GEOLOGY AND GEOPHYSICS, B.A.

The complementary fields of geology and geophysics are combined in one interdisciplinary department, with graduate degrees offered in both disciplines. The undergraduate degree is in geology and geophysics.

Geology offers unusual opportunities to interweave knowledge from many disciplines in the study of natural Earth phenomena. Those who enjoy the challenge of integrating different kinds of information into a unified interpretation will find geology particularly satisfying. Most geology students enjoy travel and have a strong interest in the natural environment as it is today and as it has developed through the past 4.5 billion years. A natural capacity for historical and sequential thought, inductive reasoning, and three-dimensional perception is helpful, and these skills will be developed. Geodetic investigations are becoming increasingly quantitative and experimental, and thus require some computer experience and a strong foundation in chemistry, physics, and mathematics.

The student of geophysics is interested in developing a quantitative understanding of the structure and dynamics of the Earth’s interior from the shallow crust to deep core. Courses in geophysics apply basic physical laws and processes, such as those governing gravity, magnetism, heat flow, and seismic wave propagation, to the study of the Earth. An undergraduate may choose to concentrate in geophysics, magnetism, heat flow, and seismic wave propagation, to the study of the Earth. An undergraduate may choose to concentrate in geophysics, magnetism, heat flow, and seismic wave propagation, to the study of the Earth.

HOW TO GET IN

BACKGROUND REQUIREMENTS

(Exceptions for Geophysics and Engineering Geology Track noted below)

a. A one-year course sequence in calculus: MATH 221 Calculus and Analytic Geometry 1 – MATH 222 Calculus and Analytic Geometry 2 recommended; MATH 211 Calculus – MATH 213 Calculus and Introduction to Differential Equations, or any combination of calculus courses, including transfer credits, that totals at least 8 credits at the intermediate level, is acceptable.

b. The equivalent of a one-year course sequence in general chemistry: CHEM 109 Advanced General Chemistry recommended; CHEM 103 General Chemistry I – CHEM 104 General Chemistry II, or any combination of general chemistry courses, including transfer credits, that totals at least 8 credits, is acceptable.

c. An equivalent of a one-year course sequence in general physics that totals at least 8 credits: PHYSICS 207 General Physics – PHYSICS 208 General Physics recommended; PHYSICS 103 General Physics – PHYSICS 104 General Physics, PHYSICS 201 General Physics – PHYSICS 202 General Physics, PHYSICS 247 A Modern Introduction to Physics – PHYSICS 248 A Modern Introduction to Physics, or any combination of general physics courses, including transfer credits, that totals at least 8 credits, is acceptable. Students preparing to specialize in paleontology may, with approval of the Undergraduate Studies Committee, substitute ZOOLOGY/BOTANY 151 Introductory Biology – ZOOLOGY/BOTANY 152 Introductory Biology or other appropriate courses in biological sciences for the physics requirement.

DECLARING A MAJOR

To declare a major in geology and geophysics, students must have taken one of the following geoscience courses: GEOSCI 202 Introduction to Geologic Structures, GEOSCI 204 Geologic Evolution of the Earth, or GEOSCI/GLE 360 Principles of Mineralogy. Students must meet with an undergraduate advisor and complete a Major Declaration Form.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatetext) section of the Guide.

General Education

• Breadth—Humanities/Literature/Arts: 6 credits
• Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
• Breadth—Social Studies: 3 credits
• Communication Part A & Part B *
• Ethnic Studies *
• Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE BREADTH AND DEGREE REQUIREMENTS: BACHELOR OF ARTS (B.A.)

Students pursuing a bachelor of arts degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum. View a comparison of the degree requirements here. (https://pubs.wisc.edu/home/archives/ug15/images/babs2009.pdf)

BACHELOR OF ARTS DEGREE REQUIREMENTS

Mathematics Fulfilled with completion of University General Education requirements Quantitative Reasoning a (QR A) and Quantitative Reasoning b (QR B) coursework. Please note that some majors may require students to complete additional math coursework beyond the B.A. mathematics requirement.
**Background Requirements**

1. The equivalent of a one-year course sequence in calculus that totals at least 8 credits:

   - MATH 221 Calculus and Analytic Geometry 1 – MATH 222 Calculus and Analytic Geometry 2 recommended; MATH 211 Calculus – MATH 213 Calculus and Introduction to Differential Equations, or a combination of calculus courses, including transfer credits, that totals at least 8 credits at the intermediate level, is acceptable. MATH 171 Calculus with Algebra and Trigonometry I and MATH 217 Calculus with Algebra and Trigonometry II count as a first semester course in a one-year course sequence.

2. The equivalent of a one-year course sequence in general chemistry that totals at least 8 credits:

   - CHEM 109 Advanced General Chemistry recommended; CHEM 103 General Chemistry I – CHEM 104 General Chemistry II, CHEM 115 Chemical Principles I – CHEM 116 Chemical Principles II, or a combination of general chemistry courses, including transfer credits, that totals at least 8 credits, is acceptable.

3. The equivalent of a one-year course sequence in general physics that totals at least 8 credits:

   - PHYSICS 207 General Physics – PHYSICS 208 General Physics recommended; PHYSICS 103 General Physics – PHYSICS 104 General Physics, PHYSICS 201 General Physics – PHYSICS 202 General Physics, PHYSICS 247 A Modern Introduction to Physics – PHYSICS 248 A Modern Introduction to Physics, or a combination of general physics courses, including transfer credits, that totals at least 8 credits, is acceptable. Students preparing to specialize in paleontology may, with approval of the Undergraduate Studies Committee, substitute ZOOLOGY/BOTANY 151 Introductory Biology – ZOOLOGY/BOTANY 152 Introductory Biology or other appropriate courses in biological sciences for the physics requirement.

(Except to Background Requirements for the Geophysics and Engineering Geology Track are noted below)

### Non–L&S Students Pursuing an L&S Major

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements and do not need to complete the L&S breadth and degree requirements above. Please note that the following special degree programs are not considered majors so are not available to non–L&S degree-seeking candidates:

- Applied Mathematics, Engineering and Physics (Bachelor of Science – Applied Mathematics, Engineering and Physics)
- Journalism (Bachelor of Arts – Journalism; Bachelor of Science – Journalism)
- Music (Bachelor of Music)
- Social Work (Bachelor of Social Work)

### Requirements for the Major

Prospective majors are strongly encouraged to seek assistance from a faculty advisor in order to choose courses appropriate to their interests and career plans. Advisors can also assist students in choosing a track that is appropriate for their interests and career goals.

**Background Requirements**

1. The equivalent of a one-year course sequence in calculus that totals at least 8 credits:

   - MATH 221 Calculus and Analytic Geometry 1 – MATH 222 Calculus and Analytic Geometry 2 recommended; MATH 211 Calculus – MATH 213 Calculus and Introduction to Differential Equations, or a combination of calculus courses, including transfer credits, that totals at least 8 credits at the intermediate level, is acceptable. MATH 171 Calculus with Algebra and Trigonometry I and MATH 217 Calculus with Algebra and Trigonometry II count as a first semester course in a one-year course sequence.

2. The equivalent of a one-year course sequence in general chemistry that totals at least 8 credits:

   - CHEM 109 Advanced General Chemistry recommended; CHEM 103 General Chemistry I – CHEM 104 General Chemistry II, CHEM 115 Chemical Principles I – CHEM 116 Chemical Principles II, or a combination of general chemistry courses, including transfer credits, that totals at least 8 credits, is acceptable.

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   - PHYSICS 207 General Physics – PHYSICS 208 General Physics recommended; PHYSICS 103 General Physics – PHYSICS 104 General Physics, PHYSICS 201 General Physics – PHYSICS 202 General Physics, PHYSICS 247 A Modern Introduction to Physics – PHYSICS 248 A Modern Introduction to Physics, or a combination of general physics courses, including transfer credits, that totals at least 8 credits, is acceptable. Students preparing to specialize in paleontology may, with approval of the Undergraduate Studies Committee, substitute ZOOLOGY/BOTANY 151 Introductory Biology – ZOOLOGY/BOTANY 152 Introductory Biology or other appropriate courses in biological sciences for the physics requirement.

### Tracks

#### Geology Track

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>GEOSCI/G L E 350</td>
<td>Introduction to Geophysics: The Dynamic Earth</td>
<td>3</td>
</tr>
<tr>
<td>GEOSCI 375</td>
<td>Principles of Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>GEOSCI 430</td>
<td>Sedimentology and Stratigraphy</td>
<td>3</td>
</tr>
<tr>
<td>GEOSCI/G L E 455</td>
<td>Structural Geology</td>
<td>4</td>
</tr>
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</table>

### Track Requirements

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</tr>
<tr>
<td>GEOSCI 430</td>
<td>Sedimentology and Stratigraphy</td>
<td>3</td>
</tr>
<tr>
<td>GEOSCI/G L E 455</td>
<td>Structural Geology</td>
<td>4</td>
</tr>
</tbody>
</table>
Select 4 credits of GEOSCI electives numbered 300 and above  

Total Credits 17

1 Except GEOSCI 331 Gems: The Science Behind the Sparkle.

**Geophysics and Engineering Geology Track**

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<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>GEOSCI/G L E 431</td>
<td>Sedimentary &amp; Stratigraphy Lab</td>
<td>1</td>
</tr>
<tr>
<td>GEOSCI/G L E 455</td>
<td>Structural Geology</td>
<td>4</td>
</tr>
<tr>
<td>GEOSCI/G L E 474</td>
<td>Rock Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>GEOSCI/G L E 594</td>
<td>Introduction to Applied Geophysics</td>
<td>3</td>
</tr>
<tr>
<td>GEOSCI/G L E 595</td>
<td>Field Methods in Applied and Engineering Geophysics</td>
<td>1</td>
</tr>
<tr>
<td>GEOSCI/G L E 627</td>
<td>Hydrogeology</td>
<td>3-4</td>
</tr>
</tbody>
</table>

Select one of the following:  

- E M A 303 Mechanics of Materials  
- M E 306 Mechanics of Materials  
- PHYSICS 311 Mechanics  
- PHYSICS 322 Electromagnetic Fields

Select one of the following:  

- MATH 234 Calculus--Functions of Several Variables  
- MATH 319 Techniques in Ordinary Differential Equations  
- MATH 320 Linear Algebra and Differential Equations  
- MATH 340 Elementary Matrix and Linear Algebra

Total Credits 21-23

Students choosing this track may not take PHYSICS 103 General Physics & PHYSICS 104 General Physics. A student may substitute E M A 201 Statics & E M A 202 Dynamics for PHYSICS 201 General Physics, PHYSICS 207 General Physics or PHYSICS 247 A Modern Introduction to Physics, and complete the major Physics requirement with PHYSICS 202 General Physics, PHYSICS 208 General Physics or PHYSICS 248 A Modern Introduction to Physics.

Students who are not geological engineering (GLE) majors may substitute GEOSCI/G L E 350 Introduction to Geophysics: The Dynamic Earth for either GEOSCI/G L E/M S & E 474 Rock Mechanics or GEOSCI/G L E 627 Hydrogeology.

**Environmental Geoscience Track**

Directed Electives

Select one course from each of the following four categories:  

- Surface Environments:  
  - GEOSCI/GEOG 320 Geomorphology  
  - GEOSCI/GEOG 420 Glacial and Pleistocene Geology  
  - GEOSCI 430 Sedimentology and Stratigraphy  
  - GEOSCI/G L E 627 Hydrogeology

Geochemistry:  

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<tr>
<td>GEOSCI 375</td>
<td>Principles of Geochemistry</td>
<td></td>
</tr>
<tr>
<td>GEOSCI 610</td>
<td>Geochronology, Timescales, and Rates of Geologic Processes</td>
<td></td>
</tr>
<tr>
<td>GEOSCI/G L E 629</td>
<td>Contaminant Hydrogeology</td>
<td></td>
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</tbody>
</table>

**Geobiology:**  

- GEOSCI 304 Geobiology  
- GEOSCI/ZOOLOGY 541 Paleobiology  
- GEOSCI/ZOOLOGY 542 Invertebrate Paleontology

**Earth Resources:**  

- GEOSCI/ENVIR ST 410 Minerals as a Public Problem
- GEOSCI/ENVIR ST 411 Energy Resources  
- GEOSCI/G L E 455 Structural Geology  
- GEOSCI 515 Principles of Economic Geology  
- GEOSCI/G L E 594 Introduction to Applied Geophysics

**Geoscience Electives**

Select 3 to 5 credits of GEOSCI electives numbered 300-level and higher to reach minimum of 17 credits for the track  

Total Credits 17-19

1 Except GEOSCI 331 Gems: The Science Behind the Sparkle.

**General Geology Track**

Select 17 credits of GEOSCI electives numbered 300-level and higher  

Total Credits 17

1 Except GEOSCI 331 Gems: The Science Behind the Sparkle.

**RESIDENCE AND QUALITY OF WORK**

2.000 GPA in all GEOSCI and major courses  

2.000 on 15 upper-level major credits, taken in residence  

15 credits in GEOSCI, taken on campus  

1 GEOSCI 300 through GEOSCI 699 count as upper level in the major, excluding GEOSCI 331

**HONORS IN THE MAJOR**

Students may declare Honors in the Geology and Geophysics Major in consultation with the departmental undergraduate advisor.

**HONORS IN THE MAJOR IN GEOLOGY AND GEOPHYSICS: REQUIREMENTS**

To earn Honors in the Geology and Geophysics Major, students must satisfy both the requirements for the major (above) and the following additional requirements:

- Earn a 3.300 overall university GPA  
- Earn a 3.400 GPA in all GEOSCI courses
• Complete a two-semester Senior Honors Thesis in GEOSCI 681 Senior Honors Thesis and GEOSCI 682 Senior Honors Thesis, for a total of 6 credits, with a grade of B or better.

UNIVERSITY DEGREE REQUIREMENTS

Total Degree To receive a bachelor’s degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.

Residency Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.

Quality of Work Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

LEARNING OUTCOMES

1. Acquire quantitative and spatial reasoning skills and the ability to apply those skills to problems in geoscience.

2. Be able to explicate key biological, chemical and physical Earth structures, processes, the interactions between them, and the roles that they play in determining the state of the Earth system.

3. Utilize geological observations and measurements to solve problems involving the timing of geological events in Earth history.

4. Combine data and lab/field-based observations into a novel synthesis and/or description/model of how Earth systems operate.

5. Be able to critique published scientific data, results, and interpretations thereof, as well as identify and assess related work in the scientific literature.

6. Be able to effectively communicate scientific concepts, methods, and results.

ADVISING AND CAREERS

ADVISING

Contact the Department of Geoscience for general information about advising.

Philip Brown, undergraduate advisor in the major: economic geology, mineralogy, geochemistry
pbrown@geology.wisc.edu
608-262-5954
365 Weeks Hall

Kurt Feigl, undergraduate advisor in the major: tectonic applications of geodesy
feigl@geology.wisc.edu
608-262-0176
A248 Weeks Hall

Clay Kelly, undergraduate advisor in the major: micropaleontology and paleoceanography
ckelly@geology.wisc.edu
608-262-1698
463 Weeks Hall

Basil Tikoff, Undergraduate advisor in the major: structural geology
basil@geology.wisc.edu
608-262-4678
176 Weeks Hall

Huifang Xu, Undergraduate advisor in the major: mineral science, nanogeoscience, and electron microscopy
hfxu@geology.wisc.edu
608-265-5887
A352 Weeks Hall

Lucas Zoet, Undergraduate advisor in the major: glaciology and glacial geomorphology
lzoet@wisc.edu
608-262-1921
256B Weeks Hall

Eric Schueffner, Undergraduate advisor
elschueffner@wisc.edu
608-890-3231
230 Weeks Hall

CAREERS

More than half of all professional geologists and geophysicists work in hydrogeology or the petroleum and mining industries. Such jobs involve an unusual breadth of training and personal adaptability, and the M.S. degree is generally required. About one fifth of all geoscientists work in state and federal geological surveys, and in government research activities such as oceanographic programs. These positions largely involve problems in geologic mapping, mineral resources, groundwater, and engineering. Geophysics offers opportunities in earthquake studies, seismic verification of nuclear test bans, and crustal rock characterization techniques for waste disposal and groundwater modeling. Many geology students continue on to obtain a Ph.D. degree and become faculty members at a college or university. A geology and geophysics major is also appropriate for those interested in careers in elementary or secondary education, environmental policy, or environmental law. Faculty advisors can provide additional information on career opportunities.

The College of Letters & Science encourages majors to begin working on their career exploration and preparation soon after arriving on campus. Our department partners with SuccessWorks at the College of Letters & Science. L&S graduates are in high demand by employers and graduate programs. It is important that students are career ready at the time of graduation, and we are committed to their success.

L&S CAREER RESOURCES

SuccessWorks at the College of Letters & Science helps students leverage the academic skills learned in their major, certificates, and liberal arts degree, explore and try out different career paths, participate in internships; prepare for the job search and/or graduate school
applications; and network with professionals in the field (alumni and employers).

SuccessWorks can also assist students in career advising, résumé and cover letter writing, networking opportunities, and interview skills, as well as course offerings for undergraduates to begin their career exploration early in their undergraduate career.

• SuccessWorks (https://careers.ls.wisc.edu)
• Set up a career advising appointment (https://careers.ls.wisc.edu/make-an-appointment)
• INTER-LS 210 L&S Career Development: Taking Initiative (1 credit, targeted to first- and second-year students)—for more information, see Inter-LS 210: Career Development, Taking Initiative (https://careers.ls.wisc.edu/inter-ls-210-career-development-taking-initiative)
• Learn how we're transforming career preparation: L&S Career Initiative (http://ls.wisc.edu/lsci)

PEOPLE

Professors Bahr, Brown, Carroll, DeMets, Feigl, Goodwin, Johnson, Kelly, Peters, Roden, Singer, Thurber, Tikoff, Tobin, Valley, Wang, Xu

Associate Professor Meyers

Assistant Professors Cardiff, Marcott, Zoet