GEOLOGY - BACHELOR OF ARTS (BA)

The options available in the undergraduate program in geological sciences are geology and geophysics and lead to the BA degree. Both options provide a strong basis for understanding the functioning of the Earth system. Students who are uncertain as to which option best suits their needs should contact a departmental advisor or faculty member. In each option, the undergraduate program emphasizes coursework in theoretical, laboratory and field-oriented aspects of the geological sciences. The nearby Rocky Mountains provide a natural laboratory for many of these courses.

Students interested in the geological sciences may also wish to consider the Baker Residential Academic Program. Students who do not wish to pursue a career in the geosciences, or who would like to combine a basic knowledge of geologic sciences with that of some other field, should consider using geological sciences as one subject in a distributed studies major or as a minor. Students who intend to pursue graduate study in the geological sciences are encouraged to consider developing an honors thesis as part of their undergraduate studies.

The two options available in the undergraduate major offer different focus areas of instruction. Both options offer excellent preparation for students interested in pursuing professional careers, or graduate study, in the geological sciences.

Each option emphasizes knowledge in:

- The ways in which Earth responds to internal and external forces; the physical, chemical and biological evolution of Earth; and the nature of the materials of which the Earth is made.
- The role of physics, chemistry, mathematics and biology in understanding geological processes.
- The history of discoveries and ideas that have contributed to our current knowledge of Earth and the planetary system.

Program Tracks

Geology Track

The geology option emphasizes processes that function both in the solid earth and at Earth's surface:

- The mineralogy and petrology of igneous, metamorphic and sedimentary rocks.
- The processes of sedimentation and the applications of stratigraphy and paleobiology in the reconstruction of Earth history.
- The role of geophysics and geochemistry in understanding the nature of Earth and its history.
- The study of faults, folds and other rock structures and the tectonic processes that create those structures.
- The methods used in the field to map and interpret the diverse variety of rock types and structures.
- The function of the integrated Earth system including the atmosphere, hydrosphere, biosphere and geosphere.
- The fundamental controls on surface Earth processes including energy balance, hydrology, geomorphology, geochemistry and biogeochemistry.
- The role of humans in the Earth system.

Geophysics Track

The geophysics option emphasizes:

- Applications of fundamental mathematical formulations and physical principles to an understanding of the Earth.
- Methods utilized to map and characterize those portions of the planet that lie below the surface, from just beneath our feet down to the core.

Requirements

Required Courses and Credits

Students must complete the general requirements of the College of Arts and Sciences and the required courses listed below.

All required major courses and all required ancillary courses must be passed with a C- or better and cannot be taken pass/fail. Students must have a grade point average of at least 2.000 in the major in order to graduate.

Students in either the geology option or the geophysics option must take the following coursework in GEOL. For more information, view the Program Tracks (p. 2) section.

Code	Title	Credit Hours
Required Courses		
One of the following introductory GEOL courses		3
GEOL 1010	Exploring Earth	3
or GEOL 1012	Exploring Earth for Scientists	
or GEOL 1020	Dodos, Dinos, and Deinococcus: The History of a Habitable Planet	
or GEOL 1040	Geology of Colorado	
or GEOL 1060	Global Change: An Earth Science Perspective	
or GEOL 1150	Water, Energy and Environment: An Introduction to Earth Resources	
or GEOL 1170	Our Deadly Planet	
or GEOL 1180	Our Microbial Planet	
GEOL 1030	Introduction to Geology Laboratory 1	1
GEOL 2001	Planet Earth	4
GEOL 2005	Introduction to Earth Materials	4
GEOL 2700	Introduction to Field Geology	2
Total Credit Hours		**17**

Ancillary Coursework

Students in either the geology option or the geophysics option must take the following coursework from outside GEOL.

Code	Title	Credit Hours
Select one of the following Calculus 1 & 2 sequences:		8-10
MATH 1300 & MATH 2300	Calculus 1 and Calculus 2	
APPM 1350 & APPM 1360	Calculus 1 for Engineers and Calculus 2 for Engineers	
Complete a calculus-based general physics sequence with lab:		9
PHYS 1110	General Physics 1	
PHYS 1120	General Physics 2	

PHYS 1140	Experimental Physics 1	
Total Credit Hours		**17-19**

Additional information on required courses and other departmental requirements may be obtained from the departmental office. Students should contact the department for a list of current major requirements.

Transfer students must satisfactorily complete a minimum of 12 credit hours of advanced work (3000-level or above) in the Department of Geological Sciences in Boulder if they wish to obtain a degree in geology from CU Boulder. Before registering for the first time, or within the first week of the semester, such students must see a geological sciences department undergraduate advisor to have previous coursework in geology, math and allied sciences evaluated.

Graduating in Four Years

Consult the Four-Year Guarantee Requirements for information on eligibility. The concept of "adequate progress" as it is used here refers only to maintaining eligibility for the four-year guarantee; it is not a requirement for the major. To maintain adequate progress in geology, students should meet all college requirements plus specific departmental requirements. These departmental requirements vary slightly between the two major options. Detailed information is available from the department office, but in general these requirements include:

- Declare a geology major and begin coursework in the major during the first semester freshman year.
- Meet with a departmental advisor prior to the second and fifth semesters and during the seventh semester.
- Complete at least 33 credit hours (geology option; 44 credit hours for geophysics option) required for the major by the end of the fourth semester.
- Complete at least 47 credit hours (geology option; 63 credit hours for geophysics option) required for the major by the end of the sixth semester.
- Complete the remaining requirements for the major by the end of the eighth semester.

Program Tracks

Geology Option

Students electing the geology option are required to take the following additional courses:

Code	Title	Credit Hours
Tier 3 Courses		
Select one of the following Solid Earth courses: [3]		3-4
GEOL 3010	Introduction to Mineralogy	
GEOL 3020	Petrology	
GEOL 3120	Structural Geology	
GEOL 3320	Introduction to Geochemistry	
GEOL 3330	Principles of Geophysics	
GEOL 3430	Sedimentology and Stratigraphy	
Select one of the following Surface Processes courses: [3]		3-4
GEOL 3030	Introduction to Hydrogeology	
GEOL 3320	Introduction to Geochemistry	
GEOL 3410	Paleobiology	
GEOL 3430	Sedimentology and Stratigraphy	
GEOL 3820	The Fluid Earth	
GEOL 4060	Oceanography	
GEOL 4160	Introduction to Biogeochemistry	
GEOL 4241	Earth Surface Processes	
Select one of the following Quantitative Geoscience courses: [3]		3
GEOL 3010	Introduction to Mineralogy	
GEOL 3030	Introduction to Hydrogeology	
GEOL 3330	Principles of Geophysics	
GEOL 3820	The Fluid Earth	
GEOL 4241	Earth Surface Processes	
Select two of the following advanced-field modules:		4-5
GEOL 4150	Planetary Field Geology	
GEOL 4711	Igneous and Metamorphic Field Geology	
GEOL 4712	Structural Field Geology	
GEOL 4714	Field Geophysics	
GEOL 4715	Field Techniques in Hydrogeology	
GEOL 4716	Environmental Field Geochemistry	
GEOL 4717	Field Seminar in Geology and Tectonics	
GEOL 4719	Field Analysis and Tectonics of Crystalline Rocks	
GEOL 4721	Field Methods in Active Tectonics	
GEOL 4723	Field Studies in Sedimentology	
GEOL 4725	Field Based Special Topics in Geoscience	
GEOL 4755	Field Geobiology	
EVEN 4100	Environmental Sampling and Analysis	
Upper-division electives		
Sufficient additional upper-division coursework from following list to total 27 upper-division credits. (Of these 27, a minimum of 18 upper-division credits must be GEOL.) [1]		14
Any GEOL 3000- to 4000-level course (with exceptions, see footnote) [2]		
Or approved non-GEOL courses from following list:		
APPM 3050	Scientific Computing in Matlab	
ASTR 3710	Formation & Dynamics of Planetary Systems	
ASTR 3720	Planets and Their Atmospheres	
ASTR 3750	Planets, Moons, and Rings	
ASTR 4800	Space Science: Practice and Policy [1]	
ATOC 4720	Atmospheric Dynamics	
ATOC 4800	Policy Implications of Climate Controversies [1]	
CHEM 4511	Physical Chemistry 1	
CVEN 4404	Water Chemistry	
CVEN 4718	Mechanics and Dynamics of Glaciers	
EBIO 3080	Evolutionary Biology	
EBIO 3850	Animal Diversity: Invertebrates	
EBIO 4030	Limnology	
EBIO 4060	Landscape Ecology	
EBIO 4155	Ecosystem Ecology	
EBIO 4410	Biological Statistics	
EBIO 4500	Plant Biodiversity and Evolution	
ECON 3403	International Economics and Policy [1]	
ENVD 4023	Environmental Impact Assessment [1]	

ENVS 3434	Introduction to Applied Ecology	
EVEN 4100	Environmental Sampling and Analysis	
GEOG/ENVS 4201	Biometeorology	
GEOG 4251	River Processes and Forms: Fluvial Geomorphology	
GEOG 4261	Glaciers and Permafrost	
GEOG 4321	Snow Hydrology	
GEOG 4401	Soils Geography	
MCDB 4350	Microbial Diversity and the Biosphere	
MUSM 4914	Museum Practicum in Geology	
PSCI 3183	International Law	
Total Credit Hours		**27-30**

Code	Title	Credit Hours
Additional Ancillary Coursework for Geology Option:		
Complete a general chemistry sequence with labs:		
CHEM 1113	General Chemistry 1	4
CHEM 1114	Laboratory in General Chemistry 1	1
CHEM 1133	General Chemistry 2	4
CHEM 1134	Laboratory in General Chemistry 2	1
Total Credit Hours		**10**

1 A maximum of 3 of these credit hours may consist of a policy course from the following list: ASTR 4800, ATOC 4800, ECON 3403, ENVD 4023 and PSCI 3183.

2 GEOL 3005, GEOL 3040, GEOL 3070, GEOL 3520, GEOL 3720 and GEOL 3950, cannot be used to fulfill the upper-division elective requirements within the major.

3 Note that some courses are listed in multiple major specific categories. Students can choose which category to apply the course to but, a given course can be applied to only one category.

Geophysics Option

Students electing the geophysics option are required to take the following additional courses:

Code	Title	Credit Hours
Geophysics track courses		
GEOL 3120	Structural Geology	4
GEOL 3330	Principles of Geophysics	3
GEOL 4714	Field Geophysics	2
One Surface Processes course		*3-4*
GEOL 3030	Introduction to Hydrogeology	3-4
or GEOL 3320	Introduction to Geochemistry	
or GEOL 3410	Paleobiology	
or GEOL 3430	Sedimentology and Stratigraphy	
or GEOL 3820	The Fluid Earth	
or GEOL 4060	Oceanography	
or GEOL 4070	Paleoclimatology	
or GEOL 4160	Introduction to Biogeochemistry	
or GEOL 4241	Earth Surface Processes	
One additional Tier 3 approved GEOL course not used to satisfy Surface Processes course requirement.		*3-4*
Select two of the following non-GEOL Geophysics Advanced Elective courses: [1]		*6*
APPM 4350	Methods in Applied Mathematics: Fourier Series and Boundary Value Problems	
MATH 4470	Partial Differential Equations	
PHYS 3210	Classical Mechanics and Mathematical Methods 2	
PHYS 3310	Principles of Electricity and Magnetism 1	
Total Credit Hours		**24-27**

1 The non-GEOL courses in this category count toward the credits in the Geology major and are factored into the Geology major GPA.

Code	Title	Credit Hours
Additional Ancillary Coursework for the Geophysics Option:		
CHEM 1113	General Chemistry 1	4
CHEM 1114	Laboratory in General Chemistry 1	1
APPM 2350	Calculus 3 for Engineers	4-5
or MATH 2400	Calculus 3	
MATH 2130 & MATH 3430	Introduction to Linear Algebra for Non-Mathematics Majors and Ordinary Differential Equations	4-6
or APPM 2360	Introduction to Differential Equations with Linear Algebra	
PHYS 2130	Introduction to Quantum Mechanics and Its Applications	3
PHYS 2210	Classical Mechanics and Mathematical Methods 1	3
One computing course		3-4
APPM 1650	Python for Math and Data Science Applications	
APPM 3050	Scientific Computing in Matlab	
CSCI 1200	Introduction to Computational Thinking	
CSCI 1300	Computer Science 1: Starting Computing	
GEOL 3600	Introduction to Python Programming for Earth Scientists	
INFO 1701	Programming for Information Science 1	
Total Credit Hours		**22-26**

Recommended Four-Year Plans of Study

Geology Track

Through the required coursework for either track of the major, students will fulfill all 12 credits of the Natural Sciences area of the Gen Ed Distribution Requirement including the Lab Requirement, as well as the QRMS area of the Gen Ed Skills area.

Year One		
Fall Semester		**Credit Hours**
GEOL 1012	Exploring Earth for Scientists (Preferred, or any other GEOL 1000-level except GEOL 1030)	3
GEOL 1030	Introduction to Geology Laboratory 1	1
CHEM 1113 & CHEM 1114	General Chemistry 1 and Laboratory in General Chemistry 1	5

Gen. Ed. Skills course (example: Lower-Division Written Communication)		3
Gen. Ed. Distribution/Diversity course (example: Arts & Humanities/US Perspective)		3
	Credit Hours	**15**
Spring Semester		
GEOL 2005	Introduction to Earth Materials	4
CHEM 1133 & CHEM 1134	General Chemistry 2 and Laboratory in General Chemistry 2	5
MATH 1300 or APPM 1350	Calculus 1 or Calculus 1 for Engineers	4-5
Elective/MAPS		3
	Credit Hours	**16-17**
Year Two		
Fall Semester		
GEOL 2001	Planet Earth	4
GEOL 2700	Introduction to Field Geology	2
MATH 2300 or APPM 1360	Calculus 2 or Calculus 2 for Engineers	4-5
Gen. Ed. Distribution course (example: Arts & Humanities)		3
Gen. Ed. Distribution/Diversity course (example: Social Sciences/Global Perspective)		3
	Credit Hours	**16-17**
Spring Semester		
GEOL Surface Processes course		3-4
GEOL Solid Earth course		3-4
PHYS 1110	General Physics 1	4
Elective		3
Elective		3
	Credit Hours	**16-18**
Year Three		
Fall Semester		
PHYS 1120	General Physics 2	4
PHYS 1140	Experimental Physics 1	1
Elective approved for GEOL major - Upper-division		3-4
Gen. Ed. Distribution course (example: Social Sciences)		3
Upper-division Elective		3
	Credit Hours	**14-15**
Spring Semester		
GEOL Quantitative Geoscience course		3-4
GEOL 4000-level Field Geology course		2-3
Gen. Ed. Skills course (example: Upper-division Written Communication)		3
Gen. Ed. Distribution course (example: Arts & Humanities)		3
Upper-division Elective		3
	Credit Hours	**14-16**
Year Four		
Fall Semester		
GEOL 4000-level Field Geology course		2
Elective approved for GEOL major - Upper-division		3-4
Gen. Ed. Distribution course (example: Social Sciences)		3
Gen. Ed. Distribution course (example: Arts & Humanities) - Upper-division		3
Upper-division Elevtive		3
	Credit Hours	**14-15**
Spring Semester		
Elective approved for GEOL major - Upper-division		3-4
Elective approved for GEOL major - Upper-division		3-4
Elective approved for GEOL major - Upper-division		3-4
Gen. Ed. Distribution course (example: Social Sciences)		3
Upper-division Elective		3-0
	Credit Hours	**15**
	Total Credit Hours	**120-128**

Geophysics Track

Through the required coursework for either track of the major, students will fulfill all 12 credits of the Natural Sciences area of the Gen Ed Distribution Requirement including the Lab Requirement, as well as the QRMS area of the Gen Ed Skills area.

Year One		
Fall Semester		**Credit Hours**
GEOL 1012	Exploring Earth for Scientists (Preferred, or any other GEOL 1000-level except GEOL 1030)	3
GEOL 1030	Introduction to Geology Laboratory 1	1
MATH 1300 or APPM 1350	Calculus 1 or Calculus 1 for Engineers	4-5
Gen. Ed. Skills course (example: Lower-Division Written Communication)		3
Gen. Ed. Distribution/Diversity course (example: Arts & Humanities/US Perspective)		3
	Credit Hours	**14-15**
Spring Semester		
GEOL 2001	Planet Earth	4
MATH 2300 or APPM 1360	Calculus 2 or Calculus 2 for Engineers	5
CHEM 1113 & CHEM 1114	General Chemistry 1 and Laboratory in General Chemistry 1	5
Elective/MAPS		3
	Credit Hours	**17**
Year Two		
Fall Semester		
GEOL 2005	Introduction to Earth Materials	4
CSCI 1200 or CSCI 1300	Introduction to Computational Thinking or Computer Science 1: Starting Computing	3-4
PHYS 1110	General Physics 1	4
Gen. Ed. Distribution/Diversity course (example: Social Sciences/Global Perspective)		3
	Credit Hours	**14-15**
Spring Semester		
GEOL 2700	Introduction to Field Geology	2
GEOL 3330	Principles of Geophysics	3
APPM 2350 or MATH 2400	Calculus 3 for Engineers or Calculus 3	4-5
PHYS 1120	General Physics 2	4

PHYS 1140	Experimental Physics 1	1
	Credit Hours	**14-15**
Year Three		
Fall Semester		
GEOL 3120	Structural Geology	4
GEOL 4714	Field Geophysics	2
PHYS 2130	Introduction to Quantum Mechanics and Its Applications	3
APPM 2360	Introduction to Differential Equations with Linear Algebra	4
Gen. Ed. Distribution course (example: Social Sciences) - Upper-division		3
	Credit Hours	**16**
Spring Semester		
GEOL surface processes course		3-4
Tier 3 approved GEOL course		3-4
PHYS 2210	Classical Mechanics and Mathematical Methods 1	3
Gen. Ed. Skills course (example: Upper-division Written Communication)		3
Gen. Ed. Distribution course (example: Arts & Humanities) - Upper-division		3
	Credit Hours	**15-17**
Year Four		
Fall Semester		
Geophysics Advanced Elective		3
Geophysics Advanced Elective		3
Gen. Ed. Distribution course (example: Social Sciences)		3
Gen. Ed. Distribution course (example: Arts & Humanities)		3
Gen. Ed. Distribution course - Upper-division		3
	Credit Hours	**15**
Spring Semester		
Geophysics Advanced Elective		3
Gen. Ed. Distribution course (example: Social Sciences)		3
Upper-division Elective		3
Upper-division Elective		3
Elective or Upper-division Elective (if needed)		3
	Credit Hours	**15**
	Total Credit Hours	**120-125**

Learning Outcomes

By the completion of the program, students will be able to:

- Make and record observations (e.g., in the field, from experiments, etc.).
- Analyze data.
- Interpret data.
- Reason through problems to derive solutions.
- Design a research study.