality, and metadata, as well as implementation and management of specific GIS projects. Hands-on experience with ArcGIS software is provided through a series of student exercises completed throughout the semester. Students will also be taught how to process both vector and raster data using ArcGIS software. The course is relevant for students from numerous disciplines in the natural sciences, social sciences, and business, which require the analysis and graphical representation of spatial data. Three hours of lecture per week. Note: This course is cross-listed as GLS 205. Students may not receive credit for both ENV 205 and GLS 205.

ENV 220 Weather and Climate Change 3 Credits

This course introduces students to the concepts of weather and climate change. These concepts frame a continuum from short-term or daily changes in the atmosphere (meteorology) to those changes averaged over much longer periods of time (climatology). Students will learn the fundamentals of weather forecasting, the causes of natural variation in the Earth's climate, and the impact of human actions on the Earth's climate. Connections will be drawn to other current issues in the Earth system, including land use change, biodiversity, and pollution. Three hours of lecture per week.

Prerequisite(s): GEO 100 or permission of instructor.

ENV 375 Environmental Biogeochemistry 3 Credits

This course examines the biogeochemical interactions among various environmental components, including water, rock, soil, organisms, and atmosphere. Covered topics focus on the relation between the biosphere and changes in the Earth's environment and atmosphere. The transfer of energy and nutrients within terrestrial ecosystems also is explored. Case studies from various examples will be used to understand ecosystem dynamics. Long-term environmental change and present-day ecosystem restoration activities are examined in the context of biotic offsets and land-use planning. The biogeochemical cycles of some environmentally sensitive compounds and elements in natural systems, such as pesticides, mercury, and lead, also may be examined. Three hours of lecture per week.

Prerequisite(s): GEO 100 or GEO 113, CHE 120, CHE 121, CHE 122, CHE 123.

GEO 100 Earth Systems Science 3 Credits

Investigates the major global processes that occur on Earth. These processes can be grouped into four major systems: atmosphere, hydrosphere, lithosphere, and cosmosphere. Each system interacts with and affects the other systems creating, in a sense, a single Earth process. With this approach, the student will view the Earth as a whole, and understand that the many seemingly separate components that make up this planet are, in fact, a set of interacting processes, that operate in cycles through time, within a single global system. Three hours of lecture per week. This course counts towards the fulfillment of the Disciplinary Perspectives element of the CLAS general education curriculum.

GEO 102 Earth Materials and Processes Lab 1 Credits

This lab course introduces students to the origin, identification, and significance of geologic materials, processes, and landforms. Hands-on experiences with mineral and rock specimens, topographic and geologic maps, and GPS and other data collection techniques are emphasized, along with field trip and in-lab observations, measurements, and interpretations. One three-hour lab per week.

Prerequisite(s): concurrent enrollment in, or prior completion of, GEO 100 or GEO 113 is required.

GEO 168 Mesozoic Ruling Reptiles 3 Credits

This course provides an introduction to the vertebrate groups that dominated the land (Dinosaurs), the seas (Mosasaurs, Plesiosaurs, Pliosaurus, Tylosaurus, and Ichthyosaurs) and the skies (Pterosaurs, Pterodactyls) during the Mesozoic Era (65-250 million years ago). Students study the diversity of skeletal architectures and their reconstructed function and the often controversial, inferred anatomy, physiology, reproductive strategy, habit, and social behaviors of these animals that are different from mainstream reptiles, birds, and mammals. They also learn about the paleogeographical, and paleoclimatological conditions that facilitated the evolutionary rise to dominance and diversification of these vertebrate groups and the debated causes of their eventual extinction. These topics also serve to illustrate how the scientific approach works and how competing hypotheses are evaluated. Three hours of lecture per week. Weekend field trips may be required. This course counts towards the fulfillment of the Disciplinary Perspectives element of the CLAS general education curriculum.

GEO 304 Elements of Mineralogy 4 Credits

This course examines the physical properties, chemistry, atomic structure, crystallography, uses, and environmental impacts of important minerals found in the Earth's lithosphere and biosphere. In addition, lab assignments and exercises emphasize crystal symmetry and chemistry; polarizing microscope, ICP, SEM, and x-ray analytical techniques; the graphical display and interpretation of compositional data; optical properties of isotropic and uniaxial minerals; and the identification of mineral hand specimens. Three hours of lecture and one three-hour lab per week. At least one weekend field trip required. Prerequisite(s): GEO 100 or GEO 113, and GEO 102, and CHE 120, CHE 121 taken prior or concurrently; or permission of instructor.

Corequisite(s): GEO 304L.

GEO 304L Mineralogy Lab 0 Credits

This lab is a co-requisite and must be taken with the corresponding course.

Corequisite(s): GEO 304.

GEO 305 Petrology and Petrography 4 Credits

The origin, evolution, and terrestrial distribution of igneous and metamorphic rocks are presented and detailed. Classroom lectures and discussions emphasize rock geochemistry, mineralogic variability, the constraints placed on petrogenetic models by physio-chemical studies of natural and synthetic systems, and the relation of the various rock types to current plate tectonic theory and other whole-earth processes. The laboratory emphasizes the continuing development of optical microscopy skills, the identification of rock texture and mineralogy in thin section and hand specimen, the optical determination of mineral composition, and the recognition of possible petrogenetic processes as recorded in the rocks themselves. Three hours of lecture and one three-hour lab per week. Two weekend field trips required. Prerequisite(s): GEO 304, and CHE 122 and CHE 123 or taken prior or concurrently; or permission of instructor.

Corequisite(s): GEO 305L.

GEO 305L Petrology and Petrography Lab 0 Credits

This lab is a co-requisite and must be taken with the corresponding course.

Corequisite(s): GEO 305.

GEO 306 Sedimentology and Stratigraphy 4 Credits

The principles of weathering, erosion, transportation, and deposition of sediment are the focus of this course. Sediment characteristics are examined to identify the processes involved in transporting grains and the specific environment in which the grains were deposited. Students will learn how to collect, analyze, and interpret sedimentary data and how to interpret surface and subsurface stratigraphic data using various techniques, such as lithostratigraphic, biostratigraphic, and geophysical, correlations. Field trips will expose students to different sedimentary environments and provide opportunities for students to learn how to conduct fieldwork. Three hours of lecture and one three-hour lab per week. Weekend field trips may be required. Prerequisite(s): GEO 100.

Corequisite(s): GEO 306L.

GEO 306L Sedimentology and Stratigraphy Lab 0 Credits

This lab is a co-requisite and must be taken with the corresponding course.

Corequisite(s): GEO 306.

GEO 310 Structural Geology 4 Credits

The origin, distinguishing characteristics, and geographic distribution of deformational structures of the Earth's crust. In the laboratory, GPS, GIS, geologic maps, and three-dimensional problems are used in the study of typical surface and subsurface geologic problems. Three hours of lecture and one three-hour lab per week. Weekday and/or weekend field trips may be required. Prerequisite(s): GEO 100 or GEO 113, GEO 102.

Corequisite(s): GEO 310L.

GEO 310L Structural Geology Lab 0 Credits

This lab is a co-requisite and must be taken with the corresponding course.

Corequisite(s): GEO 310.

GEO 350 Soil and Surficial Processes 4 Credits

This course examines the physical, chemical, hydrological, and biological aspects of soil and their relation to geomorphologic development. Specific topics include descriptions of soil texture and structures, soil classification, soil colloids, soil redox and pH, and their effect on vadose zone water chemistry. Soil genesis and erosion controls, microbiology/ecology, nutrient cycles, and modern soil pollution from sludge and pesticide applications, as well as domestic and industrial chemical spills, also are discussed. The lab portion of the course introduces the basic techniques of soil analysis, both physical and chemical, and field survey methods. Three hours of lecture and one three-hour lab per week. Prerequisite(s): GEO 100 or GEO 113, and GEO 102.

Corequisite(s): GEO 350L.

GEO 350L Soil and Surficial Processes Lab 0 Credits

This lab is a co-requisite and must be taken with the corresponding course.

Corequisite(s): GEO 350.

GEO 407 Hydrology and Water Resources 4 Credits

This course introduces the principles that govern both surface water and groundwater flows that have applications to societal water needs. Surface water topics cover the basics of the hydrologic cycle, the processes of precipitation, evapotranspiration, runoff, and infiltration, and various factors affecting water supply and water quality issues in a modern watershed. Groundwater topics examine the principles that govern flow through a porous medium and the basics of well hydraulics under different pumping conditions that community development requires. Laboratory exercises will give students hands-on experience with the delineation of watersheds, analysis of precipitation data, and flow contaminant transport modeling. The field portion of the laboratory includes runoff and stream discharge measurements, as well as hydraulic conductivity estimations from both slug and pumping tests. Three hours of lecture and one three-hour lab per week. Prerequisite(s): GEO 100 or GEO 113, GEO 102, and MTH 105.

Corequisite(s): GEO 407L.

GEO 407L Hydrology and Water Resources Lab 0 Credits

This lab is a co-requisite and must be taken with the corresponding course.

Corequisite(s): GEO 407.

MAR 120 Oceanography 3 Credits

In this course, students will investigate the geological, chemical, physical, and biological processes that shape the ocean. Emphasis will be placed on how these processes interact with each other and with human populations. These interactions influence important global phenomena that impact all our lives, including weather and climate, the distribution of marine organisms and other natural resources, and coastal processes. Understanding these phenomena will enable students to make more informed decisions and contribute to serious global marine issues. Students will learn through a combination of hands-on exercises designed to foster a deeper understanding of the scientific content as well as the scientific process, practical experiences with real data, readings, and some lectures. CLAS general education areas addressed: DP & GP.

MAR 121 Introductory Oceanography Lab 1 Credits

This lab course introduces students to the fundamental aspects of geological, chemical, physical and biological oceanography. Students learn through inquiry-based, hands-on exercises and activities using actual data collected in the lab and in the field. Independent projects and local field trips during lab and on weekends may be required. One three-hour lab per week. This course counts towards the fulfillment of the Disciplinary Perspectives element of the CLAS general education curriculum.

Corequisite(s): MAR 120 or GLS 120 or as prerequisite(s).

MAR 210 Marine Life through Time 4 Credits

Survey of the important developments in marine life over the last three billion years from the Pre-Cambrian evolution of one-celled organisms, through the Cambrian explosion of complex marine invertebrate life and subsequent diversification of backboned organisms in the Ordovician time, to the colonization of marginal marine and freshwater habitats in the Silurian-Devonian geological periods, and ultimately to extinctions during global crises of the late Devonian, Permian, Triassic, Cretaceous, and Pleistocene time intervals. The emphasis is on evolutionary adaptive breakthroughs within each phylum, particularly the significant morphological and anatomical innovations, and the subsequent radiation of these higher taxa into new habitats and niches through geologic time. Three hours of lecture and one three-hour lab per week.

Prerequisite(s): GEO 100 & GEO 102; or GEO 113 & GEO 102 (can be signed in to take 102 with 113); or BIO 115; or BIO 116; or permission of instructor.

MAR 210L Marine Life through Time Lab 0 Credits

This lab is a co-requisite and must be taken with the corresponding course. Corequisite(s): MAR 210.

Prerequisite(s): GEO 100 & GEO 102; or GEO 113 & GEO 102 (can be signed in to take 102 with 113); or BIO 115; or BIO 116; or permission of instructor.

MAR 340 Marine Processes and Environments: Seminar 3 Credits

This course is designed as a seminar course. Therefore, students will learn to lead class discussions, to analyze and critique peer-reviewed journal articles, and to enhance their presentation skills. Students will interpret graphical, spatial, and numerical data to support their positions. Content will emphasize the interactions among marine processes, biological features, and geologic landforms.

Prerequisite(s): MAR 120 or GEO 100; GEO 306.

PHY 100 Principles of Physics I 3 Credits

Introductory noncalculus physics with applications for pre-professional, biology, and geological, environmental and marine sciences majors. Classical mechanics, energy, mechanical waves, fluid statics and dynamics, thermodynamics. Elements of modern physics are interwoven with those of classical physics from the beginning. Not open to chemistry, physics, or mathematics majors. Three hours of lecture per week. Prerequisite(s): MTH 105, MTH 210, MTH 211 or MTH 212.

Corequisite(s): PHY 100L.

PHY 100L Principles of Physics I Lab 1 Credits

For students concurrently taking PHY 100. One three-hour lab per week.

Corequisite(s): PHY 100.