



Twin Cities Campus

Earth Sciences Ph.D.

Department of Earth Sciences

College of Science and Engineering

Link to a [list of faculty](#) for this program.

Contact Information:

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Website: <http://www.esci.umn.edu/programs/graduate>

- Program Type: Doctorate
- Requirements for this program are current for Spring 2020
- Length of program in credits: 48
- This program does not require summer semesters for timely completion.
- Degree: Doctor of Philosophy

Along with the program-specific requirements listed below, please read the [General Information](#) section of the catalog website for requirements that apply to all major fields.

The modern earth sciences are a remarkable synthesis of the physical and biological sciences. They are at the forefront of inquiry into and solutions of most of the major issues involving the global environment: climate, oceans, freshwater in all its forms, natural resources, and natural disasters. Like no other field, they integrate all the systems, from surface to great depth, from physics to chemistry to biology, and over all of geologic time and all geographic scales. The program includes the fields of structural geology, tectonics, petrology, hydrogeology, geomorphology, sedimentology, surface processes, geochemistry, biogeochemistry, biogeology, chemical oceanography, mineralogy, mineral and rock magnetism, rock and mineral physics, geodynamics, seismology, geostatistics, planetary geology, and geophysics and applied geophysics.

Students may accommodate other areas of interest such as engineering geology, environmental geology, materials science, soil science, and paleoecology by choosing a minor or supporting field from outside the program.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Prerequisites for Admission

The preferred undergraduate GPA for admittance to the program is 3.00.

Bachelor's degree in geology, geophysics, earth and material sciences, chemistry, physics, biology, or environmental science.

Other requirements to be completed before admission:

At least one year of study each in calculus, chemistry, and physics is required. In general, an outstanding academic record is expected.

Special Application Requirements:

Materials required for a complete application file include the student's statement of purpose, three letters of recommendation, transcripts, official GRE scores, and the Application for Admission. Applications are considered at any time; however, to be considered for financial aid, all materials must be submitted by December 15. Studies may begin in any semester or summer session, although fall semester is preferable. **IMPORTANT:** Refer to the Graduate Programs section of the department website (<http://www.esci.umn.edu/programs/gradprospective>) for a listing of all required application materials and preferred method of submission.

Applicants must submit their test score(s) from the following:

- GRE

International applicants must submit score(s) from one of the following tests:

- TOEFL
 - Internet Based - Total Score: 79
 - Internet Based - Writing Score: 21



- Internet Based - Reading Score: 19
- Paper Based - Total Score: 550
- IELTS
 - Total Score: 6.5
- MELAB
 - Final score: 80

Key to [test abbreviations](#)(GRE, TOEFL, IELTS, MELAB).

For an online application or for more information about graduate education admissions, see the [General Information](#) section of the catalog website.

Program Requirements

12 credits are required in the major.

12 credits are required outside the major.

24 thesis credits are required.

This program may be completed with a minor.

Use of 4xxx courses toward program requirements is permitted under certain conditions with adviser approval.

A minimum GPA of 3.0 is required for students to remain in good standing.

At the onset of studies, a coursework "compact" will be developed with the student, his/her advisor, and the graduate studies committee. The compact will be reviewed annually to assure timely progress and revise as needed.

Students must choose one of five tracks in the earth sciences program: geology, geophysics, biogeology, hydrogeology, or earth sciences. Tracks carry coursework requirements that are part of the student's course compact.

The PhD requires a minimum 12 credits of coursework in earth sciences, including the track requirements, a minimum of 12 credits in a minor or supporting field, plus 24 thesis credits.

A maximum of 9 credits of 4xxx-level coursework may be used towards programs requirements. Coursework taken A/F must be completed with an average grade of B or better.

Required Courses

All students must complete ESCI 8001, preferably in the first year.

[ESCI 8001](#) - Introductory Graduate Seminar (2.0 cr)

Minor or Supporting Program Coursework

Take 12 credits in a minor or in supporting fields outside ESCI.

Thesis Credits

Take 24 credits after passing preliminary oral exam

[ESCI 8888](#) - Thesis Credit: Doctoral (1.0 - 24.0 cr)

Program Sub-plans

Students are required to complete one of the following sub-plans.

Students may not complete the program with more than one sub-plan.

Biogeology

Biogeology represents a rapidly growing area at the intersection between Earth and the life sciences. It includes research in microbial evolution and biochemistry, microbe/mineral chemical interactions, the role of organisms in basic geological processes, the principles through which organisms or organic compounds can be used to reconstruct surface conditions, biogeochemical cycling, pollution control and remediation, the origin of life on Earth, and astrobiology. This is a broad field that is moving in new and exciting directions, and witnessing explosive growth in understanding the variety of ways biology mediates geology and vice versa. Many of the most basic earth surface processes are now seen as intimately biological with rates and pathways dictated by organic processes. Understanding the importance of these processes, quantifying them through time and place, and learning to utilize and/or control them will be major components of earth sciences research in the 21st century.

Required Courses

Take 6 or more credit(s) from the following:

- [ESCI 8402](#) - Biogeochemical Cycles in the Ocean (3.0 cr)



- ESCI 8801 *{Inactive}*(3.0 cr)

Earth Sciences

This generalist track exists for students whose curriculum and/or thesis (paper or project for MS Plan B) do not fit any of the other four tracks. Because it is not specific to a discipline, there are no mandatory courses in the major apart from the introductory graduate seminar, a minimum of 6 additional graduate-level credits in the major program, 12 supporting program credits or completion of all requirements for a minor, and thesis credits. A curriculum specific to the student will be set through the compact process.

6-credit minimum; courses determined on an individual basis.

Geology

Geology uses field observation, laboratory work, analog and computer modeling, chemical and biological probes and assays to understand Earth's coupled rock, water and biological systems, the underlying processes, and their history of interaction as evidenced in the rock record.

Required Courses

Take 6 or more credit(s) from the following:

- ESCI 5302 - Isotope Geology (3.0 cr)
- ESCI 5351 *{Inactive}*(3.0 cr)
- ESCI 5353 - Electron Microprobe Theory and Practice (3.0 cr)
- ESCI 5502 *{Inactive}*(3.0 cr)
- ESCI 5503 - Advanced Petrology (3.0 cr)
- ESCI 5601W *{Inactive}*[WI] (4.0 cr)
- ESCI 5705 - Limnogeology and Paleoenvironment (3.0 cr)

Geophysics

Geophysics uses remote sensing probes (seismic waves, potential fields, etc.), laboratory simulation of deep Earth conditions and computer modeling of fluid and continuum mechanical dynamics to investigate the structure, composition, history and dynamics of solid Earth and other planets.

Required Courses

ESCI 4211 *{Inactive}*(3.0 cr)

Take 1 or more course(s) totaling 3 or more credit(s) from the following:

- ESCI 4212 - Geodynamics (3.0 cr)
- ESCI 5201 - Time-Series Analysis of Geological Phenomena (3.0 cr)
- ESCI 5203 - Mineral and Rock Physics (3.0 cr)
- ESCI 5204 - Geostatistics and Inverse Theory (3.0 cr)
- ESCI 8203 - Environmental Geophysics (3.0 cr)
- ESCI 8204 - Geomagnetism and Paleomagnetism (3.0 cr)

Hydrogeology

Hydrogeology uses direct observation and remote sensing, computer modeling and laboratory simulation to constrain the interaction of water and rock in Earth's shallow subsurface. Freshwater is Earth's most precious and increasingly overexploited resource. Hydrogeology is a key discipline in the effective shepherding of this important reserve. This track establishes a baseline curriculum for hydrogeology at the graduate level. The compact process will identify additional coursework appropriate to the student's prior training and research directions.

Required Courses

ESCI 4702 - General Hydrogeology (4.0 cr)

Take 1 or more course(s) totaling 3 or more credit(s) from the following:

- ESCI 5205 *{Inactive}*(3.0 cr)
- ESCI 5971 - Field Hydrogeology (2.0 cr)