

GEOLOGY AND EARTH SCIENCE, PHD

Banner Code: SC-PHD-GESC

Academic Advising

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The Geology and Earth Science, PhD degree program prepares students with advanced knowledge and skills to analyze the structure, composition, and evolution of the Earth, the history of life the Earth supports, and the processes that govern the formation and behavior of the Earth's landforms and materials. The program trains students in the observation, measurement, and analysis of Earth's systems: the hydrosphere (i.e., bodies of water), the lithosphere (i.e., solid matter), and the atmosphere. The program focuses on the interrelationships of these systems and their interactions with the biosphere (i.e., Earth's living matter). Graduates of the program will be able to perform independent research, supervise the work of technicians, and coordinate work with other scientists, both in the field and in the lab. Graduates will be prepared for research and development of natural resources, such as petroleum and critical minerals. Graduates also will be able to teach undergraduates and graduate students at community colleges, colleges, and universities.

The program combines study in the disciplines of both geology and Earth science. Geology, the more traditional term for this area of study, is the study of the present and ancient Earth from the perspective of the rock record. The study of Earth science is inclusive of geology, but also encompasses study of present-day Earth processes, including those involving the atmosphere, oceans, and freshwater systems. Geologists and Earth scientists must be educated and trained in the use of a wide variety of tools. In the field, geoscientists use hammers and chisels to collect rock samples and also use ground-penetrating radar equipment to search for Earth resources. In the lab, X-rays and electron microscopes are used to determine the chemical and physical composition of rock samples. Remote sensing equipment is used to collect data, and geographic information systems and modeling software are used to analyze the data collected. The program is designed to provide students with training in the use and analysis of these tools and technologies.

The field of geology and Earth science is broad, giving it significant impact in several areas relevant to the economic health of society. Rapid advances in the field are occurring in four critical areas. First, geologic hazards such as earthquakes, landslides, and coastal threats from rising sea level are increasing. Second, characterizing the Earth's climate and global habitability across geologic time is essential to gauge the impacts of current and future climate change. Third, exploration for new mineral resources for emerging technologies and commodities is essential to fuel these industries. Fourth, providing authoritative stewardship for effective planet protection and sustainability is critical for the future well-being of humanity.

The Geology and Earth Science PhD degree program responds to the increasing need for geologists and Earth scientists with advanced education and training to understand and adapt to geological hazards,

apply the history of climate change to present and future climate changes, and explore for new Earth, mineral, and energy resources.

Admissions & Policies

Admissions

University-wide admissions policies can be found in the Graduate Admissions Policies (<https://catalog.gmu.edu/admissions/graduate-policies/>) section of this catalog.

Applicants should have an undergraduate or graduate degree in geology, Earth sciences, or a related field from an institution of higher education accredited by a Mason-recognized U.S. institutional accrediting agency or international equivalent with a GPA of at least 3.00 in their undergraduate work.

To apply for this program, please complete the George Mason University Admissions Application (<https://www2.gmu.edu/admissions-aid/apply-now/>) and supply three letters of recommendation.

Policies

For policies governing all graduate programs, see AP6 Graduate Policies (<https://catalog.gmu.edu/policies/academic/graduate-policies/>).

Transferring Previous Graduate Credit into this Program

Previously earned and relevant graduate credits may be eligible for transfer into this program; details can be found in the Credit by Exam or Transfer (<https://catalog.gmu.edu/policies/academic/graduate-policies/>) section of this catalog.

Requirements

Degree Requirements

Total credits: 72

Students should refer to the Admissions & Policies tab for specific policies related to this program.

Core Courses

Code	Title	Credits
Geology and Earth Science Foundation		
GEOL 525	Modeling Earth Signals and Systems	3
GEOL 540	Modern Methods in Geology	3
GEOL 541	Great Events in Earth History	3
GEOL 601	The Lithosphere	3
GEOL 752	Earth Sciences in Academia	2
Geology and Earth Science Seminars		
Select a total of four credits in any combination of the following seminar courses:		4
GEOL 536	Paleontology Seminar	
GEOL 792	Seminar in Earth Systems Science, Geology, Earth Science	

Research Methods

GEOL 720	Bayesian Methods in Geology and Earth Sciences	3
GEOL 996	Doctoral Reading and Research (repeat for a total of 15 credits)	15
STAT 634	Case Studies in Data Analysis	3
Total Credits		39

Restricted Elective Courses

Code	Title	Credits
Select 18 credits from the following, approved in advance by the Graduate Coordinator. ¹		18
GEOL 500	Selected Topics in Modern Geology	
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GEOL 504	Sedimentary Geology	
GEOL 506	Soil Science	
GEOL 510	Advanced Structural Geology	
GEOL 512	Invertebrate Paleontology	
GEOL 513	Hydrogeology	
GEOL 521	Geology of Energy Resources	
GEOL 532	Paleoclimatology	
GEOL 534	Vertebrate Paleontology	
GEOL 535	Quantitative Stratigraphy	
GEOL 553	Field Mapping Techniques	
GEOL 563	Coastal Morphology and Processes	
GEOL 565	Paleoceanography	
GEOL 603	Geochemistry	
GEOL 734	Paleobiology	
GEOL 741	Isotopes in Geology	
Total Credits		18

¹ Select courses that have not previously been completed at the undergraduate course level.

Dissertation Committee

Requirements for the dissertation committee's composition can be found in the AP6.10.5 (<https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-10-5>) section of this catalog.

Students may select a fourth member with approval of the PhD Program Director. This option typically would be employed in order to include an external expert relevant to the student's field of study.

Comprehensive Exam

The comprehensive exam includes written and oral components to assess whether students have the subject matter knowledge and skills to successfully propose and complete a dissertation research project and an oral component. Students must complete the comprehensive exam within two semesters after the completion of all core and concentration coursework on their approved program of study. The comprehensive exam will consist of a set of questions tailored to the individual student. The committee will be comprised of the same individuals as the Dissertation Committee. Exams will be graded on a pass/fail basis. Students must successfully pass both the written and oral portions of the comprehensive exam in order to advance to candidacy. Students who fail either the written or the oral portion of the comprehensive exam will be granted one attempt to retake the examination the following semester.

Students who do not pass the second attempt will be dismissed from the PhD program.

Written Comprehensive Exam

The written portion of the comprehensive exam will assess the student's ability to apply theoretical concepts towards the designing of potential research studies necessary to write a doctoral dissertation. It will also assess the student's capability to form research questions and present appropriate methodologies to test such questions (including, for example: Study design, analytical model development, data acquisition or collection, data management, and analysis and interpretation). The questions on the exam will be linked with the student's program of study and proposed research subject matter.

Oral Comprehensive Exam

The oral portion of the comprehensive exam will assess the student's knowledge and comprehension of the subject matter background to the field of geology and Earth sciences as a whole, as well as the specific body of knowledge related to the student's chosen area of specialty and research. The student must demonstrate mastery in articulating answers including the limitations around data to prepare them for effectively working with various audiences.

Dissertation

Code	Title	Credits
GEOL 998	Doctoral Dissertation Proposal (repeated for a minimum of 12 credits)	12
GEOL 999	Doctoral Dissertation (repeated for a minimum of 3 credits)	3
Total Credits		15

Advancement to Candidacy

Advancement to candidacy is based upon the student's successful completion of all required coursework and passing the comprehensive examination. Advancement to candidacy is a prerequisite for admission into GEOL 998 Doctoral Dissertation Proposal.

Dissertation Proposal

Students who have advanced to candidacy begin working on the dissertation proposal the semester after passing their comprehensive exams by registering for GEOL 998 Doctoral Dissertation Proposal. Students design the conceptual framework for their research projects in consultation with the dissertation committee. A draft dissertation proposal should be submitted to the student's dissertation committee within two semesters of completing the comprehensive exam. The proposal should include a detailed literature review that provides the context and rationale for the research questions and describes the proposed study design and analytic methods. The proposal must address the feasibility of completing the dissertation research within an appropriate time. A list of dissertation committee members must be included in the proposal, confirming each committee members' agreement to serve on the committee.

An oral proposal defense will be scheduled with all dissertation committee members in attendance. During the oral proposal defense, students describe their proposed research and address questions by the committee members. At the conclusion of the oral defense, the dissertation committee either approves the dissertation or provides written recommendations for improving the proposed research with clearly stated expectations for resubmission. All proposal defenses are open to faculty and students in the College of Science. Candidates

attending the oral defense may be allowed to ask questions. The dissertation committee holds an executive session after the formal defense to finalize a decision for the student. Passing the proposal defense is a prerequisite for GEOL 999 Doctoral Dissertation. Failure to submit the proposal in a timely manner is grounds for academic probation.

Dissertation Defense

The dissertation defense is an oral presentation of the dissertation work in a public forum open to all members of the university community. An abstract and draft dissertation approved by the dissertation committee in conformance with University Library requirements is required before the defense can be scheduled. The student consults with the dissertation committee to identify a date and time for the dissertation defense. Once a date and time has been confirmed, the student works with the appropriate area administrative assistant to reserve a room for the defense. All dissertation committee members should be present. The dissertation committee convenes after the public session to discuss and approve the dissertation. The student is notified after the committee's executive session. The student is responsible for making all required edits before final acceptance of the dissertation adhering to the university's timeline for graduation.

Program Outcomes

Learning Outcomes

1. Demonstrate a breadth of knowledge of geology and earth sciences across the subfields of geology and earth sciences, along with a depth knowledge in their area(s) of specialization.
2. Exhibit expertise in research methodologies, analytical techniques, and interpretation of findings applicable to a variety of geologic research questions.
3. Effectively conduct critical reviews of relevant scientific literature.
4. Incorporate appropriate ethical standards in all research activities.
5. Produce original, reproducible research that contributes to the knowledge base of geology and earth sciences.
6. Expertly communicate research results to both scientific peers and general audiences.
7. Master the skills to conduct a research program including running a research laboratory and writing effective grant proposals.
8. Design instructional strategies in geology and Earth sciences that facilitate student learning in higher education.