Department of Earth Sciences offers M.S. and Ph.D. degrees in Earth Sciences (Geography, Geology, and Geobiology content areas). We stress independent thesis research with supporting course work. Our expertise spans most of the subfields of Earth Sciences. Our Geography faculty includes specialties including historical and cultural geography, settlement geography, resource geography (energy and water), economic geography, planning, bioclimatology, applications of GIS and snow science. The interests of our Geology faculty include composition and structure of the crust, quantitative geomorphology, sedimentation and stratigraphy. Our Geobiology faculty has research interests in vertebrate paleontology, paleoecology, biogeography, paleoclimatology, and geomicrobiology. Our program strengths are in basin analysis and energy resources, dinosaur paleontology, geography of the northern Rocky Mountains, architecture and composition of the lithosphere, snow science and cryospheric processes, and climate change. Examples of thesis titles can be found on the Department of Earth Sciences web page (see above).

Admission
The department generally expects applicants to have a GPA of 3.0 or higher and GRE Scores better than the 50th percentile and a strong academic background in Earth Sciences (Geography, Geology, or Geobiology). International students must have an English proficiency score (at or above) the following: TOEFL, [IBT: 93, CBT: 237, or PBT: 580], IELTS [level 7.0], or PTE [level 61]. The department does not accept general applicants to our graduate program. An applicant should identify a major advisor from the list of faculty (found on the department website above), contact that individual, and determine whether there is space available in that adviser’s program.

For applicants who wish to study geography, the department requires the equivalent of a geography minor (eight semester geography courses including map skills, world regional, human, and physical geography) as background. A geography undergraduate degree is preferred and coursework and practical experience involving geographic skills such as cartography, field methods, aerial photograph interpretation, remote sensing, GIS and quantitative methods are considered a desirable part of an applicant’s background.

For applicants who wish to study geology, the department expects him/her to have a year each of calculus, physics and chemistry as well as physical geography, mineralogy, petrology, historical geology, geomorphology, sedimentation, stratigraphy, structural geology, and a field geology course which emphasizes mapping. These requirements are typically met by an undergraduate degree in geology. Applicants who have not completed all requirements may be admitted, but are expected to make up deficiencies during the first year of graduate study.

For applicants who wish to study geobiology, the department expects an applicant to have a degree in geology, biology or a closely related field. The most competitive applicants have significant upper-division course work in both geology and biology.

For optimum course scheduling, applicants are accepted into the graduate program only at the start of Fall semester. Under certain conditions, we will admit a student for summer or spring, but this must be coordinated by the major professor. Successful applicants must be accepted both by the department and by The Graduate School.

Program Requirements
Students are expected to develop a solid curricular foundation in geography, geology or geobiology. Graduate programs include a core of geography, geology, or geobiology courses and are further tailored in consultation with the advisor and graduate committee to the specific talents and interests of the individual student. Coursework in disciplines outside the department is encouraged to support and enhance specific research areas in the Earth Sciences.

Graduate and 400-level (senior) courses in earth science include: snow dynamics, geobiology, geomicrobiology, Quaternary Environments of the Western US, Quaternary paleoecology, and Quaternary environments. Graduate and 400-level (senior) courses of study in geography include: historical geography, geographic thought, population geography, water and society, vulnerability and environmental hazards, advanced topics in resource geography, topics in political ecology, mountain geography, applied GIS and spatial analysis, tourism planning, advanced regional geography, East Asia in the global system, GIS research fundamentals, settlement geography, and land use planning. All graduate students with a concentration in Geography are required to complete a 1-credit (500 level) course entitled Current Research and Applications in Geography in the Fall of their first year. Graduate and 400-level (senior) courses of study in geology include: tectonics, igneous petrology, metamorphic petrology, sedimentary petrology, graduate structural geology, volcanology, glacial geology, advanced stratigraphy, clastic sedimentology, tectonics of sedimentary basins, petroleum geology, depositional systems, vertebrate paleontology, macroevolution and the fossil record, taphonomy, comparative vertebrate anatomy, geology of the northern Rocky Mountains. All graduate students enroll in a 2-credit seminar during their first fall semester.

Facilities
The primary research facility is the northern Rocky Mountain field laboratory which includes Yellowstone National Park, and the Greater Yellowstone GeoEcoSystem. Field work is also done in China, Argentina, Chile, Nepal, Namibia, and New Zealand. Field-based research in the Rocky Mountains is a component of many Earth Sciences graduate students’ study. Field equipment include tools for location and altitude (from conventional compasses and altimeters to auto levels, a total station and GPS ground stations), sampling devices including suspended and bedload sediment samplers, current meters paleomagnetic rock drills, hammer seismograph, auto level, total station, snow density kits, U.S. Federal Snow samplers, ram sondes, shear frames, lake-sediment coring equipment and the like. Field work is supplemented by laboratory analysis in several facilities across campus. The Department has crushers, Franz magnetic-susceptibility separator, balances, rock saws, lap wheels, and a paleontology preparation laboratory. The Department also has several high-quality (Leitz and Nikon) transmitted and reflected light research petrographic microscopes with photo microscopy and cathode luminescence capability and computer-driven image analysis capabilities. There is an MSU Paleocology Lab under the direction of Cathy Whitlock, a geomicrobiological/geochemoal laboratory under the direction of Mark Skidmore, a structural geology
laboratory under the direction of David Lageson and Mary Hubbard, a snow and avalanche laboratory under the direction of Jordy Hendriks, and a geochem wet laboratory under the direction of Jean Dixon.

There are other laboratories on campus that Earth Scientists use. The MSU Spatial Sciences Center under the direction of Rick Lawrence provides instruction and research opportunities for faculty and students interested in Global Positioning Systems, GIS and remote sensing. This center supports ARC/INFO and ERDAS on workstations, pcARC/INFO and IDRISI and IMAGINE on PCs, and a variety of digitizers, scanners, printers and plotters for data input and output.

The Imaging and Chemical Analysis Laboratory (ICAL) contains analytical equipment which includes a scanning electron microscope (with EDS, BSE, and CL spectrometers), automated powder X-ray diffraction, X-ray photoelectron spectroscopy, Auger electron spectroscopy, and time-of-flight SIMS.

The Subzero Science and Engineering Laboratory under the direction of Ed Adams has a variety of cold rooms for research on snow and ice including a flume laboratory for the study of ice in streams and lakes, and laboratories with radiation and thermal pulses to examine snow and ice properties under varying weather and climatic regimes.

The vertebrate (dinosaur) paleontology laboratory of the Museum of the Rockies, contains state-of-the-art microscopic and computerized image-enhancement equipment for the study of dinosaur bones, as well as other chemical and mechanical equipment for the preparation and analysis of fossilized vertebrates.

Graduate students in Geography may also work closely with faculty and facilities in the Departments of Political Science, Native American Studies, Sociology and Anthropology, Agricultural Economics and Economics, and History and Philosophy.

**Assistance**

Graduate students in Earth Sciences have been successful with National Science Foundation Fellowships and research grants from Geological Society of America, the American Association of Petroleum Geologists, the Society for Sedimentary Geology, the U.S. Forest Service, and Sigma Xi, and have won University-wide and regional awards for thesis research.

Teaching and research assistantships are available each year. Graduate scholarships are awarded annually on a competitive basis in the second year of residence to assist with thesis research. See the Earth Sciences website or contact the department for more information.

**Degree Offered**

- M.S. in Earth Sciences (http://catalog.montana.edu/graduate/letters-science/earth-sciences/ms-earth-sciences)
- M.S. in Land Rehabilitation (http://catalog.montana.edu/graduate/agriculture/land-resources-environmental-sciences/ms-land-rehabilitation) (Interdisciplinary degree)
- Ph.D. in Earth Sciences (http://catalog.montana.edu/graduate/letters-science/earth-sciences/phd-earth-sciences)
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 Adobe Garamond Pro.

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