Earth Science

The Wiess School of Natural Sciences

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Degrees Offered: B.A., B.S., M.A., Ph.D.

The undergraduate program in geology focuses on a strong core of courses in all areas of earth materials, processes, and history, as well as in allied sciences. Students also gain experience with analytical equipment, computer systems, and in fieldwork. The undergraduate geophysics major combines courses that apply physics to the study of the earth's interior with course work in geology and mathematics. The program emphasizes computational geophysics and reflection seismology. A second major can lay the foundation for a career in environmental geology, and students may also acquire certification in earth science as a teaching field.

Advanced graduate work is available in marine geology and paleoceanography, stratigraphy, carbonate and siliciclastic sedimentology, igneous petrology, geochemistry, structural geology, regional tectonics, global plate tectonics, reflection and crustal seismology, and computational geophysics and geodynamics. Ideally, programs of study and research incorporate more than one of these specialties.

Degree Requirements for B.S. in Geology

For general university requirements, see Graduation Requirements (pages 16–18). Students completing the B.S. program should have a total of at least 129 hours at graduation. Students must complete the following courses.

Earth Science
ESCI 101 *The Earth*
or ESCI 102 *Evolution of the Earth*
or ESCI 107 *Oceans and Global Change*
or ESCI 108 *Crises of the Earth*
ESCI 105 *Introductory Lab for Earth Science*
ESCI 311 *Mineralogy and Optics*
ESCI 312 *Petrology*
ESCI 331 *Structural Geology*
ESCI 332 *Sedimentology*
ESCI 334 *Geological and Geophysical Techniques*
ESCI 390 *Field Geology*
ESCI 442 *Exploration Geophysics*
or ESCI 446 *Solid Earth Geophysics*

Math and Other Sciences
MATH 101/102 *Single Variable Calculus I* and *II*
MATH 211 *Ordinary Differential Equations and Linear Algebra*
CHEM 121/122 *General Chemistry with Laboratory*
or CHEM 151/152 *Honors Chemistry with Laboratory*
PHYS 101 or 111 *Mechanics*
PHYS 102 or 112 *Electricity and Magnetism*
NSCI 230 *Computation in Natural Science*
or CAAM 210 *Introduction to Engineering Computation (C)*
or CAAM 211 *Introduction to Engineering Computation (F)*
or COMP 210 *Introduction to Principles of Scientific Computation*

Required Electives. Majors must also complete at least 12 hours in additional science and engineering courses at the 300 level or higher from an approved list; double majors must complete only 6 hours.

Environmental Geology. Students interested in careers in environmental geology are encouraged to take some of the following courses as electives.

ESCI 353 *Environmental Geochemistry*
ESCI 326/426 *Environmental Geology*
ESCI 451 *Analysis of Environmental Data*
ESCI 454 *Geographic Information Science*
ENVI 306 *Global Environmental Law and Sustainable Development*
ENVI 401 *Introduction to Environmental Chemistry*
ENVI 406 *Introduction to Environmental Law*
ENVI 412 *Hydrology and Watershed Analysis*

In addition, students may consider a second major in environmental science and engineering.

Degree Requirements for B.S. in Geophysics

For general university requirements, see Graduation Requirements (pages 16–18). Students completing the B.S. program should have a total of at least 129 hours at graduation. Students must complete the following courses.

Earth Science
ESCI 101 *The Earth*
or ESCI 102 *Evolution of the Earth*
or ESCI 107 *Oceans and Global Change*
or ESCI 108 *Crises of the Earth*
ESCI 105 *Introductory Lab for Earth Science*
ESCI 311 *Mineralogy and Optics*
or ESCI 332 *Sedimentology*
ESCI 331 *Structural Geology*
ESCI 334 *Geological and Geophysical Techniques*
ESCI 390 *Field Geology*
ESCI 461 *Seismology I*
ESCI 442 *Exploration Geophysics*
ESCI 444 *Reflection Seismic Data Processing Lab*
ESCI 446 *Solid Earth Geophysics*
ESCI 441 *Geophysical Data Analysis*
or ESCI 462 *Tectonophysics*
or ESCI 464 *Global Tectonics*

Math and Other Sciences
MATH 101/102 *Single Variable Calculus I* and *II*
MATH 211 *Ordinary Differential Equations and Linear Algebra*
MATH 212 *Multivariable Calculus*
CHEM 121/122 *General Chemistry with Laboratory*
or CHEM 151/152 *Honors Chemistry with Laboratory*
PHYS 101 or 111 *Mechanics*
PHYS 102 or 112 *Electricity and Magnetism*
PHYS 201 *Waves and Optics*
PHYS 231 *Elementary Physics Lab II*
NSCI 230 *Computation in Natural Science*
or CAAM 210 *Introduction to Engineering Computation (C)*
or CAAM 211 *Introduction to Engineering Computation (F)*
or COMP 210 *Introduction to Principles of Scientific Computation*

Degree Requirements for B.A. in Geology

For general university requirements, see Graduation Requirements (pages 16–18). Students completing the B.A. program should have a total of at least 120 hours at graduation. Students must complete the following courses.

Earth Science
ESCI 101 *The Earth*
or ESCI 102 *Evolution of the Earth*
or ESCI 107 *Oceans and Global Change*
or ESCI 108 *Crises of the Earth*
ESCI 105 *Introductory lab for Earth Science*
ESCI 311 *Mineralogy and Optics*
ESCI 312 *Petrology*
ESCI 331 *Structural Geology*
ESCI 332 *Sedimentology*
ESCI 334 *Geological and Geophysical Field Techniques*

Math and Other Sciences
MATH 101/102 *Single Variable Calculus I* and *II*
CHEM 121/122 or CHEM 151/152 *General Chemistry I* and *II*

6 credits from the following list
BIOL 201/202 *Introductory Biology I* and *II*
BIOL 211, 213 *Biology Lab Modules*
MATH 211 *Differential Equations*
PHYS 101/102, 125/126 *Introductory Physics*
NSCI 230, CAAM 210/211, COMP 210 *Programming*

Required Electives. Students must also complete at least 12 hours in additional courses in Science and Engineering (including ESCI) at the 200 level or higher, from an approved list.

Undergraduate Independent Research

The department encourages, but does not require, both geology and geophysics undergraduate majors to pursue independent supervised research in ESCI 481/482 Research in Earth Science. See also Honors Programs (page 33).

Degree Requirements for M.A. and Ph.D. in Earth Science

All incoming students should have a strong background in physics, chemistry, and mathematics and should have, or should acquire, a broad grounding in fundamental earth sciences. The department encourages applications from well-qualified students with degrees in the other sciences and mathematics. For general university requirements, see Graduate Degrees (pages 60–65). The requirements for the M.A. and Ph.D. in earth science are similar, but the Ph.D. demands a significantly higher level of knowledge, research skills, and scholarly independence. Most students need at least two years beyond the bachelor's degree to complete the M.A. and at least two years beyond the M.A. degree for the Ph.D.

Candidates determine, with their major professor and advisory committee, a course of study approved by the department Graduate Committee, following the *Guidelines for* Advanced Degrees in the Department of Earth Science distributed to all incoming students. For both degrees, candidates must:

- Complete 20 semester hours of course work at the 400 level and above (or other approved courses), not including research hours
- Maintain a grade point average of 3.00 (B) or better
- Prepare a written thesis
- Pass an oral exam based on the proposal
- Produce a publishable thesis that represents an original contribution to science
- Defend the research and conclusions of the thesis in an oral examination

Students of exceptional ability with a bachelor's degree and department approval may work directly toward the Ph.D., in which case the course of study is equivalent to that required for both degrees; performance on the examinations and the thesis, however, should be at the level required for the Ph.D.

Because the graduate programs require full-time study and close interaction with faculty and fellow students, the department discourages students from holding full (or nearly full) time jobs outside the university. Outside employment must be approved by the chair.

See ESCI (pages 347–352) in the Courses of Instruction section.