

EARTH SCIENCE - BACHELOR OF SCIENCE (BS)

The undergraduate program in earth science includes two options leading to the BS degree, geosciences and geophysics. 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 earth science. The nearby Rocky Mountains provide a natural laboratory for many of these courses.

Students interested in earth science may also wish to consider the Baker Residential Academic Program. Students who do not wish to pursue a career in earth science, or who would like to combine a basic knowledge of earth science with that of some other field, should consider using earth science as one subject in a distributed studies major or as a minor. Students who intend to pursue graduate study in earth science 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 earth science.

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.

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 must specialize in either the geosciences emphasis or the geophysics emphasis. For more information, view the program tracks section.

Required Courses (Both Emphases)

Code	Title	Credit Hours
Tier 1 Trunk Courses		
<i>One of the following introductory EARTH courses</i>		3
ERTH 1010	Exploring Earth	
ERTH 1012	Exploring Earth for Scientists	
ERTH 1020	Dodos, Dinosaurs, and Deinococcus: The History of a Habitable Planet	

ERTH 1040	Geology of Colorado	
ERTH 1060	Global Change: An Earth Science Perspective	
ERTH 1150	Water, Energy and Environment: An Introduction to Earth Resources	
ERTH 1160	Environmental Geoscience: Where Science Meets Society	
ERTH 1170	Our Deadly Planet	
ERTH 1180	Our Microbial Planet	
Introductory EARTH laboratory		1
ERTH 1030	Introduction to Earth Science Laboratory	1
Tier 2 Trunk courses		10
ERTH 2001	Planet Earth	
ERTH 2005	Introduction to Earth Materials	
ERTH 2700	Introduction to Field Geology	

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 earth sciences 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 earth sciences, 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 an earth sciences 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 (geosciences emphasis; 44 credit hours for geophysics emphasis) required for the major by the end of the fourth semester.
- Complete at least 47 credit hours (geosciences emphasis; 63 credit hours for geophysics emphasis) 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

Geosciences Emphasis

Students electing the geosciences emphasis 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
ERTH 3010	Introduction to Mineralogy	
ERTH 3020	Petrology	
ERTH 3120	Structural Geology	
ERTH 3320	Introduction to Geochemistry	
ERTH 3330	Principles of Geophysics	
ERTH 3430	Sedimentology and Stratigraphy	
Select one of the following Surface Processes courses: ³		3-4
ERTH 3030	Introduction to Hydrogeology	
ERTH 3320	Introduction to Geochemistry	
ERTH 3410	Paleobiology	
ERTH 3430	Sedimentology and Stratigraphy	
ERTH 3820	The Fluid Earth	
ERTH 4241	Earth Surface Processes	
Select one of the following Quantitative Geoscience courses: ³		3
ERTH 3010	Introduction to Mineralogy	
ERTH 3030	Introduction to Hydrogeology	
ERTH 3330	Principles of Geophysics	
ERTH 3820	The Fluid Earth	
ERTH 4241	Earth Surface Processes	
Select two of the following advanced-field modules:		4-5
ERTH 4714	Field Geophysics	
ERTH 4715	Field Techniques in Hydrogeology	
ERTH 4716	Environmental Field Geochemistry	
ERTH 4717	Field Seminar in Geology and Tectonics	
ERTH 4719	Field Analysis and Tectonics of Crystalline Rocks	
ERTH 4721	Field Methods in Active Tectonics	
ERTH 4723	Field Studies in Sedimentology	
ERTH 4725	Field Based Special Topics in Earth Science	
EVEN 4100	Environmental Sampling and Analysis	
<i>Upper-division electives</i>		
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 EARTH.) ¹		14
Any EARTH 3000- to 4000-level course (with exceptions, see footnote) ²		
Or approved non-ERTH 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
Ancillary Mathematics and Natural Sciences Coursework for Geosciences Option:		
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:		
PHYS 1110	General Physics 1	4
PHYS 1120	General Physics 2	4
PHYS 1140	Experimental Physics 1	1
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		27-29

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 EARTH 3005, EARTH 3040, EARTH 3520, EARTH 3720 and EARTH 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 Emphasis

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

Code	Title	Credit Hours
Required Courses		
ERTH 3120	Structural Geology	4
ERTH 3330	Principles of Geophysics	3
ERTH 4714	Field Geophysics	2
Surface Processes ¹		3-4
Choose one:		
ERTH 3030	Introduction to Hydrogeology	
or ERTH 3320	Introduction to Geochemistry	
or ERTH 3410	Paleobiology	
or ERTH 3430	Sedimentology and Stratigraphy	
or ERTH 3820	The Fluid Earth	
or ERTH 4241	Earth Surface Processes	
One additional Tier 3 approved EARTH course not used to satisfy Surface Processes course requirement. ¹		3-4
Non-ERTH Geophysics courses ²		
Complete the two following physics courses		6
PHYS 2130	Introduction to Quantum Mechanics and Its Applications	
PHYS 2210	Classical Mechanics and Mathematical Methods 1	
Select two of the following non-ERTH Geophysics Advanced Elective courses:		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		27-29

¹ 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.

² The non-ERTH courses in this category count toward the credits in the Earth Science BS and are factored into the major GPA.

Code	Title	Credit Hours
Ancillary Mathematics, Natural Science and Computing Coursework for the Geophysics Emphasis		
Complete one of the following calculus 1, 2 and 3 sequences:		12-15
MATH 1300 & MATH 2300 & MATH 2400	Calculus 1 and Calculus 2 and Calculus 3	
APPM 1350 & APPM 1360 & APPM 2350	Calculus 1 for Engineers and Calculus 2 for Engineers and Calculus 3 for Engineers	
Complete linear algebra and differential equations:		4-6

MATH 2130 & MATH 3430	Introduction to Linear Algebra for Non-Mathematics Majors and Ordinary Differential Equations	
or APPM 2360	Introduction to Differential Equations with Linear Algebra	
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	
Complete general chemistry 1 with lab:		5
CHEM 1113	General Chemistry 1	
CHEM 1114	Laboratory in General Chemistry 1	
Complete one computing course:		3-4
APPM 1650	Python for Math and Data Science Applications	
APPM 3050	Scientific Computing in Matlab	
ASTR 2600	Introduction to Scientific Programming	
CSCI 1200	Introduction to Computational Thinking	
CSCI 1300	Computer Science 1: Starting Computing	
ERTH 3600	Introduction to Python Programming for Earth Scientists (Preferred)	
INFO 1701	Programming for Information Science 1	
PHYS 2600	Introduction to Programming and Scientific Computing	
Total Credit Hours		33-39

Plan(s) of Study

Geosciences Emphasis

Through the required coursework for either track of the BS, 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
ERTH 1012	Exploring Earth for Scientists	3
ERTH 1030	Introduction to Earth Science 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		
ERTH 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		3
	Credit Hours	16-17

Year Two**Fall Semester**

ERTH 2001	Planet Earth	4
ERTH 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

ERTH Surface Processes course		3-4
ERTH 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 EARTH major - Upper-division		3-4
Gen. Ed. Distribution course (example: Social Sciences)		3
Upper-division Elective		3
Credit Hours		14-15

Spring Semester

ERTH Quantitative Geoscience course		3-4
ERTH 4000-level advanced-field module		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**

ERTH 4000-level EARTH 4000-level advanced-field module		2
Elective approved for EARTH 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 Elective		3
Credit Hours		14-15

Spring Semester

Elective approved for EARTH major - Upper-division		3-4
Elective approved for EARTH major - Upper-division		3-4
Elective approved for EARTH 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 Emphasis

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**

ERTH 1012	Exploring Earth for Scientists	3
ERTH 1030	Introduction to Earth Science 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

ERTH 2005	Introduction to Earth Materials	4
MATH 1300 or APPM 1350	Calculus 1 or Calculus 1 for Engineers	4-5
PHYS 1110	General Physics 1	4
Gen. Ed. Distribution course (example: Social Sciences)		3
Credit Hours		15-16

Year Two**Fall Semester**

ERTH 2001	Planet Earth	4
MATH 2300 or APPM 1360	Calculus 2 or Calculus 2 for Engineers	4-5
PHYS 1120	General Physics 2	4
PHYS 1140	Experimental Physics 1	1
Gen. Ed. Distribution/Diversity course (example: Social Sciences/Global Perspective)		3
Credit Hours		16-17

Spring Semester

ERTH 2700	Introduction to Field Geology	2
PHYS 2130	Introduction to Quantum Mechanics and Its Applications	3
MATH 2400 or APPM 2350	Calculus 3 or Calculus 3 for Engineers	4-5
Gen. Ed. Distribution course (example: Social Sciences)		3
Gen. Ed. Distribution course (example: Arts & Humanities)		3
Credit Hours		15-16

Year Three**Fall Semester**

ERTH 3120	Structural Geology	4
APPM 2360 or MATH 2130	Introduction to Differential Equations with Linear Algebra or Introduction to Linear Algebra for Non-Mathematics Majors	3-4
Geophysics Programming Requirement (ERTH 3600 is preferred)		3-4

Gen. Ed. Distribution course (example: Social Sciences - Upper-division)	3
Gen. Ed. Distribution course (example: Arts & Humanities)	3

Credit Hours	16-18
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Spring Semester

ERTH surface processes course	3-4
ERTH 3330 Principles of Geophysics	3
PHYS 2210 Classical Mechanics and Mathematical Methods 1	3
Gen. Ed. Skills course (example: Upper-division Written Communication)	3
Upper Division Elective	3

Credit Hours	15-16
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Year Four**Fall Semester**

ERTH 4714 Field Geophysics	2
Non-ERTH Geophysics Advanced Elective PHYS 3210, PHYS 3310, MATH 470, or APPM 4350	3
Upper-division Elective	3
Upper-division Elective	3
Upper-division Elective	3

Credit Hours	14
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Spring Semester

ERTH Geophysics Advanced Elective	3-4
Non-ERTH Geophysics Advanced Elective PHYS 3210, PHYS 3310, MATH 470, or APPM 4350	3
Gen. Ed. Distribution course (example: Arts & Humanities - Upper-Division)	3
Upper-division Elective	3
Elective or Upper-division Elective (if needed)	3

Credit Hours	15-16
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Total Credit Hours	121-128
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In addition, staying at CU Boulder to pursue a bachelor's–accelerated master's program enables students to continue working with their established faculty mentors.

BS and MS in Earth Science**Admission Requirements**

In order to gain admission to the BAM program named above, a student must meet the following criteria:

- Have a cumulative GPA of 3.000 or higher.
- Have at least junior class standing.
- Have completed all ancillary (math, physics and chemistry) prerequisite courses with a passing grade at the time of admission.

Program Requirements

Students may take up to and including 12 graduate credit hours while in the undergraduate program which can later be used toward the master's degree. However, only six credit hours may be double counted toward the bachelor's degree and the master's degree. Students must maintain a 3.000 GPA while in the BAM program.

Students must apply to graduate with the bachelor's degree and apply to continue with the master's degree early in the semester in which the undergraduate requirements will be completed.

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

Bachelor's–Accelerated Master's Degree Program(s)

The bachelor's–accelerated master's (BAM) degree program options offer currently enrolled CU Boulder undergraduate students the opportunity to receive a bachelor's and master's degree in a shorter period of time. Students receive the bachelor's degree first but begin taking graduate coursework as undergraduates (typically in their senior year).

Because some courses are allowed to double count for both the bachelor's and the master's degrees, students receive a master's degree in less time and at a lower cost than if they were to enroll in a standalone master's degree program after completion of their baccalaureate degree.