

Information and Departmental Plan of Study

The intellectual excitement of modern geosciences is fueled by our exploration of the dynamic forces and delicate balances that mold our planet and have rendered it conducive to life for much of its history. Our landscape is continually reshaped by the movement of cold continents atop the hot, viscous mantle, and our lives are altered by the earthquakes and volcanic eruptions that attend their collision. Rocks that cover the Earth's surface sink to great depths and transform under enormous temperatures and pressures, perhaps to be uplifted as mountains and exposed to future generations by the forces of erosion. The ocean and atmosphere engage in a continuous and complex dialogue that controls Earth's climate. Chemical reactions operating within microorganisms and on a variety of mineral and other natural surfaces are integrated into large geochemical fluxes, which distribute the resources needed for life, and life in turn alters these fluxes. This process operates within the framework of biological evolution, in which diverse organisms appear, evolve, and vanish, sometimes leaving a transfigured world in their wake. All of these processes influence our daily lives in profound and surprising ways.

Many of the great challenges to humanity, today and in the future, involve processes that are studied by Earth scientists, leading to a rapidly increasing role for the field in issues of environmental regulation and public policy. A background in the Earth sciences is an essential component of contemporary education. Practicing geoscientists study nature both in the field and in the lab. To an ever-increasing degree, they must quantify observations with the aim of not only describing the past but also predicting the future of our planet, often with the aid of rigorous laboratory and field experiments, and intensive computation and modeling. The diversity of processes that characterize Earth as a whole requires geosciences to be an extraordinarily interdisciplinary field with direct connections to mathematics, physics, chemistry, biology, and computer science. As a result of these connections, the geosciences department frequently draws students from many backgrounds. Many of our most successful graduates begin their undergraduate careers in subjects ranging from physics to English. [The Department of Geosciences](#) welcomes this intellectual variety, and our undergraduate program allows flexibility while stressing the importance of a sound understanding of the basic sciences.

Prerequisites *(See table on next page)*

1a) Three prerequisite requirements for entering the concentration (MAT 104 or AP credit, COS 126, and either GEO 202 or GEO 203) Students should elect GEO 202 or GEO 203 with an eye toward their likely track of study. Students who need to take the other course for their specialization may count the course used as a prerequisite as an elective (in #5, below).

1b) With permission of the Director of Undergraduate Studies (DUS), a student can substitute GEO 102 or GEO 103, a Geosciences Freshman Seminar, or certain Geosciences 300/400 level courses for GEO 202 or GEO 203.

General Requirements

2) One statistics requirement, to be completed by the end of the junior year (GEO 422 or ORF 245).

3) Four required core math and science courses that vary depending on the chosen specialization. ISC 231-234 and/or AP credit may substitute for some of these courses. Students interested in graduate school are encouraged to take more than these minimum basic science requirements.

Departmental Requirements

4) Two core geoscience requirements that vary depending on the chosen specialization.

5) Five elective 300/400 level geosciences courses.

There are five department specializations: Microbiology (MB), Environmental Geochemistry (EG), Oceans, Atmosphere, & Climate (OA), Geology & Earth History (GE), and Geophysics (GP). Each specialization has a different set of prerequisites (1,2), basic science requirements (3), geoscience core requirements (4) & recommended electives (5) as follows:

	MICRO BIOLOGY (MB)	ENVIRONMENTAL GEOCHEMISTRY (EG)	OCEANS, ATMOSPHERE, & CLIMATE (OA)	GEOLOGY & EARTH HISTORY (GE)	GEOPHYSICS (GP)
To declare concentration sophomore year	MAT 104	MAT 104	MAT 104	MAT 104	MAT 104
To declare concentration sophomore year	COS 126	COS 126	COS 126	COS 126	COS 126
To declare concentration sophomore year	GEO 202	GEO 202	GEO 202	GEO 203	GEO 203
By end of junior year	GEO 422 or ORF 245	GEO 422 or ORF 245	GEO 422 or ORF 245	GEO 422 or ORF 245	GEO 422 or ORF 245
Required Core Math and Science	EEB 211	MOL 214	MAT 201	MAT 202	MAT 201

Required Core Math and Science	MOL 214	CHM 201	mat 202	CHM 201	MAT 202
Required Core Math and Science	CHM 201	CHM 202	CHM 201	CHM 202	PHY 103 or 105
Required Core Math and Science	CHM 202	PHY 103	PHY 103	PHY 103	PHY 104 or 106
Required Core Geoscience	GEO 363	GEO 363	GEO 361	GEO 362	GEO 371 or 442
Required Core Geoscience	GEO 417	GEO 360	GEO 425	GEO 464	MAE 305
Recommended Electives	GEO 362	GEO 361	GEO 362	GEO 378	GEO 419
Recommended Electives	GEO 416	GEO 370	GEO 363	GEO 372	GEO 424
Recommended Electives	GEO 418	GEO 417	GEO 366	GEO 370	GEO 441
Recommended Electives	GEO 428	GEO 418	GEO 367	GEO 373	GEO 422
Recommended Electives	MOL 345	GEO 428	GEO 368	GEO 365	GEO 464
Recommended Electives	MOL 380	GEO 470	GEO 427	GEO 202	GEO 370
Recommended Electives		FRS	GEO 428	FRS	GEO 202
Recommended Electives		CHM 301	GEO 203	MAE 305	FRS
Recommended Electives		CEE 311	FRS	MAE 221	
Recommended Electives		CEE 306/307	MAE 305		
Recommended Electives		CEE 471			

Students are urged to consult with DUS or a member of the undergraduate work committee before choosing hybrid specializations or pursuing specialization-electives outside of geosciences. In general, the Department is flexible about course selections and requirements; however, we must ensure a degree of coherency in each student's course of study.

Junior Colloquium is a weekly luncheon meeting, convened during the fall term, to teach Juniors basic techniques in proposal writing and analytical computing. This one-hour colloquium is **mandatory** for all geosciences concentrators (including those in the geological engineering program).

Certificate Programs

The Department offers a certificate program in geological engineering in collaboration with the Department of Civil and Environmental Engineering, which is described in the entry for the Program in Geological Engineering. The Department also collaborates with the certificate programs in Environmental Studies (PEI), Materials Science and Engineering (MSE), Planets and Life, and Teacher Preparation. Several geosciences courses fulfill requirements of these certificate programs.

All students considering a concentration in the Department should see the departmental representative. They are encouraged to consult as soon as possible, even as first-year students, to aid in the design of a course of study. The Department offers an open house in both the fall and spring terms to introduce prospective students to departmental courses, faculty, students, and research interests.

For full details, see the department's [website \(link is external\)](#).

Geoscience Advisers

At the beginning of each academic year, each geosciences junior and senior is assigned an adviser, who is a faculty member and part of the Undergraduate Work Committee. Students are expected to regularly meet with their advisers for discussions on curriculum, course selection, choice of junior and senior research paper topics, study abroad plans, and the like. Once the courses have been selected in consultation with advisers, students turn in their signed fall and spring course worksheet to the undergraduate coordinator. Any course changes should also be discussed and approved by the adviser or the undergraduate chair.

Independent Work

Please begin by examining the [Geosciences Junior Paper and Senior Thesis Guide \(link is external\)](#).

Junior Independent Work

All juniors are required to conduct independent research in both the fall and spring terms. Each term, this work includes a written progress report, final written report, and a poster presentation of your final JP work. Faculty members will evaluate student poster presentations and submit feedback and grades. Although geengineers are not required to conduct JP research, some geengineers have conducted independent research in geosciences or engineering for course credit.

Different research topics are available in any given year and some ideas are listed in the Shopping Guide, which students obtain from the undergraduate coordinator. Students are encouraged to consult with their faculty advisers for suggestions regarding selection of the JP project. If students have other exciting ideas for possible JP projects, they are encouraged to consult their faculty advisers to discuss the feasibility of these projects.

The fall JP consists of a research proposal. The proposal includes a statement of the hypothesis you are proposing to test, a literature review that motivates your work, and preliminary data collection (i.e., field work, laboratory analysis, and/or data mining) and analysis that convinces the reader you will be able to test your central hypothesis. The fall JP is presented as a poster presentation to the Geosciences Department prior to submitting a final written report.

The spring JP project is a full scientific research paper. A student may choose to work on the same topic they proposed in the fall, or on a completely new topic with a new adviser. All spring JP work must include original data analysis; a literature review by itself does not qualify as a JP project. Many opportunities for collecting data are available, either through the student's own efforts (including field work, experiments conducted in any of the several laboratories in the department, and computer simulations) or by accessing databases made available by and for the scientific community at large. The spring JP is presented as a poster to the Geosciences Department prior to submitting a final written report.

Proposals for funding to support independent work are due in late September/early October for the fall JP, and mid-February for the spring JP (but please see the ST/JP Guide for details each year as the due dates are subject to change). Part of the JP grade is awarded based on two reports submitted at two different milestones during the semester. The final grade for both fall and spring independent research is decided based on the quality of the research and the written and oral work of the student.

Senior Independent Work

The senior research thesis project involves a much more in-depth study in the chosen topic and is a full-year effort. Students should budget their time accordingly. Each geosciences senior will choose an appropriate faculty member as senior thesis adviser in consultation with the departmental adviser and the faculty members that support the student's interests. The student is expected to conduct research in the adviser's laboratory and work closely with the adviser and/or graduate students/postdoctoral fellows.

The Department publishes a Shopping Guide, which lists some research topics that the geosciences faculty members currently are pursuing. The Shopping Guide is a good starting point to identify a list of topics and research advisers from which students can select a topic and adviser for their senior independent research in consultation with the departmental adviser and faculty members. Students interested in pursuing a topic that is not part of the Shopping Guide are encouraged to approach their departmental advisor to discuss the feasibility of conducting the research either under the supervision of a faculty member in the department or in another department in the University. Many students select their projects early, in consultation with the faculty adviser, and begin the research during the summer preceding the senior year. The Department and the faculty adviser usually provide the necessary funds to conduct the independent research.

The Department requires that a student submit a thesis proposal (due in late September or early October) and several interim research progress reports, including the fall semester progress report, a rough draft of the thesis for feedback, and the final thesis. The goal of the interim reports is to facilitate timely adviser-student feedback, help minimize the unavoidable thesis rush at the end of the year, and ensure that the final product of the thesis is of the highest quality. In addition to writing their theses, all students give oral

presentations to the faculty and students of the geosciences department. The grade for the thesis is based on the quality of the research, the written report, and the oral presentation.

Senior Departmental Examination

The comprehensive examination in the Department consists of an oral examination based on the senior thesis and related topics.

Grading and Honors

Senior Thesis: You will be graded on (1) your thesis research plus written report and (2) oral presentation plus answers to questions.

Thesis Grade:

- i. Written thesis: Quality and clarity of writing, proper organization and citations, illustration of results, interpretation, and discussion, originality, and commitment to doing the best possible lab-, field-, or model-based research. Grade determined by adviser and second reader.
- ii. Oral presentation: Based on quality and clarity of presentation in lecture and illustrations as well as facility in answering questions pertaining to research results. Grade determined by the entire faculty.

The final thesis grade will be set only after a meeting of the faculty to discuss and rank all theses. In general, an A on a senior thesis means that the work and write-up submitted have sufficient merit to be published in a peer-reviewed journal. The final thesis grade is reported to the registrar and appears on the student's transcript.

Academic Honors

The Department awards academic honors (Honors, High Honors, Highest Honors) based on a combination of factors, including the overall grade point average (GPA), departmental GPA, the relevance and degree of difficulty of course load, junior research papers, and senior thesis. If the student has taken more than the required courses, then the courses with the highest grades that satisfy the concentration and breadth requirements are used in the calculation. For the senior thesis and junior research papers, the assigned grades will be used. In addition to grades, dedication to research, academic participation, and the overall impressions made by the student on the faculty are taken into consideration in the honors calculation. To ensure that the quality of honors remains consistent from year to year, the faculty compares student achievements with those from previous years.

Preparation for Graduate Study

Specialization in any one of the Earth sciences today requires graduate study. Students interested in pursuing graduate studies in any of the specializations are encouraged to take advanced chemistry, physics, mathematics, biology, and computer science courses. More specific information on graduate education can be obtained from the departmental representative or other faculty members.

Additional Information

Field Programs

Since experience in field geology can be an important aspect of professional training, students are encouraged to take a course in field methods in geology and oceanography.

Geological Field Camp

After their first year, sophomore or junior year, many of our students enroll in a Geosciences summer field camp (students should consult their faculty adviser in the November before they plan to attend summer field camp). Other students choose to work with a faculty member or a graduate student in the field, and may conduct independent research for junior or senior independent research as part of this opportunity. Geosciences facilitates student enrollment in these field opportunities by providing financial aid.

Experience at Sea

Students interested in ocean studies can participate in ongoing studies at sea or at the Bermuda Biological Station. The Department tries to make available opportunities to interested undergraduates to participate in an oceanographic cruise at some time during their undergraduate years.

Information on other opportunities for field experience is made available annually. The student should consult DUS if interested in participating in field programs.

Financial Assistance

Grants for field work in geology are available through the Tony Conway '36 Memorial Scholarship Fund. Grants for field and museum studies and research in natural history during the summer are available to students of high scholastic standing from the John Boyd '43 Memorial Fund and the Glenn L. Jepsen '27 Fund. Grants are available from the Erling Dorf '33 Fund for field work and the field course. The Howard T. Vaum Jr. '78 Fund supports studies in geological engineering in a field study program. Grants for environmental studies are available from the Princeton Environmental Institute. Students wishing assistance from any of these funds should present a proposal (two pages of research description) by February 15 to the DUS.

Funds are available from time to time for qualified undergraduates to serve as research assistants to faculty members during the regular academic session as well as during the summer months.

In some instances, summer employment for qualified students can be arranged with governmental, commercial, or academic field parties.