Geophysical Sciences

Department Website: http://geosci.uchicago.edu

Program of Study

The Department of the Geophysical Sciences (GEOS) offers unique programs of study in the earth, atmospheric, and planetary sciences. Topics include the physics, chemistry, and dynamics of the atmosphere, oceans, and ice sheets; past and present climate change; the origin and history of the Earth, moon, and meteorites; properties of the deep interior of the Earth and the dynamics of crustal movements; and the evolution and geography of life and the Earth's surface environments through geologic time. These multidisciplinary topics require an integrated approach founded on mathematics, physics, chemistry, and biology.

Both the BA and BS programs prepare students for careers that draw upon the earth, atmospheric, and planetary sciences. However, the BS degree provides a more focused and intensive program of study for students who intend to pursue graduate work in these disciplines. The BA degree also offers thorough study in the geophysical sciences, but it provides a wide opportunity for elective freedom to pursue interdisciplinary interests, such as environmental policy, law, medicine, business, and precollege education.

Program Requirements for the BA in Geophysical Sciences

The requirements for the BA degree in Geophysical Sciences involve completion of:

- six required courses that fulfill general education requirements for the physical sciences, biological sciences, and mathematics
- eight required science or mathematics courses
- seven elective courses pertinent to the major from the electives lists below, which must include:
  - one course in Computational Sciences (List 2)
  - four 20000-level courses designated GEOS in List 1
  - two more 20000-level science courses from any of Lists 1–2

Candidates for the BA in Geophysical Sciences complete a year of chemistry, a year of physics, a year of mathematics (including Calculus I-II), and a year of biology (GEOS 27300 Biological Evolution and BIOS 20198 Biodiversity).

The requirement for the third quarter of mathematics may be satisfied by either completing the calculus sequence (recommended for students taking the more introductory MATH 13000s sequence but not specifically required or recommended for the higher tracks such as MATH 15000s, as the first two quarters offer a sufficiently comprehensive calculus training for students to move on to other courses) or taking one of the designated mathematical methods courses instead. In addition, students must complete one elective course from Computational Sciences (List 2).

Students are encouraged to begin discipline-specific courses as early as possible. Required disciplinary courses include GEOS 13100 Physical Geology, GEOS 13200 Earth History, and GEOS 13300 The Atmosphere. With prior consent of the departmental counselor, students with the appropriate background may substitute a 20000-level course, which may be taken during or after the third year.

A minimum of six additional 20000-level science courses are required. At least four must be GEOS courses from List 1. Up to two may be chosen from other science courses in List 1. Up to two may be chosen from Computational Sciences (List 2). One may be a field course.

Summary of Requirements for the BA in Geophysical Sciences

GENERAL EDUCATION

One of the following sequences:

- CHEM 10100 Introductory General Chemistry I
- CHEM 10200 and Introductory General Chemistry II
- CHEM 11100-11200 Comprehensive General Chemistry I-II *
- CHEM 12100-12200 Honors General Chemistry I-II

One of the following sequences:

- MATH 13100-13200 Elementary Functions and Calculus I-II *
- MATH 15100-15200 Calculus I-II
- MATH 16100-16200 Honors Calculus I-II

Both of the following:

- BIOS 20198 Biodiversity
- GEOS 27300 Biological Evolution %

Total Units 600
MAJOR

GEOS 13100 & GEOS 13200 & GEOS 13300

Physical Geology and Earth History and The Atmosphere

CHEM 11300 or CHEM 12300

Comprehensive General Chemistry III Honors General Chemistry III

One of the following sequences:

PHYS 12100-12200-12300

General Physics I-II-III

PHYS 13100-13200-13300

Mechanics; Electricity and Magnetism; Waves, Optics, and Heat

PHYS 14100-14200-14300

Honors Mechanics; Honors Electricity and Magnetism; Honors Waves, Optics, and Heat

One of the following:

MATH 20000

Mathematical Methods for Physical Sciences I

MATH 20250

Abstract Linear Algebra

PHYS 22000

Introduction to Mathematical Methods in Physics

MATH 13300

Elementary Functions and Calculus III

MATH 15300

Calculus III

MATH 16300

Honors Calculus III

One Computational Sciences course (List 2)

Six electives as follows:

Four courses designated GEOS from List 1: Physical and Biological Sciences

Two additional courses from List 1: Physical and Biological Sciences and/or from List 2: Computational Sciences

Total Units 1500

* Credit may be granted by examination.

** Only Environmental Science and Geophysical Sciences majors may use this pairing to satisfy the general education requirement in the biological sciences. Geophysical Sciences majors can take these courses without the Biological Sciences prerequisites (BIOS 20150-20151) unless they pursue a double major in Biological Sciences. They are expected to show competency in mathematical modeling of biological phenomena covered in BIOS 20151.

† Only one of these electives may be a field course (GEOS 29001, GEOS 29002, GEOS 29005) and only one of these electives may be GEOS 29700 Reading and Research in the Geophysical Sciences.

§ PHYS 13100-13200-13300 or PHYS 14100-14200-14300 are the preferred courses. PHYS 12100-12200-12300 is allowable on a case-by-case basis but may not provide adequate preparation to allow for enrollment in higher level PHYS courses. Additionally, PHYS 12100 has a prerequisite of a year of chemistry. Special petition to the department counselor is required for PHYS 12100-12200-12300 approval.

% Biological Evolution has several cross-listings. Geophysical Sciences majors must register for it under the GEOS 27300 listing.

Program Requirements for the BS in Geophysical Sciences

The requirements for the BS degree in Geophysical Sciences involve completion of:

- six required courses that fulfill general education requirements for the physical sciences, biological sciences, and mathematics
- eight required science or mathematics courses
- ten elective courses pertinent to the major from the electives lists below, which must include:
  - two courses in Computational Sciences (List 2)
  - four 20000-level courses designated GEOS in List 1
  - four more 20000-level science courses from any of Lists 1–2: up to three non-GEOS courses from List 1, up to two from List 2

Candidates for the BS in Geophysical Sciences complete a year of chemistry, a year of physics, a year of mathematics (including Calculus I-II), and a year of biology (GEOS 27300 Biological Evolution, and BIOS 20198 Biodiversity).

The requirement for the third quarter of mathematics may be satisfied by either completing the calculus sequence (recommended for students taking the more introductory MATH 13000s sequence but not specifically required or recommended for the higher tracks such as MATH 15000s, as the first two quarters offer a sufficiently comprehensive calculus training for students to move on to other courses) or taking one of the designated mathematical methods courses.
instead. In addition, students must complete two elective courses from Computational Sciences (List 2). The requirements are structured to allow and encourage students to complete sequences that extend through the study of differential equations.

Students are encouraged to begin discipline-specific courses as early as possible. Required disciplinary courses include GEOS 13100 Physical Geology, GEOS 13200 Earth History, and GEOS 13300 The Atmosphere, which is the introductory sequence. With prior consent of the departmental counselor, students with the appropriate background may substitute a 20000-level course, which may be taken during or after the third year.

A minimum of eight additional 20000-level science courses are required. At least four must be GEOS courses from List 1. Up to three may be chosen from other science courses in List 1. Up to two may be chosen from Computational Sciences (List 2). One may be a field course. One may be GEOS 29700 Reading and Research in the Geophysical Sciences.

Summary of Requirements for the BS in Geophysical Sciences

GENERAL EDUCATION

One of the following sequences:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 10100 &amp; CHEM 10200</td>
<td>Introductory General Chemistry I and Introductory General Chemistry II</td>
</tr>
<tr>
<td>CHEM 11100-11200</td>
<td>Comprehensive General Chemistry I-II</td>
</tr>
<tr>
<td>CHEM 12100-12200</td>
<td>Honors General Chemistry I-II</td>
</tr>
</tbody>
</table>

One of the following sequences:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 13100-13200</td>
<td>Elementary Functions and Calculus I-II</td>
</tr>
<tr>
<td>MATH 15100-15200</td>
<td>Calculus I-II</td>
</tr>
<tr>
<td>MATH 16100-16200</td>
<td>Honors Calculus I-II</td>
</tr>
</tbody>
</table>

Both of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 20198</td>
<td>Biodiversity</td>
</tr>
<tr>
<td>GEOS 27300</td>
<td>Biological Evolution</td>
</tr>
</tbody>
</table>

Total Units: 600

MAJOR

Physical Geology and Earth History

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS 13100 &amp; GEOS 13200</td>
<td>Physical Geology and Earth History</td>
</tr>
<tr>
<td>GEOS 13300</td>
<td>The Atmosphere</td>
</tr>
<tr>
<td>CHEM 11300 or CHEM 12300</td>
<td>Comprehensive General Chemistry III</td>
</tr>
<tr>
<td>PHYS 12100-12200-12300</td>
<td>General Physics I-II-III</td>
</tr>
<tr>
<td>PHYS 13100-13200-13300</td>
<td>Mechanics; Electricity and Magnetism; Waves, Optics, and Heat</td>
</tr>
<tr>
<td>PHYS 14100-14200-14300</td>
<td>Honors Mechanics; Honors Electricity and Magnetism; Honors Waves, Optics, and Heat</td>
</tr>
</tbody>
</table>

One of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 20000</td>
<td>Mathematical Methods for Physical Sciences I</td>
</tr>
<tr>
<td>MATH 20250</td>
<td>Abstract Linear Algebra</td>
</tr>
<tr>
<td>PHYS 22000</td>
<td>Introduction to Mathematical Methods in Physics</td>
</tr>
<tr>
<td>BIOS 20152</td>
<td>Introduction to Quantitative Modeling in Biology (Advanced)</td>
</tr>
<tr>
<td>MATH 13300</td>
<td>Elementary Functions and Calculus III</td>
</tr>
<tr>
<td>MATH 15300</td>
<td>Calculus III</td>
</tr>
<tr>
<td>MATH 16300</td>
<td>Honors Calculus III</td>
</tr>
</tbody>
</table>

Two Computational Sciences courses from List 2

Eight electives as follows: ¹

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Four courses designated GEOS from List 1: Physical and Biological Sciences</td>
<td></td>
</tr>
<tr>
<td>Four additional courses from List 1: Physical and Biological Sciences and/or List 2: Computational Sciences, but only up to three courses may be non-GEOS courses from List 1 and only up to two courses may be from List 2.</td>
<td></td>
</tr>
</tbody>
</table>

Total Units: 1800

¹ Credit may be granted by examination.
** Only Environmental Science and Geophysical Sciences majors may use this pairing to satisfy the general education requirement in the biological sciences. Geophysical Sciences majors can take these courses without the Biological Sciences prerequisites (BIOS 20150-20151) unless they pursue a double major in Biological Sciences. They are expected to show competency in mathematical modeling of biological phenomena covered in BIOS 20151.

‡ Only one of these electives may be a field course (GEOS 29001, GEOS 29002, GEOS 29005) and only one of these electives may be GEOS 29700 Reading and Research in the Geophysical Sciences.

§ PHYS 13100-13200-13300 or PHYS 14100-14200-14300 are the preferred courses. PHYS 12100-12200-12300 is allowable on a case-by-case basis but may not provide adequate preparation to allow for enrollment in higher level PHYS courses. Additionally, PHYS 12100 has a prerequisite of a year of chemistry. Special petition to the department counselor is required for PHYS 12100-12200-12300 approval.

% Biological Evolution has several cross-listings. Geophysical Science majors must register for it under the GEOS 27300 listing.

Lists of Elective Courses 1–2

List 1: Physical and Biological Sciences

Geophysical Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS 20500</td>
<td>Topics in the Geophysical Sciences ***</td>
</tr>
<tr>
<td>GEOS 21000</td>
<td>Mineralogy</td>
</tr>
<tr>
<td>GEOS 21005</td>
<td>Mineral Science</td>
</tr>
<tr>
<td>GEOS 21100</td>
<td>Introduction to Petrology</td>
</tr>
<tr>
<td>GEOS 21200</td>
<td>Physics of the Earth</td>
</tr>
<tr>
<td>GEOS 21205</td>
<td>Introduction to Seismology, Earthquakes, and Near-Surface Earth Seismicity</td>
</tr>
<tr>
<td>GEOS 21400</td>
<td>Thermodynamics and Phase Change</td>
</tr>
<tr>
<td>GEOS 22000</td>
<td>Origin and Evolution of the Solar System</td>
</tr>
<tr>
<td>GEOS 22040</td>
<td>Formation of Planetary Systems in Our Galaxy: From Dust to Planetesimals</td>
</tr>
<tr>
<td>GEOS 22050</td>
<td>Formation of Planetary Systems in Our Galaxy: From Planetesimals to Planets</td>
</tr>
<tr>
<td>GEOS 22060</td>
<td>What Makes a Planet Habitable?</td>
</tr>
<tr>
<td>GEOS 22200</td>
<td>Geochronology</td>
</tr>
<tr>
<td>GEOS 23205</td>
<td>Introductory Glaciology</td>
</tr>
<tr>
<td>GEOS 23400</td>
<td>Global Warming: Understanding the Forecast</td>
</tr>
<tr>
<td>GEOS 23800</td>
<td>Global Biogeochemical Cycles</td>
</tr>
<tr>
<td>GEOS 23805</td>
<td>Stable Isotope Biogeochemistry</td>
</tr>
<tr>
<td>GEOS 23900</td>
<td>Environmental Chemistry</td>
</tr>
<tr>
<td>GEOS 24220</td>
<td>Climate Foundations</td>
</tr>
<tr>
<td>GEOS 24230</td>
<td>Geophysical Fluid Dynamics: Foundations</td>
</tr>
<tr>
<td>GEOS 24240</td>
<td>Geophysical Fluid Dynamics: Rotation and Stratification</td>
</tr>
<tr>
<td>GEOS 24250</td>
<td>Geophysical Fluid Dynamics: Understanding the Motions of the Atmosphere and Oceans</td>
</tr>
<tr>
<td>GEOS 24705</td>
<td>Energy: Science, Technology, and Human Usage</td>
</tr>
<tr>
<td>GEOS 25400</td>
<td>Introduction to Numerical Techniques for the Geophysical Sciences</td>
</tr>
<tr>
<td>GEOS 26100</td>
<td>Phylogenetics and the Fossil Record</td>
</tr>
<tr>
<td>GEOS 26300</td>
<td>Invertebrate Paleobiology and Evolution</td>
</tr>
<tr>
<td>GEOS 26600</td>
<td>Geobiology</td>
</tr>
<tr>
<td>GEOS 26650</td>
<td>Environmental Microbiology</td>
</tr>
<tr>
<td>GEOS 26905</td>
<td>Topics in Conservation Paleobiology</td>
</tr>
<tr>
<td>GEOS 28000</td>
<td>Introduction to Structural Geology</td>
</tr>
<tr>
<td>GEOS 28100</td>
<td>Global Tectonics</td>
</tr>
<tr>
<td>GEOS 28300</td>
<td>Principles of Stratigraphy</td>
</tr>
<tr>
<td>GEOS 28600</td>
<td>Earth and Planetary Surface Processes</td>
</tr>
<tr>
<td>GEOS 29700</td>
<td>Reading and Research in the Geophysical Sciences</td>
</tr>
</tbody>
</table>

*** Petition to department counselor required to count GEOS 20500 toward degree requirements.

Field Courses in Geophysical Sciences

The department sponsors field trips that range in length from one day to several weeks. Shorter field trips typically form part of lecture-based courses and are offered each year. (The trips are open to all students and faculty if space permits.) Longer trips are designed as undergraduate field courses, and one such course may be used as an elective science course
for the major. Destinations of field courses have recently included Baja California, Death Valley, Nevada, Salton Trough, Newfoundland, and the Bahamas.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS 29001</td>
<td>Field Course in Geology</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 29002</td>
<td>Field Course in Modern and Ancient Environments</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 29005</td>
<td>Field Course in Environmental Science</td>
<td>100</td>
</tr>
</tbody>
</table>

Astronomy and Astrophysics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTR 24100</td>
<td>The Physics of Stars</td>
<td>100</td>
</tr>
</tbody>
</table>

Biological Sciences*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 20188</td>
<td>Fundamentals of Physiology</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 20189</td>
<td>Fundamentals of Developmental Biology</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 20196</td>
<td>Ecology and Conservation</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 20200</td>
<td>Introduction to Biochemistry</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 21208</td>
<td>Fundamentals of Molecular Biology</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 22243</td>
<td>Biomechanics of Organisms</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 22244</td>
<td>Introduction to Invertebrate Biology</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 22250</td>
<td>Chordates: Evolution and Comparative Anatomy</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 23262</td>
<td>Mammalian Evolutionary Biology</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 23266</td>
<td>Evolutionary Adaptation</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 23289</td>
<td>Marine Ecology</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 23404</td>
<td>Reconstructing the Tree of Life: An Introduction to Phylogenetics</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 23406</td>
<td>Biogeography</td>
<td>100</td>
</tr>
<tr>
<td>BIOS 25206</td>
<td>Fundamentals of Bacterial Physiology</td>
<td>100</td>
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</table>

Semester in Environmental Science/MBL

The following courses are the College designations for the Semester in Environmental Science that is taught at the Marine Biological Laboratory (MBL) in Woods Hole, Massachusetts. Registration in ENSC 23820 Biogeochemical Analysis in Terrestrial and Aquatic Ecosystems – Marine Biological Laboratory, ENSC 24100 Ecology – Marine Biological Laboratory, and ENSC 29800 Independent Undergraduate Research in Environmental Sciences – Marine Biological Laboratory, plus one of ENSC 24200 Methods in Microbial Ecology – Marine Biological Laboratory, ENSC 24300 Roles of Animals in Ecosystems – Marine Biological Laboratory, or ENSC 28100 Quantitative Environmental Analyses – Marine Biological Laboratory is required. Admission to the Semester in Environmental Science program is by application, which must be received by the MBL generally in March of the year preceding the start of the semester. Admissions decisions will generally be sent in April. Note that these courses start at the beginning of September, typically four weeks prior to the start of the College’s Autumn Quarter, and are completed by the end of Autumn Quarter. More information on the course content, the application process, and deadlines can be found at college.uchicago.edu/academics/semester-environmental-science-ses. Students participating in the Semester in Environmental Science receive credit for four courses in environmental science.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ENSC 23820</td>
<td>Biogeochemical Analysis in Terrestrial and Aquatic Ecosystems – Marine Biological Laboratory</td>
<td>100</td>
</tr>
<tr>
<td>ENSC 24100</td>
<td>Ecology – Marine Biological Laboratory</td>
<td>100</td>
</tr>
<tr>
<td>ENSC 24200</td>
<td>Methods in Microbial Ecology – Marine Biological Laboratory</td>
<td>100</td>
</tr>
<tr>
<td>ENSC 24300</td>
<td>Roles of Animals in Ecosystems – Marine Biological Laboratory</td>
<td>100</td>
</tr>
<tr>
<td>ENSC 28100</td>
<td>Quantitative Environmental Analyses – Marine Biological Laboratory</td>
<td>100</td>
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* Excluding courses used to meet the general education requirement for the biological sciences

Chemistry

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>CHEM 20100-20200</td>
<td>Inorganic Chemistry I-II</td>
<td>200</td>
</tr>
<tr>
<td>CHEM 22000-22100-22200</td>
<td>Organic Chemistry I-II-III</td>
<td>300</td>
</tr>
<tr>
<td>CHEM 23000-23100-23200</td>
<td>Honors Organic Chemistry I-II-III</td>
<td>300</td>
</tr>
<tr>
<td>CHEM 26100-26200-26300</td>
<td>Quantum Mechanics; Thermodynamics; Chemical Kinetics and Dynamics</td>
<td>300</td>
</tr>
<tr>
<td>CHEM 26700</td>
<td>Experimental Physical Chemistry †</td>
<td>100</td>
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</table>

† requires CHEM 26100
### Physics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 18500</td>
<td>Intermediate Mechanics</td>
<td>100</td>
</tr>
<tr>
<td>PHYS 19700</td>
<td>Statistical and Thermal Physics</td>
<td>100</td>
</tr>
<tr>
<td>PHYS 22500</td>
<td>Intermediate Electricity and Magnetism I</td>
<td>100</td>
</tr>
<tr>
<td>PHYS 22700</td>
<td>Intermediate Electricity and Magnetism II</td>
<td>100</td>
</tr>
<tr>
<td>PHYS 22600</td>
<td>Electronics</td>
<td>100</td>
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</table>

### List 2: Computational Sciences

#### Mathematics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 20000-20100</td>
<td>Mathematical Methods for Physical Sciences I-II §</td>
<td>200</td>
</tr>
<tr>
<td>MATH 15910</td>
<td>Introduction to Proofs in Analysis</td>
<td>100</td>
</tr>
<tr>
<td>or STAT 24300</td>
<td>Numerical Linear Algebra</td>
<td></td>
</tr>
<tr>
<td>MATH 20250</td>
<td>Abstract Linear Algebra</td>
<td>100</td>
</tr>
<tr>
<td>MATH 20300</td>
<td>Analysis in Rn I</td>
<td>100</td>
</tr>
<tr>
<td>MATH 20400</td>
<td>Analysis in Rn II</td>
<td>100</td>
</tr>
<tr>
<td>MATH 20500</td>
<td>Analysis in Rn III</td>
<td>100</td>
</tr>
<tr>
<td>MATH 21100</td>
<td>Basic Numerical Analysis</td>
<td>100</td>
</tr>
<tr>
<td>MATH 27000</td>
<td>Basic Complex Variables</td>
<td>100</td>
</tr>
<tr>
<td>MATH 27300</td>
<td>Basic Theory of Ordinary Differential Equations</td>
<td>100</td>
</tr>
<tr>
<td>MATH 27500</td>
<td>Basic Theory of Partial Differential Equations</td>
<td>100</td>
</tr>
<tr>
<td>MATH 38300</td>
<td>Numerical Solutions to Partial Differential Equations</td>
<td>100</td>
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#### Biological Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS 20152</td>
<td>Introduction to Quantitative Modeling in Biology (Advanced)</td>
<td>100</td>
</tr>
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</table>

#### Physics

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 22000</td>
<td>Introduction to Mathematical Methods in Physics §§</td>
<td>100</td>
</tr>
<tr>
<td>PHYS 22100</td>
<td>Mathematical Methods in Physics $$$</td>
<td>100</td>
</tr>
</tbody>
</table>

#### Statistics

Any course in statistics at the 22000 level or higher. Some recommendations follow:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT 22000</td>
<td>Statistical Methods and Applications * ‡‡</td>
<td>100</td>
</tr>
<tr>
<td>or STAT 23400</td>
<td>Statistical Models and Methods</td>
<td></td>
</tr>
<tr>
<td>STAT 22400</td>
<td>Applied Regression Analysis</td>
<td>100</td>
</tr>
<tr>
<td>STAT 22600</td>
<td>Analysis of Categorical Data</td>
<td>100</td>
</tr>
<tr>
<td>STAT 24400-24500</td>
<td>Statistical Theory and Methods I-II ‡‡‡</td>
<td>200</td>
</tr>
<tr>
<td>STAT 26100</td>
<td>Time Dependent Data</td>
<td>100</td>
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#### Computing

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>GEOS 25400</td>
<td>Introduction to Numerical Techniques for the Geophysical Sciences</td>
<td>100</td>
</tr>
<tr>
<td>CMSC 12100-12200-12300</td>
<td>Computer Science with Applications I-II-III</td>
<td>300</td>
</tr>
<tr>
<td>CMSC 23710</td>
<td>Scientific Visualization</td>
<td>100</td>
</tr>
<tr>
<td>CMSC 28510</td>
<td>Introduction to Scientific Computing</td>
<td>100</td>
</tr>
<tr>
<td>CMSC 34200</td>
<td>Numerical Hydrodynamics</td>
<td>100</td>
</tr>
</tbody>
</table>

* AP credit for STAT 22000 does not count toward the major requirements. Students with AP credit for STAT 22000 should plan to take at least one other course from List 2 (BA program) or two other courses from List 2 (BS program).

§ Recommended prerequisite is MATH 19620 or MATH 15300 or MATH 16300

§§ Would generally substitute for MATH 20000-20100

§§§ Recommended in addition to MATH 20000-20100 for advanced students—covers partial differential equations

‡‡ Recommended for advanced students. Must be taken as a sequence to be credited. STAT 24400-24500 have no prerequisite but it is possible to take both STAT 23400 and STAT 24400-24500.

### Grading

Students majoring in geophysical sciences must receive quality grades in all courses taken to meet requirements in the major.
Honors

The BA or BS degree with honors is awarded to students who meet the following requirements: (1) a GPA of 3.25 or higher in the major and of 3.0 or higher overall; (2) completion of a paper based on original research, supervised and approved by a faculty member in geophysical sciences; (3) an oral presentation of the thesis research. All theses will be examined by the supervisor and a second reader from the faculty. Manuscript drafts will generally be due in the sixth week of the quarter in which the student will graduate (fifth week in Summer Quarter), and final manuscripts and oral presentations in the eighth week (seventh week in Summer Quarter).

Students are strongly encouraged to reach out to potential faculty supervisors no later than their third year, since theses generally arise out of research projects already begun with faculty members. When a thesis topic is determined, students should notify the undergraduate adviser of their intent to complete a thesis and confirm their eligibility. GEOS 29700 Reading and Research in the Geophysical Sciences can be devoted to the preparation of the required paper; however, students using this course to meet a requirement in the major must take it for a quality grade.

Students who wish to submit a single paper to meet the honors requirement in geophysical sciences and the BA paper requirement in another major should discuss their proposals with the undergraduate advisers from both programs no later than the end of third year. Certain requirements must be met. A consent form, to be signed by the undergraduate advisers, is available from the College adviser. It must be completed and returned to the College adviser by the end of Autumn Quarter of the student's year of graduation.

Sample BS Programs

Each student will design an individual plan of course work, choosing from a wide range of selections that take advantage of rich offerings from a variety of subdisciplines. The sample programs that appear below are merely for the purpose of illustration; many other variations would be possible. NOTE: Courses that meet general education requirements and are required for the major are not listed.

**Environmental Geochemistry**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 26200-26300</td>
<td>Thermodynamics; Chemical Kinetics and Dynamics</td>
<td>200</td>
</tr>
<tr>
<td>GEOS 21000</td>
<td>Mineralogy</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 23800</td>
<td>Global Biogeochemical Cycles</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 23805</td>
<td>Stable Isotope Biogeochemistry</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 23900</td>
<td>Environmental Chemistry</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 26650</td>
<td>Environmental Microbiology</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 28300</td>
<td>Principles of Stratigraphy</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 25400</td>
<td>Introduction to Numerical Techniques for the Geophysical Sciences</td>
<td>100</td>
</tr>
<tr>
<td>STAT 23400</td>
<td>Statistical Models and Methods</td>
<td>100</td>
</tr>
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**Geochemistry**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 26100-26200-26300</td>
<td>Quantum Mechanics; Thermodynamics; Chemical Kinetics and Dynamics</td>
<td>300</td>
</tr>
<tr>
<td>GEOS 21000</td>
<td>Mineralogy</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 21100</td>
<td>Introduction to Petrology</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 22200</td>
<td>Geochronology</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 23800</td>
<td>Global Biogeochemical Cycles</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 23900</td>
<td>Environmental Chemistry</td>
<td>100</td>
</tr>
<tr>
<td>MATH 20000-20100</td>
<td>Mathematical Methods for Physical Sciences I-II</td>
<td>200</td>
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</table>

**Geophysics**

<table>
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<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CMSC 12100-12200-12300</td>
<td>Computer Science with Applications I-II-III</td>
<td>300</td>
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<tr>
<td>GEOS 21000</td>
<td>Mineralogy</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 21100</td>
<td>Introduction to Petrology</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 21200</td>
<td>Physics of the Earth</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 21205</td>
<td>Introduction to Seismology, Earthquakes, and Near-Surface Earth Seismicity</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 28100</td>
<td>Global Tectonics</td>
<td>100</td>
</tr>
<tr>
<td>PHYS 18500</td>
<td>Intermediate Mechanics</td>
<td>100</td>
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<tr>
<td>PHYS 22100</td>
<td>Mathematical Methods in Physics</td>
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**Paleontology**

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<tr>
<td>BIOS 22243</td>
<td>Biomechanics of Organisms</td>
<td>100</td>
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<td>BIOS 23289</td>
<td>Marine Ecology</td>
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<td>BIOS 23404</td>
<td>Reconstructing the Tree of Life: An Introduction to Phylogenetics</td>
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<td>GEOS 21000</td>
<td>Mineralogy</td>
<td>100</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
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<tr>
<td>GEOS 26300</td>
<td>Invertebrate Paleobiology and Evolution</td>
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<td>GEOS 26600</td>
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<td>GEOS 28000</td>
<td>Introduction to Structural Geology</td>
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<tr>
<td>GEOS 28300</td>
<td>Principles of Stratigraphy</td>
<td>100</td>
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<tr>
<td>STAT 22400</td>
<td>Applied Regression Analysis</td>
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<td>STAT 23400</td>
<td>Statistical Models and Methods</td>
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<tr>
<td><strong>Physics of Climate</strong></td>
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<tr>
<td>GEOS 22060</td>
<td>What Makes a Planet Habitable?</td>
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<td>GEOS 23800</td>
<td>Global Biogeochemical Cycles</td>
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<td>GEOS 24220</td>
<td>Climate Foundations</td>
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<td>GEOS 24230</td>
<td>Geophysical Fluid Dynamics: Foundations</td>
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<td>GEOS 24240</td>
<td>Geophysical Fluid Dynamics: Rotation and Stratification</td>
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<tr>
<td>GEOS 24250</td>
<td>Geophysical Fluid Dynamics: Understanding the Motions of the Atmosphere and Oceans</td>
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<tr>
<td>MATH 20000-20100</td>
<td>Mathematical Methods for Physical Sciences I-II</td>
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<tr>
<td>GEOS 25400</td>
<td>Introduction to Numerical Techniques for the Geophysical Sciences</td>
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</tr>
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<td>STAT 23400</td>
<td>Statistical Models and Methods</td>
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<tr>
<td><strong>Planetary Science</strong></td>
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<tr>
<td>GEOS 21200</td>
<td>Physics of the Earth</td>
<td>100</td>
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<tr>
<td>GEOS 22000</td>
<td>Origin and Evolution of the Solar System</td>
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<tr>
<td>GEOS 22060</td>
<td>What Makes a Planet Habitable?</td>
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<td>GEOS 22200</td>
<td>Geochronology</td>
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<td>GEOS 24220</td>
<td>Climate Foundations</td>
<td>100</td>
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<tr>
<td>GEOS 25400</td>
<td>Introduction to Numerical Techniques for the Geophysical Sciences</td>
<td>100</td>
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<tr>
<td>GEOS 28600</td>
<td>Earth and Planetary Surface Processes</td>
<td>100</td>
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<tr>
<td>ASTR 24100</td>
<td>The Physics of Stars</td>
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</tr>
<tr>
<td>PHYS 18500</td>
<td>Intermediate Mechanics</td>
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<td>PHYS 22100</td>
<td>Mathematical Methods in Physics</td>
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<tr>
<td><strong>Structure/ Tectonics</strong></td>
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<td>GEOS 21000</td>
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<td>GEOS 21100</td>
<td>Introduction to Petrology</td>
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<tr>
<td>GEOS 21200</td>
<td>Physics of the Earth</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 21205</td>
<td>Introduction to Seismology, Earthquakes, and Near-Surface Earth Seismicity</td>
<td>100</td>
</tr>
<tr>
<td>GEOS 28000</td>
<td>Introduction to Structural Geology</td>
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<td>GEOS 28100</td>
<td>Global Tectonics</td>
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<tr>
<td>MATH 20000</td>
<td>Mathematical Methods for Physical Sciences I</td>
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<tr>
<td>PHYS 18500</td>
<td>Intermediate Mechanics</td>
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</tr>
<tr>
<td>PHYS 22500</td>
<td>Intermediate Electricity and Magnetism I</td>
<td>100</td>
</tr>
<tr>
<td>STAT 23400</td>
<td>Statistical Models and Methods</td>
<td>100</td>
</tr>
</tbody>
</table>
Font Notice

This document should contain certain fonts with restrictive licenses. For this draft, substitutions were made using less legally restrictive fonts. Specifically:

- Times was used instead of Trajan.
- Times was used instead of Palatino.

The editor may contact Leepfrog for a draft with the correct fonts in place.