EARTH AND PLANETARY SCIENCES MAJOR

The academic program aims to cover the breadth of geologic sub-disciplines, hone the skills necessary to succeed in Earth Science careers, and allow for choice based on student interests. Courses may include theory, descriptive studies, data analysis, computer modeling, laboratory exercises, and field training.

Students are encouraged to take the 200-level foundation courses as early as possible, but they need not be taken in sequence.

Students planning to attend graduate school are strongly encouraged to conduct independent study (EARTH 399-0).

Students must also complete the Undergraduate Registration Requirement (https://catalogs.northwestern.edu/undergraduate/requirements-policies/undergraduate-registration-requirement/) and the degree requirements of their home school.

Major Requirements: Department Courses (12 Units)

4 200-level Core EARTH Courses (4 units)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 201-0</td>
<td>Earth Systems Revealed</td>
</tr>
<tr>
<td>EARTH 202-0</td>
<td>Earth's Interior</td>
</tr>
<tr>
<td>EARTH 203-0</td>
<td>Earth System History</td>
</tr>
<tr>
<td>EARTH 204-0</td>
<td>Communication for Geoscientists</td>
</tr>
</tbody>
</table>

8 300-level Advanced Studies EARTH Courses (8 units)

Advanced studies courses are divided into seven sub-disciplines and three skill areas, as listed below. Students must take at least one course from four of the seven Sub-Discipline Requirement lists below, and at least one course from each of the three Skills Requirement lists below. Additional advanced studies courses to the required total of eight may be any EARTH 300- or 400-level course, but only one EARTH 399-0 Independent Study may be counted toward the major. Consult with the Director of Undergraduate Studies (DUS) regarding EARTH 390-0 Special Topics in Earth and Planetary Science courses that may meet Sub-Discipline or Skills requirements. In certain cases, the DUS may approve additional eligible courses for the Sub-Discipline and Skills Requirement course lists.

Sub-Discipline Requirement (4 courses)

Students must take at least one course from four of the following seven sub-disciplines.

Earth Materials

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 300-0</td>
<td>Earth and Planetary Materials</td>
</tr>
<tr>
<td>EARTH 301-0</td>
<td>Petrology: Evolution of Crustal and Mantle Rocks</td>
</tr>
</tbody>
</table>

Geochemistry

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 310-0</td>
<td>Aqueous Geochemistry</td>
</tr>
<tr>
<td>EARTH 312-0</td>
<td>Stable Isotope Geochemistry</td>
</tr>
<tr>
<td>EARTH 313-0</td>
<td>Radiogenic Isotope Geochemistry</td>
</tr>
<tr>
<td>EARTH 314-0</td>
<td>Organic Geochemistry</td>
</tr>
</tbody>
</table>

Seismology

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 323-0</td>
<td>Seismology and Earth Structure</td>
</tr>
<tr>
<td>EARTH 324-0</td>
<td>Earthquakes and Tectonics</td>
</tr>
<tr>
<td>EARTH 327-0</td>
<td>Geophysical Time Series Analysis</td>
</tr>
</tbody>
</table>

Geology

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 330-0</td>
<td>Sedimentary Geology</td>
</tr>
<tr>
<td>EARTH 331-0</td>
<td>Field Problems in Sedimentary Geology</td>
</tr>
<tr>
<td>EARTH 335-0</td>
<td>Tectonics and Structural Geology</td>
</tr>
</tbody>
</table>

Climate/Paleoclimate

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 340-0</td>
<td>Physics of Weather &amp; Climate</td>
</tr>
<tr>
<td>EARTH 341-0</td>
<td>Quaternary Climate Change: Ice Ages to the Age of Oil</td>
</tr>
<tr>
<td>EARTH 342-0</td>
<td>Contemporary Energy and Climate Change</td>
</tr>
<tr>
<td>EARTH 343-0</td>
<td>Earth System Modeling</td>
</tr>
</tbody>
</table>

Geophysics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 350-0</td>
<td>Physics of the Earth</td>
</tr>
<tr>
<td>EARTH 352-0</td>
<td>Global Tectonics</td>
</tr>
<tr>
<td>EARTH 353-0</td>
<td>Mathematical Inverse Methods in Earth and Environmental Sciences</td>
</tr>
</tbody>
</table>

Geobiology

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 370-0</td>
<td>Geobiology</td>
</tr>
<tr>
<td>EARTH 371-0</td>
<td>Biogeochemistry</td>
</tr>
<tr>
<td>EARTH 373-0</td>
<td>Microbial Ecology</td>
</tr>
</tbody>
</table>

Skills Requirement (3 courses)

Students must take at least one course from each of the following three skill areas. No course may be counted in more than one skills category.

Quantitative

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
<td>EARTH 310-0</td>
<td>Aqueous Geochemistry</td>
</tr>
<tr>
<td>EARTH 327-0</td>
<td>Geophysical Time Series Analysis</td>
</tr>
<tr>
<td>EARTH 343-0</td>
<td>Earth System Modeling</td>
</tr>
<tr>
<td>EARTH 353-0</td>
<td>Mathematical Inverse Methods in Earth and Environmental Sciences</td>
</tr>
<tr>
<td>EARTH 362-0</td>
<td>Data Analysis for Earth and Planetary Sciences</td>
</tr>
</tbody>
</table>

Spatial Reasoning

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 300-0</td>
<td>Earth and Planetary Materials</td>
</tr>
<tr>
<td>EARTH 330-0</td>
<td>Sedimentary Geology</td>
</tr>
<tr>
<td>EARTH 335-0</td>
<td>Tectonics and Structural Geology</td>
</tr>
<tr>
<td>EARTH 361-0</td>
<td>Scientific Programming in Python</td>
</tr>
<tr>
<td>EARTH 390-0</td>
<td>Special Topics in Earth and Planetary Science (when Level 2 geographic information systems is the topic)</td>
</tr>
</tbody>
</table>

Analytical/Instrumentation/Field

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARTH 331-0</td>
<td>Field Problems in Sedimentary Geology</td>
</tr>
<tr>
<td>EARTH 343-0</td>
<td>Earth System Modeling</td>
</tr>
<tr>
<td>EARTH 360-0</td>
<td>Instrumentation and Field Methods</td>
</tr>
<tr>
<td>EARTH 361-0</td>
<td>Scientific Programming in Python</td>
</tr>
</tbody>
</table>
Major Requirements: Related Courses (9.34-12.04 Units)

Math Courses (3-4 courses)

Students must take the following math requirements, for a total of three units if the MATH 220 sequence is selected, or a total of four units if the MATH 218 sequence is selected.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 220-1</td>
<td>Single-Variable Calculus</td>
</tr>
<tr>
<td>&amp; MATH 220-2</td>
<td>and Single-Variable Integral Calculus</td>
</tr>
<tr>
<td>or MATH 218-1</td>
<td>Single-Variable Calculus with Precalculus</td>
</tr>
<tr>
<td>&amp; MATH 218-2</td>
<td>and Single-Variable Calculus with Precalculus</td>
</tr>
<tr>
<td>&amp; MATH 218-3</td>
<td>and Single-Variable Calculus with Precalculus</td>
</tr>
<tr>
<td>MATH 226-0</td>
<td>Sequences and Series</td>
</tr>
<tr>
<td>or MATH 230-1</td>
<td>Multivariable Differential Calculus</td>
</tr>
<tr>
<td>or MATH 240-0</td>
<td>Linear Algebra</td>
</tr>
</tbody>
</table>

or equivalent

6 Additional Related Math and Science Courses

Students must take six courses (and their associated lab, if applicable) from the following options, with maximum three in any one subject.¹

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 131-0</td>
<td>General Chemistry 1</td>
</tr>
<tr>
<td>&amp; CHEM 141-0</td>
<td>and General Chemistry Laboratory 1</td>
</tr>
<tr>
<td>CHEM 132-0</td>
<td>General Chemistry 2</td>
</tr>
<tr>
<td>&amp; CHEM 142-0</td>
<td>and General Chemistry Laboratory 2</td>
</tr>
<tr>
<td>CHEM 151-0</td>
<td>Accelerated General Chemistry 1</td>
</tr>
<tr>
<td>&amp; CHEM 161-0</td>
<td>and Accelerated General Chemistry Laboratory 1</td>
</tr>
<tr>
<td>CHEM 152-0</td>
<td>Accelerated General Chemistry 2</td>
</tr>
<tr>
<td>&amp; CHEM 162-0</td>
<td>and Accelerated General Chemistry Laboratory 2</td>
</tr>
<tr>
<td>CHEM 171-0</td>
<td>Advanced General Inorganic Chemistry</td>
</tr>
<tr>
<td>&amp; CHEM 181-0</td>
<td>and Advanced General Inorganic Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM 172-0</td>
<td>Advanced General Physical Chemistry</td>
</tr>
<tr>
<td>&amp; CHEM 182-0</td>
<td>and Advanced General Physical Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM 215-1</td>
<td>Organic Chemistry I</td>
</tr>
<tr>
<td>&amp; CHEM 235-1</td>
<td>and Organic Chemistry Lab I</td>
</tr>
<tr>
<td>CHEM 215-2</td>
<td>Organic Chemistry II</td>
</tr>
<tr>
<td>&amp; CHEM 235-2</td>
<td>and Organic Chemistry Lab II</td>
</tr>
<tr>
<td>CHEM 215-3</td>
<td>Advanced Organic Chemistry</td>
</tr>
<tr>
<td>&amp; CHEM 235-3</td>
<td>and Advanced Organic Chemistry Lab</td>
</tr>
<tr>
<td>PHYSICS 135-1</td>
<td>General Physics</td>
</tr>
<tr>
<td>&amp; PHYSICS 136-1</td>
<td>and General Physics Laboratory</td>
</tr>
<tr>
<td>PHYSICS 135-2</td>
<td>General Physics</td>
</tr>
<tr>
<td>&amp; PHYSICS 136-2</td>
<td>and General Physics Laboratory</td>
</tr>
<tr>
<td>PHYSICS 135-3</td>
<td>General Physics</td>
</tr>
<tr>
<td>&amp; PHYSICS 136-3</td>
<td>and General Physics Laboratory</td>
</tr>
<tr>
<td>BIOL_SCI 201-0</td>
<td>Molecular Biology</td>
</tr>
<tr>
<td>BIOL_SCI 202-0</td>
<td>Cell Biology</td>
</tr>
<tr>
<td>&amp; BIOL_SCI 232-0</td>
<td>and Molecular and Cellular Processes Laboratory</td>
</tr>
<tr>
<td>BIOL_SCI 203-0</td>
<td>Genetics and Evolution</td>
</tr>
<tr>
<td>&amp; BIOL_SCI 233-0</td>
<td>and Genetics and Molecular Processes Laboratory</td>
</tr>
<tr>
<td>MATH 226-0</td>
<td>Sequences and Series</td>
</tr>
<tr>
<td>MATH 230-2</td>
<td>Multivariable Integral Calculus</td>
</tr>
<tr>
<td>or MATH 228-2</td>
<td>Multivariable Integral Calculus for Engineering</td>
</tr>
<tr>
<td>MATH 240-0</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>MATH 250-0</td>
<td>Elementary Differential Equations</td>
</tr>
</tbody>
</table>

¹ Note: Introductory Chemistry, Physics, Biology, and Math courses may be offered in parallel tracks. Consistent with restrictions at the University level, a student cannot receive credit for some course sequences if credit has already been awarded for an equivalent course. See Chemistry, Physics, Biology, and Math sections of this Catalog for details.

Honors in Earth and Planetary Sciences

Majors with strong academic records and an interest in pursuing honors should discuss possible research projects with a faculty member and/or the director of undergraduate studies (DUS) early in their undergraduate career, but no later than spring quarter of their junior year. After the chosen faculty mentor approves a proposed project, research is conducted and students must complete at least two quarters of EARTH 399-0 Independent Study; only one quarter may count towards major requirements. To earn the honors distinction, students must complete a thesis following the guidance provided in guidelines published on the department webpage.

Students whose grades, research, and written thesis meet departmental criteria are recommended to the college for graduation with honors. For more information, students should consult the director of undergraduate studies and see Honors in the Major (https://catalogs.northwestern.edu/undergraduate/arts-sciences/#academicoptionstext).