Department of Geosciences

Faculty
Chair and Professor
McCurry

Professors
Link
Finney
Rodgers
Thackray

Associate Professors
Crosby
Leif Tapanila
Lohse

Assistant Professors
Delparte
Godsey
Kobs
Pearson

Research Assistant Professor
Shapley

Associate Lecturer
Lori Tapanila

Assistant Lecturer
Bottenberg

Affiliate Faculty
Dehler
Glenn
Halemichael
Mahar
Plummer
Rittenour
Sherwin
Welhan

GIS Trec Affiliate
Weber

Emeriti
Blount
Hughes

Overall Departmental Goals
1. Graduates will think critically and comprehend written and verbal communications about geoscience topics.
2. Graduates will have specific skills for careers in geoscience and related industries, licensure, or to continue in graduate study.
3. Graduates will attain employment in geology or related fields or gain admission to graduate programs.

Program-Specific Goals and Objectives
I. Goals
1. Graduates will know geoscience materials, principles, and their applications to scientific inquiry and to societal concerns.

II. Objectives
1. Provide undergraduate students with coursework, laboratory experiences, field exercises and hands-on opportunities in order to achieve all goals set forth above.
2. Improve students’ awareness of opportunities for professional employment, licensure, or continued education.

The Idaho State University Department of Geosciences is an active community of scholars consisting of undergraduate and graduate students, support and research staff, and professors. Objectives of the department are to train students for professional positions or further study in all aspects of the geosciences. Most courses include field trips and hands-on experience. The Idaho State University Geology summer field camp based at the Lost River Field Station north of Mackay, Idaho, is nationally recognized and attended by students from universities nationwide.

The Idaho State University Geosciences Department offers Bachelor of Science and Bachelor of Arts degrees in Geology, Post-Baccalaureate Geotechnology Certificate, Master of Science degree in Geology, Master of Science degree in Geographic Information Science, and Master of Natural Science degree for teachers who desire more training in up to-date science methods. The B.S. in Geology with Emphasis in Engineering Geology, the M.S. in Geology with Emphasis in Environmental Geoscience, and a Doctor of Philosophy degree in Engineering and Applied Science are also available.

Students who have taken GEOL 1100 and GEOL 1100L, or GEOL 1101 and GEOL 1101L, and who have decided to major in geology, must take GEOL 1110, which is the prerequisite for many other courses in the geology major. For the purposes of a geology major or minor, only 4 credits will be granted for any combination of GEOL 1100, GEOL 1100L, GEOL 1101, GEOL 1101L, and GEOL 1110.

Bachelor of Arts in Geology
The B.A. degree is offered for students who wish either a broader-based liberal arts degree or a broader multi-disciplinary science degree than is possible with the B.S. The B.A. degree is especially suited for future earth science teachers, environmental scientists, environmental lawyers, and others who wish to learn more about how the earth works. The degree fulfills major requirements for secondary school earth science teachers. Students must fulfill 8 of the 9 university General Education Objectives (a minimum of 36 credits—see the General Education Requirements (http://coursecat.isu.edu/undergraduate/academicinformation/generaleducation) in the Academic Information section of this Catalog).

Required Courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1111 &amp; 1111L</td>
<td>General Chemistry I and General Chemistry I Lab</td>
<td>5</td>
</tr>
<tr>
<td>GEOL 1100 or GEOL 1101</td>
<td>The Dynamic Earth or Physical Geology</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 1110</td>
<td>Physical Geology for Scientists Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>GEOL 2202</td>
<td>Historical Geology</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 2210</td>
<td>Earth in Space and Time</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>GEOL 3313</td>
<td>Earth Materials I</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 3315</td>
<td>Evolution of the Earth's Surface</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4421</td>
<td>Structural Geology</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4431</td>
<td>Geobiology and the History of Life</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4452</td>
<td>Sedimentation-Stratigraphy</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4456</td>
<td>Geology of Idaho</td>
<td>2-3</td>
</tr>
<tr>
<td>or GEOL 4458</td>
<td>Geology of North America</td>
<td></td>
</tr>
</tbody>
</table>

Plus 8 to 9 other upper division geoscience credits to equal 40 GEOL credits.

1. MATH 1143, MATH 1147, or equivalent, is required for CHEM 1111; MATH 1143 and MATH 1144 or MATH 1147, or equivalent, is required for GEOL 4421.

**Bachelor of Science in Geology**

The B.S. degree is offered for undergraduates who wish to become professional geoscientists either after their bachelor’s degree or after subsequent graduate study. It trains students in the essential observational and analytical skills of field geology as well as more applied areas of microscope petrology, geochemistry, and geotechnology. The B.S. degree is designed to give the student a broad and comprehensive understanding of the discipline of geology and a firm background in math, physics, and chemistry. Students must fulfill 8 of the 9 University General Education Objectives (a minimum of 36 credits—see the General Education Requirements (http://coursecat.isu.edu/undergraduate/academicinformation/generaleducation) in the Academic Information section of this catalog).

**Required Courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1170</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1175</td>
<td>Calculus II</td>
<td>3-4</td>
</tr>
<tr>
<td>or MATH 3350</td>
<td>Statistical Methods</td>
<td></td>
</tr>
<tr>
<td>CHEM 1111</td>
<td>General Chemistry I</td>
<td>5</td>
</tr>
<tr>
<td>&amp; 1111L</td>
<td>General Chemistry I Lab</td>
<td></td>
</tr>
<tr>
<td>CHEM 1112</td>
<td>General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 1112L</td>
<td>General Chemistry II Lab</td>
<td></td>
</tr>
<tr>
<td>PHYS 1111</td>
<td>General Physics</td>
<td>6-8</td>
</tr>
<tr>
<td>&amp; PHYS 1112</td>
<td>General Physics II</td>
<td></td>
</tr>
<tr>
<td>or PHYS 2211 &amp; PHYS 2212</td>
<td>Engineering Physics I &amp; Engineering Physics II</td>
<td></td>
</tr>
<tr>
<td>GEOL 1100</td>
<td>The Dynamic Earth</td>
<td>3</td>
</tr>
<tr>
<td>or GEOL 1101</td>
<td>Physical Geology</td>
<td></td>
</tr>
<tr>
<td>GEOL 1110</td>
<td>Physical Geology for Scientists</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOL 2202</td>
<td>Historical Geology</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 2210</td>
<td>Earth in Space and Time</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 3313</td>
<td>Earth Materials I</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 3314</td>
<td>Earth Materials II</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 3315</td>
<td>Evolution of the Earth's Surface</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4403 &amp; 4403L</td>
<td>Principles of Geographic Information Systems &amp; Principles of GIS Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 4421</td>
<td>Structural Geology</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4450</td>
<td>Field Geology</td>
<td>6</td>
</tr>
<tr>
<td>GEOL 4452</td>
<td>Sedimentation-Stratigraphy</td>
<td>4</td>
</tr>
</tbody>
</table>

37 required geoscience credits plus at least 5 different upper division geoscience courses to equal at least 50 geoscience credits.

1. May choose the following optional courses: PHYS 1113, PHYS 1114, General Physics Laboratory, 2 cr; PHYS 2213, PHYS 2214, Engineering Physics Laboratory, 2 cr
2. GEOL 4450 is a 5-week summer field course, usually taken between the junior and senior years.

**Emphasis in Engineering Geology**

Complete the following courses in addition to the Bachelor of Science in Geology:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE/GEOL 4454</td>
<td>Basic Engineering Geology</td>
<td>3</td>
</tr>
<tr>
<td>CE/GEOL 4455</td>
<td>Geologic Data Methods</td>
<td>3</td>
</tr>
<tr>
<td>CE/GEOL 4475</td>
<td>Essentials of Geomechanics</td>
<td>3</td>
</tr>
<tr>
<td>CE/GEOL 4476</td>
<td>Engineering Geology Project</td>
<td>1</td>
</tr>
<tr>
<td>CE 4480</td>
<td>Earthquake Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

**Minor in Geology**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOL 1100</td>
<td>The Dynamic Earth</td>
<td>3</td>
</tr>
<tr>
<td>or GEOL 1101</td>
<td>Physical Geology</td>
<td></td>
</tr>
<tr>
<td>GEOL 1110</td>
<td>Physical Geology for Scientists</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOL 2202</td>
<td>Historical Geology</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 2210</td>
<td>Earth in Space and Time</td>
<td>3</td>
</tr>
</tbody>
</table>

**In Addition:**

Upper Division Geology electives approved by the Department 12

Total Hours 22

**Minor in GeoTechnology**

**Core Courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOL 4403 &amp; 4403L</td>
<td>Principles of Geographic Information Systems &amp; Principles of GIS Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 4404</td>
<td>Advanced Geographic Information</td>
<td>3</td>
</tr>
<tr>
<td>Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOL 4407</td>
<td>GPS Applications in Research</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 4408</td>
<td>GeoTechnology Seminar</td>
<td>1-2</td>
</tr>
<tr>
<td>or BIOL 4418</td>
<td>Ecological Topics</td>
<td></td>
</tr>
<tr>
<td>GEOL 4409</td>
<td>Remote Sensing</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Hours 13-14

**Electives (at least 5 credits):**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTH 4482</td>
<td>Independent Problems in Anthropology</td>
<td>1-3</td>
</tr>
<tr>
<td>BIOL 4482</td>
<td>Independent Problems</td>
<td>1-4</td>
</tr>
<tr>
<td>GEOL 2210</td>
<td>Earth in Space and Time</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 4427</td>
<td>Information Technology for GIS</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 4428</td>
<td>Programming for GIS</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 4480</td>
<td>Special Topics in GIS</td>
<td>1-3</td>
</tr>
<tr>
<td>GEOL 4481</td>
<td>GeoTechnology Internship</td>
<td>1-3</td>
</tr>
</tbody>
</table>
Bachelor of Science or Bachelor of Arts in Earth and Environmental Systems

The purpose of this program is to deliver a multidisciplinary education with environmental geosciences as a foundation, while also drawing upon existing courses from a diverse array of departments and programs.

The emphasis in this program spans local to global concerns. Core knowledge is developed through a set of required courses across multiple disciplines, emphasizing the Geosciences, and through required and elective core courses. The student then chooses one of three tracks composed of courses in Geosciences and related disciplines.

Curriculum Outline

The Earth and Environmental Systems curriculum consists of two components:

1. required Geosciences and cross-disciplinary Core Courses, and
2. required and elective courses in one of three cross-disciplinary tracks.

Most students will be able to complete degree requirements (74-77 credits) and General Education requirements (a minimum of 36 credits—see the General Education Requirements (http://coursecat.isu.edu/undergraduate/academicinformationGENERATEDUCTION) in the Academic Information section of this Catalog) within the typical 120-credit, 4-year Bachelor’s degree. Some of the degree requirements may also satisfy General Education requirements. Depending on results of placement tests in mathematics and other areas, students may be required to take additional coursework, and may thus require more than 120 credits to fulfill both General Education and degree requirements.

1. Required Core Courses

The Required Core Courses provide a solid background within and beyond the Department of Geosciences. Environmental Systems include physical, biological, and human systems; thus, we require course work in Geosciences, Biological Sciences, Physical Science, Chemistry, and Mathematics. Each track also includes related courses in the social sciences.

2. Cross-disciplinary Track Requirements

Cross-disciplinary tracks: the student will pursue one of three tracks, each consisting of specified and elective courses:

- BS in Environmental Systems: Upper division courses emphasizing environmental aspects of Geosciences and Biological Sciences, with supporting courses in Mathematics, Chemistry, Physics, and social sciences.
- BS in Geospatial Systems: Upper division geotechnologies courses in Geosciences and History, with supporting courses in Mathematics and social sciences.

Required Core Courses

The Required General Courses provide a solid background in Geosciences and other subjects. Environmental Systems include physical, biological and human systems; thus, the program incorporates course work in Biological Sciences, Physical Science, Mathematics, Statistics and social sciences. Some of these courses may satisfy General Education requirements.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1101</td>
<td>Biology I and Biology I Lab</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 1102</td>
<td>Biology II and Biology II Lab</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 1111</td>
<td>General Chemistry I and General Chemistry I Lab</td>
<td>5</td>
</tr>
<tr>
<td>MATH 1147</td>
<td>Precalculus (B.A.)</td>
<td>5</td>
</tr>
</tbody>
</table>

Recommended:

- ENGL 3307 Professional and Technical Writing | 3 |

Tracks - students must choose one emphasis area from the three described below

1. BS Environmental Systems Track

This track combines courses in Ecology, Environmental Geosciences, and supporting fields. This emphasis track will train students interested in field-related careers who need to understand the environmental relations between geologic and living systems.

Select two courses from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOL 4402</td>
<td>Geomorphology and Geomorphology Lab</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4300</td>
<td>Principles of Hydrogeology</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 4417</td>
<td>Introduction to Soils and Critical Zone Processes and Introduction to Soils and Critical Zone Processes Lab</td>
<td>4</td>
</tr>
</tbody>
</table>

Or other approved courses in watershed hydrology and related fields.

Select two courses from the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 4402 &amp; 4402L</td>
<td>Population Ecology and Population Ecology Lab</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 4462 &amp; 4462L</td>
<td>Freshwater Ecology and Freshwater Ecology Lab</td>
<td>4</td>
</tr>
<tr>
<td>BIOL 4489</td>
<td>Field Ecology</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4490</td>
<td>Ecosystem Ecology and Global Changes</td>
<td>4</td>
</tr>
</tbody>
</table>

Required Courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1112 &amp; 1112L</td>
<td>General Chemistry II and General Chemistry II Lab</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 4451</td>
<td>Field Methods in Environmental Sciences</td>
<td>3</td>
</tr>
</tbody>
</table>
PHYS 1111 General Physics 4 & PHYS 1113 and General Physics I Laboratory or
PHYS 2211 Engineering Physics I 3 & PHYS 2213 and Engineering Physics I Laboratory (recommended)
MATH 1160 Applied Calculus 3 or MATH 1170 Calculus I

MATH 3350 Statistical Methods 3

Recommended:
BIOL 3316 Biometry Laboratory 1

Select one course from the following:
GEOL 4410 Science in American Society 2
HIST 4430 Global Environmental History 3
POLS 4455 Environmental Politics and Policy 3

Select one elective, not used to satisfy other requirements, from the following:
GEOL 4410 Science in American Society 2
GEOL/HIST 4471 Historical Geography of Idaho 3
HIST 4430 Global Environmental History 3
HIST 4432 U.S. Environmental History 3
HIST 4489 GIS for Social Sciences 3
HIST 4490 Cartography History and Design 4 & 4490L and Cartography Lab
POLS 4455 Environmental Politics and Policy 3
POLS 4466 Public Lands Policy 3
ANTH 4402 Ecological Anthropology 3
ECON 3352 Environmental Economics 3
PHIL 4455 Environmental Ethics 3
SOC 3335 Population and Environment 3

2. BS Geospatial Systems Track
This track combines courses in Geospatial Sciences, Environmental Geosciences, and supporting fields. This emphasis track will train students interested in geotechnology-related careers with government agencies, private companies, and academic institutions.

Required Courses:
GEOL 4404 Advanced Geographic Information Systems 3
GEOL 4407 GPS Applications in Research 3
GEOL 4408 GeoTechnology Seminar 2
GEOL 4409 Remote Sensing 3
GEOL 4427 Information Technology for GIS 3
GEOL 4428 Programming for GIS 3

Select one course from the following:
GEOL 4480 Special Topics in GIS 1-3
GEOL 4481 GeoTechnology Internship 1-3
GEOL 4482 Independent Problems and Studies in Geology 1-3

Required Mathematics Courses:
MATH 3350 Statistical Methods 3
Select one of the following two courses:
MATH 1160 Applied Calculus 3 or
MATH 1170 Calculus I 4

Select one course from the following:
GEOL 4410 Science in American Society 2

3. BA Environmental Systems Track
This track combines courses in the social sciences with core science courses to develop broad-based knowledge in Environmental Science, the history and practice of environmental policy, and sociological and philosophical aspects of the environment. This emphasis track will train students interested for careers related to environmental policy and management.

Required Courses:
ECON 2201 Principles of Macroeconomics 3
ECON 2202 Principles of Microeconomics 3
GEOL 2210 Earth in Space and Time 3
GEOL 4410 Science in American Society 2
HIST 4430 Global Environmental History 3
MATH 1153 Introduction to Statistics 3 or MATH 3350 Statistical Methods
PHIL 4455 Environmental Ethics 3 or PHIL 2250 Contemporary Moral Problems
POLS 4455 Environmental Politics and Policy 3

Select one methods course from the following:
HIST 2291 The Historian's Craft 3
POLS 4453 Public Policy Analysis 3
SOC 3308 Sociological Methods and Social Work Research 3

Select three elective courses, not used to satisfy other requirements, from the following:
ANTH 4402 Ecological Anthropology 3
ECON 3352 Environmental Economics 3
GEOL/HIST 4471 Historical Geography of Idaho 3
HIST 4432 U.S. Environmental History 3
HIST 4489 GIS for Social Sciences 3
HIST 4490 Cartography History and Design 4 & 4490L and Cartography Lab
POLS 2221 Introduction to International Relations 3
POLS 4408 Urban Spaces 3
POLS 4409 Community Planning 3
POLS 4453 Public Policy Analysis 3
POLS 4466 Public Lands Policy 3
Courses

**GEOL 1100 The Dynamic Earth: 3 semester hours.**
Understanding the Earth as a dynamic system. Explores the interaction between four major earth components: the solid earth, the atmosphere, the ocean and biological communities, including humans. Specific focus on climate change, natural hazards, and Earth resources. Partially satisfies Objective 5 of the General Education Requirements. F, S, ASu

**GEOL 1100L The Dynamic Earth Lab: 1 semester hour.**
Focuses on the Earth System and the interaction of humans with the environment. Topics include: earth, water and energy resources as well as natural and human-caused disasters. COREQ: GEOL 1100. Partially satisfies Objective 5 of the General Education Requirements. F, S, ASu

**GEOL 1101 Physical Geology: 3 semester hours.**
Geological fundamentals: rocks and minerals, geologic time, plate tectonics, earthquakes, volcanoes, surface processes, earth resources and climatic change. Partially satisfies Objective 5 of the General Education Requirements. F, S, ASu

**GEOL 1101L Physical Geology Lab: 1 semester hour.**

**GEOL 1107 Real Monsters: 3 semester hours.**
A survey of nature's most impressive animals as viewed through the critical lens of science. Explore animal evolution, empirical limits on form and function, and ecosystem response to catastrophic change using evidence from fossils. Use the scientific method to hone skills of observation, deduction and induction. Satisfies Objective 7 of the General Education Requirements. F, S

**GEOL 1108 Data and Information: 3 semester hours.**
Discover, evaluate, analyze and visualize information and data from across the natural and applied sciences efficiently and ethically. Learn how to find reliable data sources, design sampling efforts, and manage a variety of data. Course themes used to illustrate topics will vary with instructor. PREREQ: C+ or better. Partially satisfies Objective 5 of the General Education Requirements. F, S

**GEOL 1108L Exploring Information Lab: 0 semester hours.**
Graded S/U. COREQ: GEOL 1108. F, S

**GEOL 1110 Physical Geology for Scientists Laboratory: 1 semester hour.**
Identification and classification of minerals, rocks, and fossils; introduction to geologic maps and plate tectonics. Field trips. Required for Geology majors. May be taken in place of GEOL 1100 or GEOL 1101L. PRE-OR-COREQ: GEOL 1100 or GEOL 1101. Partially satisfies Objective 5 of the General Education Requirements. F, S

**GEOL 1199 Experimental Course: 1-6 semester hours.**
This course is not described in the catalog. The course title and number of credits are announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times.

**GEOL 2202 Historical Geology: 3 semester hours.**
Major events in earth history: continental drift, age dating, evolution of organisms, times of extinction, mountain building, episodes of world glaciation. PREREQ: GEOL 1100 or GEOL 1101. F

**GEOL 2210 Earth in Space and Time: 3 semester hours.**
Tools-oriented course in map coordinates, GPS, basic GIS and remote sensing, spreadsheets and data analysis. Includes applications to geologic maps, cross sections, and Geologic Time Scale. PREREQ: GEOL 1100 or GEOL 1101 with C or better. PRE-or-COREQ: GEOL 1110. F, S

**GEOL 2282 Undergraduate Laboratory Experience: 1-3 semester hours.**
Participate in various laboratory or field-related tasks related to research projects, gaining practical experience via supervised operation of equipment, computers, and analytical instrumentation. PREREQ or COREQ: GEOL 1100 or GEOL 1101. Graded S/U. F, S, Su

**GEOL 3306 Environmental Geology: 3 semester hours.**
Humans and the environment. Topics include: industrial exploitation of fossil fuels, energy sources, soils, water and other materials, environmental health, pollution, waste disposal, hazards, disasters, and land use. PREREQ: GEOL 1100 or GEOL 1101. F

**GEOL 3313 Earth Materials I: 3 semester hours.**
Introduction to physical and chemical composition of the earth, emphasizing minerals, mineral associations and mineral formation, and lab-based determinative methods of mineralogy from microscopic to planetary scales. PREREQ: GEOL 1110. PREREQ or COREQ: CHEM 1111 and CHEM 1111L. F

**GEOL 3314 Earth Materials II: 3 semester hours.**
Classifications, processes and environments of formation of igneous, metamorphic and sedimentary rocks. Lab- and field-based determinative methods of rock identification, classification and interpretation. PREREQ: GEOL 2210 and GEOL 3313. S

**GEOL 3315 Evolution of the Earth's Surface: 4 semester hours.**
Evolution of the Earth's surface in recent geologic time. Physical and climatic processes that govern landscape evolution. Examination of landforms and landscapes to interpret paleo-environments and modern Earth surface processes. Lectures, discussions, laboratory exercises, and field trips. PREREQ: GEOL 1100 or GEOL 1101, and GEOL 1110. S

**GEOL 4400 Practicum in Geology Teaching: 1 semester hour.**
Practical problems in teaching geology in public schools. Lab and field trip design and safety, Internet resources, student projects. PREREQ: GEOL 2210. AF

**GEOL 4402 Geomorphology: 4 semester hours.**
Process-response approach to landforms and landscapes. Historical perspectives, endo- and exogenetic processes, equilibrium and relict landforms. Emphasis on interrelations among various geologic sub-disciplines. Field trips, some lab exercises. PREREQ: GEOL 3315 or permission of instructor. COREQ: GEOL 4402L. F

**GEOL 4402L Geomorphology Lab: 0 semester hours.**
Assignments to apply principles from GEOL 4402. COREQ: GEOL 4402. F

**GEOL 4403 Principles of Geographic Information Systems: 3 semester hours.**
Study of GIS fundamentals, introduction to GPS, databases, and metadata. Practical application of ESRI ArcView?. Build, edit, and query a GIS; basic spatial analysis. Requires competence in computer operating systems. COREQ: GEOL 4403L. F, S

**GEOL 4403L Principles of GIS Laboratory: 0 semester hours.**
Computer lab assignments to apply principles from GEOL 4403. COREQ: GEOL 4403. F, S

**GEOL 4404 Advanced Geographic Information Systems: 3 semester hours.**
Study of relational databases, including spatial analysis, and remote sensing. Practical application of Arc/Info? and Idrisi?. Exercises include digitizing, querying, digital terrain modeling, and image processing. PREREQ: GEOL 4403 and GEOL 4403L or permission of instructor. S
GEOL 4405 Volcanology: 3 semester hours.
Aspects of physical and chemical volcanology; types of volcanoes; interpretation of volcanic deposits; properties of magma; generation, rise and storage of magma; volcanic hazards and prediction. PREREQ: One of GEOL 3314, GEOL 4402, GEOL 4421 or GEOL 4452. AF

GEOL 4407 GPS Applications in Research: 3 semester hours.
Overview of satellite positioning systems usage. Topics include GPS theory, basic mapping concepts, use of mapping grade receivers for GIS data collection, and processing of carrier phase data for high precision applications. PREREQ: GEOL 4403. F

GEOL 4408 GeoTechnology Seminar: 2 semester hours.
GIS applications in natural and social sciences; ethical and legal issues, current status and recent advances in GeoTechnology. Lectures, discussion, readings. PREREQ: GEOL 4403 and GEOL 4403L or permission of instructor. F, S

GEOL 4409 Remote Sensing: 3 semester hours.
Fundamentals and applications of single frequency, multispectral, and hyperspectral remote sensing for physical, natural, engineering, and social sciences. Emphasis on acquiring, processing, integrating, and interpretation of imagery. Requires competence in computer operating systems. S

GEOL 4410 Science in American Society: 2 semester hours.
Observational basis of science; technology's historical influences on scientific developments; perceptions of science in contemporary America; tools/strategies for teaching science. PREREQ: Junior standing and permission of instructor. AF

GEOL 4411 Planetary Petrology: 3 semester hours.
Chemistry, mineralogy, tectonic association and petrogenesis of the principal igneous and metamorphic rock types on Earth and other planetary bodies. PREREQ: GEOL 3314. AF

GEOL 4412 Petrology Laboratory: 2 semester hours.
Microscopic identification of igneous and metamorphic minerals and rocks. PREREQ: GEOL 2210 and GEOL 3313; COREQ: GEOL 4411. AF

GEOL 4413 Sedimentary Rocks in Thin Section: 2 semester hours.
A variety of terrigenous, volcaniclastic, and carbonate rocks will be studied. PREREQ or COREQ: GEOL 4411. AF

GEOL 4415 Quaternary Global Change: 3 semester hours.
Use and interpretation of landforms, sediments, and fossil life in the reconstruction of Quaternary events, environment, and climates. AS

GEOL 4416 Global Environmental Change: 3 semester hours.
Analysis of the causes and effects of both natural and human-induced environmental change. Integrates knowledge from other Earth Systems Science courses, and examines and analyzes relevant problems in global environmental change using scientific methods. PREREQ: GEOL 3306 and BIOL 2209. AS

GEOL 4417 Introduction to Soils and Critical Zone Processes: 3 semester hours.
Introduction to soils with emphasis on soil formation and classification and the physical, chemical and biological properties of soils. PREREQ: CHEM 1112 and CHEM 1112L or permission of instructor. COREQ: GEOL 4417L. F

GEOL 4417L Introduction to Soils and Critical Zone Processes Lab: 1 semester hour.
Assignments to apply GEOL 4417. PREREQ: CHEM 1112 and CHEM 1112L or permission of instructor. COREQ: GEOL 4417. F

GEOL 4420 Principles of Geochemistry: 3 semester hours.
Chemistry of the earth; discussion of factors controlling abundance, distribution, and migration of chemical elements within the earth. PREREQ: GEOL 3313, CHEM 1112 and CHEM 1112L, or permission of instructor. S

GEOL 4421 Structural Geology: 4 semester hours.
Structure of the earth's crust. Investigation of behavior of materials; identification and interpretation of earth structures. PREREQ: MATH 1147 or both MATH 1143 and MATH 1144, and GEOL 4452. S

GEOL 4421L Structural Geology Laboratory: 0 semester hours.
Assignments to apply principles in GEOL 4421. S

GEOL 4422 Planetary Geology: 3 semester hours.
Formation of planetary bodies (planets, moons, asteroids and comets), internal and surficial processes, tectonics, and planetary exploration. PREREQ: GEOL 1100 or GEOL 1101 or permission of instructor. D

GEOL 4427 Information Technology for GIS: 3 semester hours.
Study of servers, networks, system administration, relational database design and management, spatial database engines, and serving maps on the internet. The course uses traditional lectures along with demonstrations, and hands-on exercises. PREREQ: GEOL 4403 and GEOL 4403L or instructor approval. S

GEOL 4428 Programming for GIS: 3 semester hours.
Course introduces students Visual Basic programming for GIS. Students will learn the fundamentals of object oriented programming, rapid application development, basic coding, help documentation, and compiling. Students will complete a project where they develop a GIS utility of their choice. PREREQ: GEOL 4403 and GEOL 4403L. F

GEOL 4430 Principles of Hydrogeology: 3 semester hours.
Surface and groundwater occurrence, movement and recovery, water quality and pollution, well construction principles, and computer modeling. PREREQ: MATH 1147 or both MATH 1143 and MATH 1144; and GEOL 1100 or GEOL 1101 or permission of instructor. F

GEOL 4431 Geobiology and the History of Life: 4 semester hours.
Principles of biology and geology applied to the study of fossil invertebrates. Consideration is given to morphology, classification, evolution, paleoecology, and the stratigraphic significance of fossils. PREREQ: Permission of instructor; GEOL 2202 recommended. COREQ: GEOL 4431L. F

GEOL 4431L Invertebrate Paleontology Lab: 0 semester hours.
Assignments to apply principles from GEOL 4431. COREQ: GEOL 4431. F

GEOL 4435 Vertebrate Paleontology: 4 semester hours.
Phylogenetic history of the vertebrates outlined in the light of morphology, classification, evolution, paleoecology, and the stratigraphic significance of fossils. Field trips. Equivalent to BIOL 4435. PREREQ: GEOL 4431, or BIOL 3304 and BIOL 3304L, or equivalent. F

GEOL 4439 Principles of Taphonomy: 3 semester hours.
Effects of processes which modify organisms between death and the time the usually fossilized remains are studied. Emphasis on vertebrates. Equivalent to ANTH 4439 and BIOL 4439. PREREQ: Permission of instructor. AS

GEOL 4440 Ore Deposits: 3 semester hours.
Nature, mode of occurrence, origin of ores with each type related to a given rock association and as the product of a particular environment. PREREQ: One of: GEOL 3314, GEOL 4452 (recommended), or GEOL 4421. AF

GEOL 4450 Field Geology: 6 semester hours.
Five-week summer field camp, applying standard geologic field instruments and geologic concepts to a series of field problems. PREREQ: GEOL 3314 (recommended) or GEOL 4420; GEOL 4421 and GEOL 4452. Su

GEOL 4451 Field Methods in Environmental Sciences: 3 semester hours.
Practical application of field methods with an Earth systems focus. Analysis of topographic and vegetational data, hydrologic methods, riverine processes and habitat, and soil characteristics, emphasizing use of GIS, GPS, remote sensing and other geotechnologies. Two-week summer course at Lost River Field Station. PREREQ: GEOL 4403, either GEOL 4415 or GEOL 4416, and BIOL 2209. Su
GEOL 4452 Sedimentation-Stratigraphy: 4 semester hours.
Principles of sedimentation from source to diagenesis. The basis of stratigraphic nomenclature, classification, and correlation of rock units. Laboratory covers unconsolidated sediment, hand specimens, and field techniques. PREREQ: GEOL 2210 and ENGL 1102 or permission of instructor. PRE-OR-COREQ: CHEM 1111 and CHEM 1111L. COREQ: GEOL 4452L. F

GEOL 4452L. Sedimentation-Stratigraphy Laboratory: 0 semester hours.
Assignments to apply principles in GEOL 4452. COREQ: GEOL 4452. F

GEOL 4454 Basic Engineering Geology: 3 semester hours.
Geology applied to civil engineering projects; rock engineering classification systems and geotechnical parameters such as joint set orientation, ground behavior and underground construction. Preparation of baseline geotechnical reports. Equivalent to CE 4454. COREQ: GEOL 3314 or CE 3332. D

GEOL 4455 Geologic Data Methods: 3 semester hours.
Geotechnical investigations for civil works projects; geologic mapping for civil engineering purposes; development of engineering geologic profiles; core logging; preparation of Geotechnical Data Reports for civil works projects. Equivalent to CE 4455. PREREQ: CE 4454. D

GEOL 4456 Geology of Idaho: 2 semester hours.
Geologic provinces and plate tectonic history of Idaho. Topics include basement, Belt Supergroup, Phanerozoic passive margin, Cordilleran orogen, accreted terranes, Idaho batholith, Challis volcanics, Idaho mineral deposits, Basin and Range, Snake River Plain and Pleistocene floods. PREREQ: GEOL 1100 or 1101. AS

GEOL 4458 Geology of North America: 3 semester hours.
Regional stratigraphy and tectonics of North America emphasizing National Parks and the Intermountain West. Graduate students will do extensive additional reading in current literature. PREREQ: GEOL 1100 or GEOL 1101. AS

GEOL 4460 Undergraduate Teaching Experience: 1 semester hour.
Supervised teaching in an undergraduate laboratory. Graded S/U. May be repeated for up to 2 credits. PREREQ: Permission of instructor. F, S, Su

GEOL 4465 Petroleum Geology: 3 semester hours.
Occurrence of hydrocarbons, well logs, geophysical methods, generation and migration of petroleum, the reservoir, traps and seals, petroleum basins, nonconventional petroleum resources. PREREQ: GEOL 2210 or permission of instructor. F

GEOL 4471 Historical Geography of Idaho: 3 semester hours.
Influences of geography and geology on Idaho's economic, political and cultural history. May be team taught and include field trips and discussion sections. Equivalent to HIST 4471 and POLS 4471. D

GEOL 4475 Essentials of Geomechanics: 3 semester hours.
Essentials of rock fracture relevant to geological engineering including stress and strain, properties and classification of rock masses, rock fracture mechanisms. Equivalent to CE 4475. PREREQ: GEOL 4421 or CE/ENGR/ME 3350. D

GEOL 4476 Engineering Geology Project: 1 semester hour.
Team projects studying actual problems in engineering geology. Equivalent to CE 4476. PREREQ: GEOL 4454 or CE 4454. D

GEOL 4480 Special Topics in GIS: 1-3 semester hours.
Visual Basic programming for GIS. PREREQ: GEOL 4403 and GEOL 4403L and permission of instructor. F, S

GEOL 4481 GeoTechnology Internship: 1-3 semester hours.
Choose a project with either Natural Resource or municipal GIS emphasis and work with real-world data at the Internship's off-campus location. Projects focus on using/creating geotechnical data. PREREQ: GEOL 4403 and GEOL 4403L or permission of instructor. F, S

GEOL 4482 Independent Problems and Studies in Geology: 1-3 semester hours.
Investigation of a geologic problem chosen by the student and approved by the staff. May be repeated for up to 6 credits. D

GEOL 4483 Earthquake Engineering: 3 semester hours.
Mechanism and characterization of earthquakes; seismic risk analysis; site and structural response; applications from points of view of engineer and geologist. Equivalent to CE 4480. PREREQ: GEOL 3313 or CE 3332, or permission of instructor. D

GEOL 4484 Laboratory Teaching Experience: 1 semester hour.
Supervised teaching of a GEOL undergraduate laboratory. PREREQ: 58 credits and permission of instructor. May be repeated for up to 2 credits. Graded S/U. F, S

GEOL 4490 Ecosystem Ecology and Global Changes: 4 semester hours.
Examination of the structure and function of ecosystems and their responses to natural and anthropogenic changes emphasizing energy, water, carbon, and nitrogen cycling. Field trip. Equivalent to BIOL 4490. PREREQ: BIOL 1101, BIOL 1102, BIOL 2209, GEOL 1101, and GEOL 1101L, or permission of instructor. PRE-OR-COREQ: CHEM 1111. S

GEOL 4491 Seminar: 1 semester hour.
Field trip or discussion of current geologic literature and geologic problems. May be repeated for up to 3 credits. PREREQ: Permission of instructor. Graded S/U. F, S

GEOL 4492 Earth and Environmental Systems Seminar: 1 semester hour.
Discussion of current topics, research, and employment opportunities in Earth Systems Science, incorporating physical science, life science, and social science. May be repeated once. PREREQ: Junior or senior standing or permission of instructor. S

GEOL 4493 Senior Thesis: 1-4 semester hours.
This is a course supervised by a committee of at least two faculty members, approved by the chairperson(s) of the department(s) involved. The thesis topic may be interdisciplinary, with credits conferred by one or more departments. May be repeated for up to 4 credits. PREREQ: 90 credits and invitation by (or permission of) department chairperson(s). F, S

GEOL 4494 Expedition Seminar: 1 semester hour.
Long-distance field trip to explore the landscape and geologic history of a region, discuss current geologic literature and geologic problems. May be repeated for up to 2 credits. Graded S/U. PREREQ: Permission of instructor. F, S

GEOL 4496 Workshop: 1-2 semester hours.
Workshops aimed at the development and improvement of skills. Does not satisfy requirements for a major or a minor. May be repeated. Graded S/U. D

GEOL 4499 Experimental Course: 1-6 semester hours.
This course is not described in the catalog. The course title and number of credits are announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times.