Earth Science

The Wiess School of Natural Sciences

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

All undergraduate majors in earth science take a 4-course core sequence, typically in the sophomore and junior years, on earth processes, materials, observations, and history. Majors also take introductory courses in mathematics, chemistry, and in many cases, physics and biology.

The selection of upper-division courses and additional science courses depends on which major, B.A. or B.S., and, for the B.S. major, which of five tracks are chosen by the student: geology, geochemistry, geophysics, environmental earth science, or a track designed by the student subject to the approval of the department undergraduate adviser. The program of study typically includes experience with analytical equipment, computer systems, and fieldwork.

The B.S. in earth science degree should be chosen by students planning a career or further study in earth science or a related field. The B.A. in earth science degree has fewer requirements and might be a good choice for students planning a career or further study to which earth science is incidental.

For general university requirements, see Graduation Requirements (pages 20–23).
Degree Requirements for B.S. in Earth Science

For general university requirements, see Graduation Requirements (pages 20–23). B.S. majors must also complete the “Additional Requirements” for one track (described below).

The following courses are required for all tracks:

- **MATH 101/102 Single Variable Calculus I and II**
- **CHEM 121/122 or 151/152 General Chemistry I and II with lab**
- **PHYS 101/102 or 111/112 Introductory Physics I and II with lab**

**Additional Requirements for the Geology Track**

The following courses are required:

- **MATH 211 Ordinary Differential Equations and Linear Algebra**
- **ESCI 334 Geological and Geophysical Techniques**
- **ESCI 390 Field Camp**

Choose one of the following courses:

- **COMP 110 Computation in Natural Science**
- **CAAM 210 Introduction to Engineering Computation (FORTRAN)**
- **CAAM 211 Introduction to Engineering Computation (C )**
- **COMP 210 Principles of Computing and Programming**

Choose one of the following courses:

- **ESCI 412 Advanced Petrology**
- **ESCI 430 Principles of Trace-Element and Isotope Geochemistry**

Choose one of the following courses:

- **ESCI 427 Sequence Stratigraphy**
- **ESCI 521 Seminar in Applied Micropaleontology**

Choose one of the following courses:

- **ESCI 421 Paleoclimatology**
- **ESCI 446 Solid Earth Geophysics**
- **ESCI 442 Exploration Geophysics I**

Choose one of the following courses:

- **ESCI 463 Advance Structural Geology**
- **ESCI 464 Global Tectonics**

Additional Requirements for the Geochemistry Track

The following courses are required:

- BIOS 201 *Introductory Biology I*
- A 6 hour field-based course or equivalent, approved by the department undergraduate adviser.

Choose 9 hours from the following:

- **ESCI 412 Advanced Petrology**
- **ESCI 421 Paleoclimatology**
- **ESCI 458 Thermodynamics/Kinetics for Geoscientists**
- **ESCI 203 Biogeochemistry**
- **ESCI 430 Principles of Trace-Element and Isotope Geochemistry**

Choose 9 hours from the following:

- All upper division ESCI courses
- **CEVE 401 Introduction to Environmental Chemistry**
- **CEVE 403 Principles of Environmental Engineering**
- **CEVE 434 Chemical Transport and Fate in the Environment**
- **CEVE 532 Physical-Chemical Processes in Environmental Engineering**
Additional Requirements for the Geophysics Track

The following courses are required:

- MATH 211 *Ordinary Differential Equations and Linear Algebra*
- MATH 212 *Multivariable Calculus*
- PHYS 201 *Waves and Optics*
- PHYS 231 *Elementary Physics Lab II*

In addition, the student must complete a field experience, equivalent to 6 semester hours, approved by the department undergraduate advisor.

Choose one of the following courses:

- COMP 110 *Computation in Natural Science*
- CAAM 210 *Introduction to Engineering Computation (FORTRAN)*
- CAAM 211 *Introduction to Engineering Computation (C )*
- COMP 210 *Principles of Computing and Programming*

Choose 6 hours from the following:

ESC1 440 *Geophysical Data Analysis: Digital Signal Processing*
ESC1 441 *Geophysical Data Analysis: Inverse Theory*
ESC1 442 *Exploration Geophysics I*
ESC1 444 *Exploration Geophysics II*
ESC1 450 *Remote Sensing*
ESC1 454 *Geographic Information Science*
ESC1 461 *Seismology I*
ESC1 462 *Tectonophysics*
ESC1 464 *Global Tectonics*
ESC1 532 *Advanced Global Tectonics*
ESC1 542 *Seismology II*

Choose 6 hours from the immediately preceding or following lists:

- Any 3- or 4- hour course in ESCI with a number between 411 and 475, except for research and special studies
- Any 300- or 400-level MATH, CAAM, OR PHYS class
- CHEM 311 *Physical Chemistry*
- CEVE 412 *Hydrology & Watershed Analysis*

Additional Requirements for the Environmental Earth Science Track

The following courses are required:

- MATH 211 *Ordinary Differential Equations and Linear Algebra*
- BIOS 201 *Introductory Biology I*
Choose one of the following courses:
• COMP 110 Computation in Natural Science
• CAAM 210 Introduction to Engineering Computation (FORTRAN)
• CAAM 211 Introduction to Engineering Computation (C )
• COMP 210 Principles of Computing and Programming

Choose 14 hours from the following, including at least two courses in ESCI:

ESCI 451 Analysis of Environmental Data
ESCI 353 Environmental Geochemistry
ESCI 442 Exploration Geophysics
ESCI 454 Geographic Information Science
ESCI 463 Advanced Structural Geology I
ESCI 504 Clastics
ESCI 506 Carbonates
ESCI 568 Paleoclimates and Human Response
CEVE 306 Global Environmental Law and Sustainable Development

Additional Requirements for the Self-Designed Track

The department recognizes the interdisciplinary nature of modern earth science and
the opportunity for students to specialize in nontraditional and emerging fields. There-
fore, students can design their own specialty track, normally in close consultation with
one faculty member and followed by approval from the department undergraduate
adviser. In addition to required earth science courses and related courses, these tracks will
generally comprise 15 additional hours that target a coherent theme from an approved list
of 300- or higher-level courses, from inside or outside the department. Interested students
are expected to submit a statement of rationale by the beginning of their third year.

Choose 9 hours from the following:

BIOS 201 Introductory Biology I
COMP 110 Computation in Natural Science
CAAM 210 Introduction to Engineering Computation (FORTRAN)
CAAM 211 Introduction to Engineering Computation (C )
COMP 210 Principles of Computing and Programming

• Complete a field experience, equivalent to 4 semester hours, approved by the
department undergraduate adviser.
• Choose 15 hours of additional courses numbered 300 or higher targeting a
coherent theme selected with approval of the department undergraduate
adviser.

Degree Requirements for B.A. in Earth Science

For general university requirements, see Graduation Requirements (pages 20–23).
The following courses are required:
MATH 101/102 Single Variable Calculus I and II
CHEM 121/122 or 151/152 General Chemistry I and II with lab
ESCI 321 Earth System Evolution and Cycles
ESCI 322 Earth Chemistry and Materials
ESCI 323 Earth Structure and Deformation with lab
ESCI 324 Earth’s Interior
ESCI 334 Geological and Geophysical Techniques

Choose 6 hours from the following:
BIOL 201/202 Introductory Biology I and II
BIOL 211, 213 Biology Lab Modules
MATH 211 Differential Equations
PHYS 101/102 or 125/126 Introductory Physics
COMP 110 Computation in Natural Science or CAAM 210 Introduction to Engineering Computation (FORTRAN) or CAAM 211 Introduction to Engineering Computation (C) or COMP 210 Principles of Computing and Programming

- Choose four upper division ESCI courses, approved by the department undergraduate advisor.
- Choose 6 hours in science and engineering (including ESCI) courses at the 200 level or above approved by the department undergraduate advisor.

Undergraduate Independent Research

The department encourages, but does not require, earth science undergraduate majors to pursue independent supervised research in ESCI 481 Research in Earth Science. See also Honors Programs (page 34).

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 science. The department encourages applications from well-qualified students with degrees in the other sciences and mathematics. For general university requirements, see Graduate Degrees (pages 65–70). 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 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
- Pass a written preliminary exam
- Maintain a grade point average of 3.00 (B) or better
- Prepare a written thesis
- 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 in the Courses of Instruction section.