**Graduate Degree Learning Outcomes**

The Earth Sciences encompass a wide variety of subdisciplines that focus on developing and promoting an understanding of our planet, its resources, marine and terrestrial environments, and the physical, chemical and biological processes involved in past and future global change. The Department of Earth Sciences offers programs of graduate study leading to Doctor of Philosophy (Ph.D.) and Master’s (M.S.) degrees. The goal of these programs is to intellectually prepare students for careers in academia, industry, applied research, employment with state and federal agencies, positions with private consulting organizations, or other areas.

*Master’s Program:*

The master’s degree provides students with experience and training in all aspects of scientific research, including the formulation and testing of hypotheses, acquiring skills needed for their chosen project, collection and interpretation of data, and summarizing significant results in thesis or publication format. The student’s research advisor and faculty guidance committee typically play a central role in defining the scale, scope, and objectives of a Master’s thesis. The thesis represents a substantial scientific contribution of sufficient quality that portions warrant submission to an academic journal for broad dissemination to the scientific community. Typically, Earth Science students complete a M.S. degree, but a M.A. may be awarded if the student desires and completes the University language requirement.

Students who successfully complete a Master’s Degree in Earth Sciences will be able to:

1. Demonstrate proficiency with the measurement, mapping, analytical and/or modeling tools that are required to quantify and analyze the aspects of Earth materials, Earth processes and Earth history that are relevant to their chosen subdiscipline.

2. Develop and test hypotheses in a systematic way while stating reasonable assumptions and caveats, and in the context of the (real-world) problem of incomplete, inconsistent and noisy data sets.

3. Show familiarity with current scientific understanding of topics that tie directly to their thesis research, as summarized in the current literature.

4. Organize and present their scientific results both in concise, well-reasoned technical writing and in front of large scientific audiences at major conferences.

5. Demonstrate the techniques required to collect the data, develop the process-based descriptions, analyze the scientific evidence, and/or quantitatively describe the behavior underlying phenomena that are central to their chosen subdiscipline.

6. Show understanding of ethical issues and responsibilities, especially in matters related to professionalism, data collection, the laboratory setting, and writing and publishing theses, dissertations, and scientific papers

*PhD Program:*

The Ph.D. program provides students with experience and training in all aspects of scientific research, including the formulation and testing of hypotheses, acquiring skills needed for their chosen project, collection and interpretation of original data, and writing up the results as a set of published papers. The expectation for a Ph.D. student extends beyond that of a Masters student in the individual’s ability to design and carry out original, independent research on a focused topic. At the Ph.D. level, the research advisor and faculty guidance committee provide guidance and input, but the student is expected to take the lead in designing, executing, and writing up the results of their research. The primary product in fulfillment of the Ph.D. degree is a dissertation that represents a unique scientific contribution with the expectation that much of the work will be published as a set of peer-reviewed research papers that advance understanding in their chosen subdiscipline so that they represent a substantial scientific contribution.

Students who successfully complete a PhD in Earth Sciences will be able to:

1. Demonstrate proficiency with the measurement, mapping, analytical and/or modeling tools that are required to quantify and analyze the aspects of Earth materials, Earth processes and Earth history that are relevant to their chosen subdiscipline.

2. Develop and test hypotheses in a systematic way while stating reasonable assumptions and caveats, and in the context of the (real-world) problem of incomplete, inconsistent and noisy data sets.

3. Show familiarity with current scientific understanding of topics that tie directly to their thesis research, as summarized in the current literature.

4. Organize and present scientific results both in concise, well-reasoned technical writing and in front of large scientific audiences at major conferences.

5. Demonstrate the techniques required to collect the data, develop process-based descriptions, analyze the scientific evidence, and/or quantitatively describe the behavior underlying phenomena that are central to their chosen subdiscipline.

6. Show understanding of ethical issues and responsibilities, especially in matters related to professionalism, data collection, the laboratory setting, and in writing and publishing theses, dissertations, and scientific papers.

7. Identify, define, and clearly argue the significance of a scientific problem, acquire the data or perform the analysis required to test competing hypothesis, and execute the research necessary to develop convincing arguments that advance scientific understanding.

**Graduate Degree Assessment Plans**

The Department of Earth Sciences assesses the performance and learning of graduate students through evaluation of course work, regular committee meetings, student presentations and peer-reviewed publications, and the culmination of student research summarized in their written thesis and oral presentation. Specific assessment techniques applied to evaluate the Master’s and Doctoral programs are summarized below. In addition to these steps taken to assess the performance of individual students, the Department of Earth Sciences is keenly interested in the success of graduates from our program and accordingly we have begun a process of formally tracking post-graduate employment and are implementing an anonymous “exit interview” survey to gather program feedback from departing graduates.

*Master’s Program:*

Master’s students in the Earth Sciences are required to complete 24 graded classroom credits in courses at the graduate level (i.e. numbered 5xx or 6xx). Aspects of learning objectives 1-3 are assessed as part of the grading process during this portion of the degree program.

In addition to the graded credits, all incoming graduate students must enroll in a one credit Geol. 607 Ethics seminar designed to address and enable partial assessment of learning objective 6.

All graduate students are required to give at least one formal presentation each year either at a conference or in a graduate or departmental seminar. Together with the completion and committee review of a written thesis and the associated oral presentation, this enables the assessment of learning objective 4.

Progress on thesis research is gauged through regular meetings between student and advisor and through meetings with a guidance or thesis committee that are held at least once each year (in spring term) and commonly more often. This is the main way in which learning objective 5 is assessed and it also enables further assessment of learning objectives 3 and 4.

*PhD program:*

PhD students in the Earth Sciences are required to complete 15 graded classroom credits in courses at the graduate level (i.e. numbered 5xx or 6xx). Aspects of learning objectives 1-3 are assessed as part of the grading process during this portion of the degree program.

In addition to the graded credits, all incoming graduate students must enroll in a one credit Geol. 607 Ethics seminar designed to address and enable partial assessment of learning objective 6.

All graduate students are required to give at least one formal presentation each year either at a conference or in a graduate or departmental seminar. Together with the completion and committee review of a written dissertation and the associated oral defense, this enables the assessment of learning objective 4.

Progress on thesis research is gauged through regular meetings between student and advisor and through meetings with a guidance or thesis committee that are held at least once each year (in spring term) and commonly more often. This is the main way in which learning objectives 5 and 7 are assessed and it also enables further assessment of learning objectives 3 and 4.

To advance to candidacy, PhD students must successfully pass a comprehensive exam that is designed to assess key aspects of learning objective 7. The exam also tests aspects of learning objectives 3, 4 and 5. As a prelude to the exam, students write two proposals on potential research projects. The exam itself includes both a written portion and an oral presentation, and the latter includes time for question aimed at assessing the student’s proposed research projects and depth of scientific knowledge needed to complete the research.