

# Geology

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Geology integrates physical, chemical, and biological studies of the Earth from its inception to the present day. Courses in Earth Science increase every student's appreciation of the world's natural processes and of how current fluctuations in the magnitudes and frequency of geological events and in the availability of natural resources affect human societies and their integrated ecosystems. Serious students of geology find opportunities in the environmental, energy, mining, teaching, engineering, and geophysics fields, and in resource management, K-12 education, academia, hydrogeology, space science, hazard management, and oceanography.

A student who enters Whitman without any prior college-level preparation in geology will have to complete 49 credits (32 in geology) to fulfill the requirements for the geology major. After a geology or geology combined major is declared, no geology course, except Geology 158, may be taken P-D-F.

**Learning Goals:** Upon graduation, a student will be able to:

- Apply geologic concepts to the interpretation of geologic materials and landscapes
- Apply quantitative techniques to geological questions
- Read and interpret geological information, including graphical data, geologic and topographic maps, and scientific literature
- Effectively communicate geologic concepts, including by written communication, oral communication, and mapmaking

**Distribution:** Courses completed in geology apply to the science and quantitative analysis (selected courses) distribution areas.

**Total credit requirements for a Geology major:** A student who enters Whitman College with no prior experience in geology will need to complete 49 credits with 32 credits in Geology.

## The Geology major:

- 32-33 credits of geology (49-50 credits total with no prior experience)
- Required geology courses:
  - Introductory geology from Geology 110 and 111, or 120 and 121, or 125 and 126
  - Geology 227, 270, 350, 358, 405, 420, and 470
  - One course from Geology 312, 321, or 368
  - Field camp (a minimum of 3 credits of Geology 480)
- Required supporting science courses:
  - Mathematics 124, 125, or 126
  - Chemistry 125 and 135 or 140
  - Physics 145 or 155
  - A minimum of 6 credits numbered higher than 125 in any of the following: mathematics and statistics, chemistry, physics, or computer science
- Notes on required courses:
  - AP credit may not be used to fulfill the supporting science coursework listed above. Students with AP credit or have tested out of any of these courses in mathematics and statistics, chemistry, physics, or computer science should take the next higher course in the department's sequence.
  - No P-D-F after declaration, except Geology 158.
- Senior requirements:
  - Geology 470
  - Senior assessment:
    - Four-hour written exam;

- Oral exam, which may be conducted in the field
- Honors
  - Students do not apply for admission to candidacy for honors
  - Accumulated at least 87 credits
  - Completed two semesters of residency at Whitman.
  - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  - Major GPA of at least 3.500
  - Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  - Earn a grade of at least A- on the honors thesis or project and the honors thesis course
  - Pass the senior assessment with distinction
  - Chair of the department will notify the Registrar of students attaining Honors no later than the beginning of week 12 of the semester.
  - An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

**The Geology minor:**

- 16 credits
- Required courses:
  - Introductory geology from Geology 110 and 111, or 120 and 121, or 125 and 126
  - At least one of the following: Geology 227, 270, 301, 312, or 350.

**The Astronomy-Geology combined major:**

- 61-63 total credits
  - 20 credits in astronomy
  - 27-28 credits in geology
  - 4 credits in chemistry
  - 4 credits in physics
  - 6 credits in mathematics and statistics
- Required astronomy courses:
  - Astronomy 177, 178, and 179
  - One course from Astronomy 310, 320, 330, 350, 360, or 380
  - At least two additional credits in Astronomy courses numbered 310-392
  - Two credits of Astronomy 490
- Required geology courses:
  - Introductory geology from Geology 110 and 111, or 120 and 121, or 125 and 126
  - Geology 227, 270, 350, 358, and 470
  - Two of the following: Geology 310, 405, or 420
  - Two credits of Geology 490
- Other required courses:
  - Chemistry 125, 135
  - Mathematics 124 or 125, 126
  - Physics 145 or 155
- Notes on courses:
  - No courses for the major may be taken P-D-F.
  - Strongly recommended courses: Computer Science 167, Mathematics 225, 244, Chemistry 126, 136, Physics 156, 245, 255
- Senior requirements:

- Astronomy 490
- Geology 470 and 490
- Senior assessment:
  - Comprehensive written exams in both geology and astronomy
  - One-hour oral exam by astronomy and geology faculty
- Honors
  - Students do not apply for admission to candidacy for honors
  - Accumulated at least 87 credits
  - Completed two semesters of residency at Whitman.
  - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  - Major GPA of at least 3.500
  - Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  - Earn a grade of at least A- on the honors thesis or project and the honors thesis course
  - Pass the senior assessment with distinction
  - Chair of the department will notify the Registrar of students attaining Honors no later than the beginning of week 12 of the semester.
  - An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

#### **The Biology-Geology combined major:**

- 66-70 total credits
  - 23-26 credits in biology
  - 26-29 credits in geology
  - 14-18 credits in other departments
- Required biology courses:
  - Biology 111, 112, 205
  - Four credits from the Organismal Biology category
  - Four credits from the Ecology/Evolution category
  - At least four additional credits in Biology and/or BBMB courses numbered 200 and above
  - Three credits of Biology 489, 490, or 498 (or three credits of Geology 480, 490, or 498)
- Required geology courses:
  - Introductory geology from Geology 110 and 111, or 120 and 121, or 125 and 126
  - Geology 227, 270, 350, 358, and 470
  - Geology 312 or 368
  - One course from Geology 301, 321, or 405
  - Three credits of Geology 480, 490, or 498 or three credits of Biology 490 or 498
- Required supporting science courses:
  - Chemistry 125, 126, 135, and 136, or Chemistry 140
  - Chemistry 245
  - Mathematics 124 or 125, Mathematics 126 or a statistics course (Mathematics 128 or 247, Economics 227, Psychology 210, or Sociology 208)
- Notes on courses:
  - No courses taken P-D-F may be applied to the major
  - Two semesters of Physics and field experience are strongly recommended.
- Senior requirements:
  - Geology 470
  - Geology 490 or 498, or Biology 490 or 498
  - Senior assessment:

- Comprehensive written exams in both geology and biology;
    - One-hour oral exam by biology and geology faculty
- Honors:
  - Students do not apply for admission to candidacy for honors
  - Accumulated at least 87 credits
  - Completed two semesters of residency at Whitman.
  - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  - Major GPA of at least 3.500
  - Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  - Earn a grade of at least A- on the honors thesis or project and the honors thesis course
  - Pass the senior assessment with distinction
  - Chair of the department will notify the Registrar of students attaining Honors no later than the beginning of week 12 of the semester.
  - An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

**The Chemistry-Geology combined major:**

- 51-55 total credits
  - 16-20 credits in chemistry
  - 25 credits in geology
- 10 credits from other departments
- Required chemistry courses
  - The full General Chemistry sequence by either
    - Chemistry 125, 126, 135, and 136, or
    - Chemistry 140
  - Chemistry 310
  - Two of the following, including at least one lab (indicated with asterisk (\*))
    - Chemistry 320\*
    - Chemistry 346 (with or without 1 credit lab, Chemistry 352\*)
    - Chemistry 305 or 388\*
- Required geology courses
  - Introductory geology from Geology 110 and 111, or 120 and 121, or 125 and 126
  - Geology 227, 270, 350, 358, 405, 460, and 470
- Required supporting science courses
  - Mathematics 124 or 125, 126
  - Physics 145 or 155
- Notes on courses
  - No courses taken P-D-F may be applied to the major
  - Majors are strongly encouraged to do a senior research project, enrolling in:
    - One credit of Chemistry 401 or 402
    - Two credits in Chemistry 490 or 498, or three credits of Geology 490 or 498
- Senior requirements
  - Geology 470
  - Senior assessment:
    - Comprehensive written exams in both geology and chemistry
    - One-hour oral exam by chemistry and geology faculty
- Honorsb
  - Students do not apply for admission to candidacy for honors
  - Accumulated at least 87 credits
  - Completed two semesters of residency at Whitman.

- Cumulative GPA of at least 3.300 on all credits earned at Whitman College
- Major GPA of at least 3.500
- Complete a written thesis or research project prepared exclusively for the satisfaction of this program
- Earn a grade of at least A- on the honors thesis or project course with a geology or chemistry department faculty (Chemistry or Geology 498).
- Pass the senior assessment with distinction
- Chair of the department will notify the Registrar of students attaining Honors no later than the beginning of week 12 of the semester.
- An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

**The Geology-Computer Science combined major:**

- 49-56 total credits
  - 17 credits in computer science (21 if the student has not previously taken Computer Science 167 or equivalent)
  - 18-20 credits in geology
  - 10-11 credits in supporting science courses
  - 4-5 credits of senior requirements
- Required Computer Science courses:
  - Computer Science 270 (with a prerequisite of 167 or equivalent experience)
  - Computer Science 255 or 355
  - Computer Science/Mathematics 215
  - Three additional credits of Computer Science at the 200 level
  - Three additional credits of Computer Science at the 300 level
- Required Geology courses:
  - Introductory geology (Geology 110 and 111, or 120 and 121, or 125 and 126)
  - Geology 227 and 270
  - Two of the following Geology courses: 301, 310, 350, 418, 420, 460
- Required supporting science courses:
  - Mathematics 124 or 125
  - Physics 145 or 155
  - Chemistry 125 or 140
- Senior requirements:
  - Geology 470
  - Computer Science 495 and 496, or 3 credits of Geology 490 or 498
- Notes on courses:
  - No courses taken P-D-F may be applied to the major
  - Geology 158 recommended
- Honors:
  - Students do not apply for admission to candidacy for honors
  - Accumulated at least 87 credits
  - Completed two semesters of residency at Whitman.
  - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  - Major GPA of at least 3.500
  - Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  - Earn a grade of at least A- on the honors thesis or project and the honors thesis course
  - Pass the senior assessment with distinction

- Chair of the department will notify the Registrar of students attaining Honors no later than the beginning of week 12 of the semester.
- An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

### **The Geology-Physics combined major**

- 61-62 total credits (with no credit for prior experience)
  - 25 credits in geology
  - 21-22 credits in physics
  - 13 credits in mathematics and statistics (including Mathematics 125 and 126)
  - 4 credits in chemistry
- Required geology courses:
  - Introductory geology from Geology 110 and 111, or 120 and 121, or 125 and 126
  - Geology 227, 270, 310, 358, 405, 420, and 470
- Required physics courses:
  - Physics 145 or 155 or 347
  - Physics 156, 245, 255, and 267
  - Two of the following: Physics 325, 339, 347, 357, or 385
    - Physics 347 may not be used to satisfy multiple requirements
- Required supporting science courses:
  - Chemistry 125 and 135
  - Mathematics 225 and 244
- Other Notes:
  - No courses taken P-D-F may be applied to the major
  - If students place out of Physics 155, they must take Physics 347
- Senior requirements:
  - Geology 470
  - Senior assessment:
    - Comprehensive written exams in both geology and physics
    - One-hour oral exam by physics and geology faculty
- Honors
  - Students submit a Honors in Major Study Application to their department
  - Students must submit a proposal for their thesis or project
    - Must be submitted within the first six weeks of the two-semester period in which student is eligible
  - Accumulated at least 87 credits
  - Completed two semesters of residency at Whitman.
  - Cumulative GPA of at least 3.300 on all credits earned at Whitman College
  - Major GPA of at least 3.500
  - Complete a written thesis or research project prepared exclusively for the satisfaction of this program
  - Earn a grade of at least A- on the honors thesis or project and the honors thesis course.
  - Pass the senior assessment with distinction
  - The department will submit the Honors applications to the Registrar's Office of students pursuing Honors by the specified deadline
  - The department submit "Senior Assessment/Major Study Certificate" to the Registrar's Office no later the Reading Day
  - An acceptable digital copy of the Honors Thesis must be submitted to Penrose Library no later than Reading Day

**The Geology-Environmental Studies combined major:** The requirements are fully described in the *Environmental Studies* listing of the catalog.

**The Geology+French combined major:**

- 66-69 total credits (with no prior experience in either Geology or French) consisting of 24-26 credits of geology, 14-15 credits in related foundational STEM fields, and 20 credits in French
- Required geology courses
  - One introductory course plus lab: Geology 110 and 111, or 120 and 121, or 125 and 126)
  - Geology 227, 270, 350, 358, and 470
  - Two courses from Geology 405, 418, and 420
  - One course from Geology 312, 321, or 368
- Required supporting Science courses
  - Chemistry 125, 135
  - Mathematics 124 or 125 or 126
  - Physics 145 or 155
  - One 3 or 4 credit course numbered above 125 from Chemistry, Computer Science, Mathematics and Statistics, or Physics
- Notes on required courses
  - AP credit may not be used to fulfill the supporting science coursework listed above. Students who have AP credit or have tested out of any of these courses in mathematics and statistics, chemistry, computer science, or physics should take the next higher course in the department's sequence.
  - No course may be taken P-D-F after declaration of major, except Geology 158.
- Senior requirements
  - Geology 470
  - Senior assessment:
    - Four-hour geology written exam;
    - Geology oral exam, which may be conducted in the field
- A total of 20 additional credits comprised as follows:
  - At least 16 credits taught in French at the 200 level or above, or equivalent.
  - Up to 8 credits may be comprised of any combination of the following:
    - Up to 4 credits from approved courses taught in English
    - Up to 8 credits transferred from Off-Campus Studies or another institution. Any university-level course taught entirely in French may count toward this requirement regardless of topic.
    - Up to 4 credits "double-dipped" with approved courses counting toward another major or minor program
    - Up to 4 AP/IB credits (see note)
- Attainment of B2 or Advanced Low level on a recognized language proficiency assessment (DELF, ACTFL, etc.).
- Two or more of the following integrative components with the primary major:
  - A thesis topic that explicitly incorporates a significant portion of French/ Francophone content, broadly understood (textual, geographic, Earth materials from a Francophone country, etc.).
  - A grade of B or higher in a course in Geology taught in French (normally only an option through Off-Campus Studies)
  - A field camp conducted primarily in French
  - An oral presentation of the senior project (or equivalent), in French, for a general public
  - Portfolio + reflective essay in French
- Complete the senior self-evaluation survey about their combined major experience.
- Honors in Geology+French will be determined according to the criteria of the Geology major.

**107 Special Topics in Geology**

**1-4 credits**

Any current offerings follow.

**110 The Physical Earth****Not offered 2023-24****3 credits**

Physical geology including earth materials, the processes responsible for uplift and erosion, landforms, plate tectonics and the earth's interior. Three lectures per week. Open only to first- and second-year students; others by consent of instructor. Students who have received credit for Geology 120 or 125 may not receive credit for Geology 110. *Corequisite:* Geology 111.

**111 The Physical Earth Lab****Not offered 2023-24****1 credit**

Laboratory exercises to accompany classroom instruction in The Physical Earth. Must be taken concurrently with Geology 110. Topics may include the identification of rocks and minerals, interpretation of topographic and geologic maps, and fluvial processes. One three-hour laboratory per week; field trips. Students who have received credit for Geology 121 or 126 may not receive credit for Geology 111. *Corequisite:* Geology 110. *Lab fee:* maximum \$20.

**120 Geologic History of the Pacific Northwest****Fall****Spencer****3 credits**

An examination of the geologic history of the Pacific Northwest, including Washington, Idaho, Oregon, northern California, and southern British Columbia. Fundamental geologic processes that have shaped the Pacific Northwest will be examined through detailed study of different locales in the region. Three lectures per week. Open to first- and second-year students, others by consent of instructor. Students who have received credit for Geology 110 or 125 may not receive credit for Geology 120. *Corequisite:* Geology 121.

**121 Geologic History of the Pacific Northwest Lab****Fall****Spencer****1 credit**

Laboratory exercises to accompany classroom instruction in Geologic History of the Pacific Northwest. Must be taken concurrently with Geology 120. Topics may include general geologic skills such as the identification of rocks and minerals, interpretation of topographic and geologic maps, and fluvial processes, with a particular focus on the topics examined in lecture. One three-hour laboratory per week; field trips. Students who have received credit for Geology 111 or 126 may not receive credit for Geology 121. *Corequisite:* Geology 120. *Lab fee:* maximum \$20.

**125 Environmental Geology****Fall, Spring****Fall: Staff; Spring: Persico****3 credits**

Natural geologic processes including Holocene deglaciation, landslides, flooding, volcanism, and earthquakes pose risks both to human wellbeing and societal infrastructure. Human decisions for how we choose to interact with the physical environment and its resources (atmosphere, soils, energy sources, minerals) may further imperil societies or may inform global and regional mitigation of Anthropocene climate change, water quality and quantity problems, resource use, and land erosion and mass movement. This introductory course provides exploration and discussion of geologic processes within the paradigm of plate tectonics. Three lecture/discussion periods per week. Students who have received credit for Geology 110, 120, or 210 may not receive credit for Geology 125. Open to first- and second-year students; others by consent of instructor. *Corequisite:* Geology 126.

**126 Environmental Geology Lab****Fall, Spring****Fall: Staff; Spring: Persico****1 credit**

Laboratory exercises to accompany classroom instruction in Environmental Geology. Must be taken concurrently with Geology 125. Topics may include general geologic skills such as the identification of rocks and minerals, interpretation of topographic and geologic maps, and fluvial processes, with a particular focus on natural hazards such as floods and mass movement. One three-hour laboratory per week; field trips. Students who have received credit for Geology 111 or 121 may not receive credit for Geology 126. *Corequisite:* Geology 125. *Lab fee:* maximum \$20.



**130 Weather and Climate****Spring****Pogue****3 credits**

An introductory course in meteorology designed for nonscience majors with an emphasis on the weather patterns and climate of the Pacific Northwest. Topics covered include Earth's heat budget, atmospheric stability, air masses, midlatitude cyclones, global circulation patterns and climates, and the origins of violent weather phenomenon.

**140 Tactics for scientific study of societal challenges****Not offered 2023-24****1 credit**

Human communities must adapt to gradual and abrupt changes in the physical environment. Sea-level rise, storm surge, flooding, and landslides are examples of hazardous environmental events requiring mitigation. While enhancing the infrastructure that copes with these physical changes, geoscientists ensure energy, water, and mineral resources and mitigate toxic legacy waste. Necessary first steps in associated geoscience investigations require identifying the scope and scale of a research question and evaluating which scientific instrument to implement during a project. This 1 credit course provides a science experience for incoming first-year students interested in pursuing any science major. The course is intended for students whose high school science had few hands-on science lab experiences. This course may include one or two half-day field trips to local county and city infrastructure and to local geologic features. The course also introduces scientific instrumentation including the imaging capabilities of electron microscopes, chemical analysis using X-Ray fluorescence spectroscopy, and/or laser analysis of particle sizes. Other activities include guest speakers, discussion of science articles written for the general public, and one short writing assignment. For first-year students only; participation pending approval of a short application. No distribution credit. This course does not count toward the Geology major. Graded credit/no credit.

**150 Earth's Climate: Past, Present, & Future****Not offered 2023-24****3 credits**

The land we live on, the air we breathe, and the water we drink are all part of the Earth's climate system. This remarkably complex system has changed dramatically over the past four and a half billion years. Changes in climate have occurred for a variety of reasons and on a variety of timescales. Some of those changes are well understood while others are still being studied today. Recently, we have reached a new paradigm where human activity is the predominant cause of climate change. In the 21st century, arguably no other scientific field has made such broad inroads into the public's consciousness and no other topic has been so thoroughly misunderstood, demonized, and misrepresented as climate science. This course will cover the complexities of natural and anthropogenic climate change through the fields of paleoclimatology and Earth systems science. We will explore the many methods of paleoclimatic reconstruction using proxy climate indicators, how the carbon cycle is connected through Earth's four major subsystems, how climate affects biota and vice versa, and what past abrupt climate changes can tell us about future climate changes. We will end the semester by contemplating the future of Earth's climate including climate mitigation strategies such as geoengineering.

**158 Regional Geology****Fall, Spring****Fall: Spencer; Spring: Pogue****1-3 credits**

The geology of part of the United States or elsewhere, with emphasis on geologic history, including petrology, stratigraphy, tectonics, and geomorphology. Lectures on the geology and other aspects of the area will precede field trips, which will take place during vacations and on long weekends. Geologic mapping may be involved. May be repeated for credit for different areas. *Prerequisites:* Geology 110 or 120 or 125 and consent of instructor. Graded credit/no credit. *Fee:* maximum \$75 per semester.

**227 Sedimentology and Stratigraphy****Spring****Staff****4 credits**

Fundamental principles of analysis pertaining to sedimentary rocks and rock sequences. Fluid flow, weathering, sediment transport, sedimentary structures, depositional systems. Geologic time and chronostratigraphy. Principles

of Lithostratigraphy. Three one-hour lectures and one three-hour lab/week. Field trips. Textbook, professional articles, in-class presentations, research paper. *Prerequisite:* Geology 110 or 120 or 125.

### **229 Geology and Ecology of Soils**

**Spring**

**Staff**

**3 credits**

Soils provide nutrients, water and support for growing plants, host an amazing variety of organisms, and even influence global climate. This class will focus on the dynamic systems in soil and on the interactions between soils and larger ecosystem properties. Course topics will include pedogenic processes, agricultural ecosystems, the interpretation of paleosols, and the role of soils in the global biogeochemical cycling of organic carbon and nutrients. Lectures, field trip(s).

### **258 Geology in the Field**

**1-3 credits**

An exploration of the geology of a region, followed by a field trip to that area. Likely to include geomorphology; structure and tectonics; minerals, rocks, and sediments; fossils and stratigraphy. Classes followed by a field trip at least a week long. Students will make maps and presentations and keep a detailed notebook. *Fee:* variable depending on location, possible scholarships available. May be repeated as location changes. Any current offerings follow.

### **270 Minerals, Society, and the Environment**

**Spring**

**Nicolaysen**

**4 credits**

This intermediate-level course examines the role of minerals in human societies and Earth systems with particular emphasis on internal structure of minerals, the carbon cycle and carbon sequestration, the nuclear fuel cycle, and the growing concern regarding mining and resource scarcity. Skills include hand sample identification of minerals, analysis of crystal structure by X-Ray Diffraction, analysis of mineral composition by X-Ray Fluorescence or electron microscopy, primary literature searches and science writing. Lectures, discussions, and laboratory exercises. *Prerequisites:* Chemistry 125 and 135, and Geology 110 or 120 or 125. Open to Seniors by consent of instructor only. *Lab fee:* maximum \$50.

### **301 Hydrology**

**Not offered 2023-24**

**4 credits**

A class devoted to understanding water resources, including both surface water and groundwater. We will study the hydrologic cycle and the properties of water, the shape and behavior of streams, the recharge and movement of groundwater, and environmental management of water including wells, dams, irrigation, and water contaminants. Lab topics will include stream gauging and the construction of hydrographs and hyetographs, determining peak discharge, water sampling, flow nets, well tests, and computer modeling of groundwater and contaminant flow. Three lectures and one three-hour lab per week. *Prerequisite:* Geology 110 or 120 or 125. *Corequisite:* Geology 301L. *Recommended prerequisites:* Chemistry 125 and Mathematics 126.

### **310 Geophysics**

**Not offered 2023-24**

**3 credits**

An introductory course in the application of seismic, gravitational, thermal, and magnetic methods for the study of the structure and composition of the interior of the Earth. *Prerequisites:* Geology 110 or 120, or 125 and Mathematics 124 or 125.

### **312 Earth History**

**Not offered 2023-24**

**4 credits**

The physical and biological events during the geologic past. Special consideration given to plate tectonics and fossils in the lectures, and to fossils and geologic maps in the laboratories. Three lectures and one three-hour lab per week; required and optional field trips. *Prerequisite:* Geology 110 or 120 or 125 or consent of instructor.

### **321 Sedimentary Basin Analysis**

**Not offered 2023-24**

**4 credits**

An intermediate-level course that examines the evolution of selected marine and nonmarine sedimentary basins primarily in North America. Consideration of sedimentary features ranging from small-scale sedimentary structures and grain textures and composition to bedform geometry, unit contacts and tectonic significance of depositional features represented. Fossil succession, biostratigraphy and paleoenvironmental indications. Hydrocarbon and other economically significant mineral potential. Geologic map interpretation of important sedimentary basins. Lectures, presentations, and field trips. Professional articles, Internet sources, reference sources. *Prerequisites:* Geology 110 or 120 or 125 and 227. *Recommended prerequisite:* Geology 368. Offered in alternate years.

### **338 Pages of Stone: The Literature of Geology**

**Not offered 2023-24**

**3 credits**

Critical reading of the work of writers on Earth science. Examination of works demonstrating different styles, from scientific to poetry to descriptive prose, and how those writers incorporate Earth into their work. Two lectures per week, papers, in-class presentations, field trip. *Prerequisites:* Geology 110 or 120 or 125, or consent of instructor. Offered in odd-numbered years.

### **340 Volcanoes**

**Not offered 2023-24**

**3 credits**

An investigation of volcanoes, including morphology, composition, eruption processes, periodicity, and impacts on climate and humans. Exploration of the topic will occur through lecture, in-class experiments, computer simulations, discussion of primary literature, and several field trips. *Prerequisite:* Geology 110 or 120 or 125. Offered in alternate years. *Fee:* maximum \$40 unless field trip is outside of the Pacific Northwest.

### **350 Geomorphology**

**Fall**

**Persico**

**4 credits**

Description, origin, development, and classification of landforms. Relationships of soils, surficial materials, and landforms to rocks, structures, climate, processes, and time. Maps and aerial photographs of landscapes produced in tectonic, volcanic, fluvial, glacial, periglacial, coastal, karst, and eolian environments. Exercises on photo-geology. Lectures, discussions, laboratories, and field trips. *Prerequisite:* Geology 110 or 120 or 125; open only to Geology majors and others by consent of instructor.

### **358 Field Geology of the Northwest**

**Fall, Spring**

**Fall: Spencer; Spring: Pogue**

**1 credit**

The geology of part of the Pacific Northwest, with emphasis on geologic history, including petrology, stratigraphy, tectonics, and mineralogy. Geologic mapping, paleontology, and mineralogy may also be involved. Most field trips will take place on long weekends. Each student will be required to write a report. May be repeated for credit for different areas. Required of all geology and geology combined majors. *Prerequisite:* Geology 110 or 120 or 125 and consent of instructor. *Fee:* maximum \$75 per semester.

### **368 Paleobiology**

**Not offered 2023-24**

**3 credits**

A comprehensive examination of the fossil record through Earth history. Taxonomy and classification of important fossil groups, evolution and extinction, functional anatomy and morphology, ecologic significance of individual taxa and assemblages through time, paleogeographic reconstruction based on the fossil record, time-significance of fossil groups. Two lectures, one three-hour lab/week. Textbook, journal articles, research paper, and weekend field trip. *Prerequisites:* Geology 110 or 120 or 125 and Geology 227. Offered in alternate years.

### **390 Independent Study**

**Fall, Spring**

**Staff**

**1-3 credits**

A reading or research project in an area of the earth sciences not covered in regular courses and of particular interest to a student. Maximum of six credits. *Prerequisite:* consent of instructor.

### **405 Volcanoes and the Solid Earth**

**Fall**

**Nicolaysen**

**4 credits**

The geologic history of the Pacific Northwest provides excellent examples of an active tectonic margin including accretion of oceanic crust and arc terranes and current arc volcanism. We examine magma generation and differentiation, volcano morphology, and physio-chemical processes of volcanoes from Earth's mantle to the surface through interpretation of rock suites from the Stillwater Complex, the Cascade and Alaska-Aleutian arcs, and the Columbia River Basalt Group. Lab activities include reading the primary literature, hand sample identification, use of petrographic microscopes, interpretation of thermodynamic phase diagrams, an introduction to computer modeling of magmas (e.g., MELTS), and field trips possibly including one overnight field trip. *Prerequisites:* Chemistry 125, 135, and Geology 270 (formerly 343). *Lab fee:* maximum \$30.

### **410-411 Problems in Earth Science**

**1-4 credits**

Specific problems in the geological sciences will be considered. Textbook and/or professional articles, discussions, paper, possible field trips. May be repeated for credit with different topics. *Prerequisite:* consent of instructor. Any current offerings follow.

#### **410 ST: Problems in Earth Science: Developing analytical skills in electron microscopy and X-ray fluorescence**

**Spring**

**Nicolaysen**

**1 credit**

This course explores the foundations of electron microscopy imaging and of compositional analysis using X-ray techniques. Students will practice using a Scanning Electron Microscope for 4-6 hours individually. Students will obtain major and trace element compositions of Earth materials using a portable X-Ray Fluorescence spectrometer. Students will reduce data using spreadsheets and engage in using calibration and analytical standards to ensure data quality. At least one discussion will cover scientific ethics to explore topics of data fabrication and data falsification and how to engage in ethically sound and reliable analysis. Course includes lecture, discussion of scientific papers, practice using instrumentation and spreadsheets, and a short presentation by the student. *Prerequisite or Corequisite:* Geology 270; Geology 405 recommended.

### **415 Terroir**

**Fall**

**Pogue**

**3 credits**

*Terroir* is a French word that refers to the idea that agricultural products derive unique sensory characteristics from the physical and cultural environment in which they are produced. The focus of the course will be on the science, philosophy, economics, and politics of terroir, in particular as they relate to the production and marketing of wine. The course will only be open to seniors or others by consent, providing they are 21 years of age. *Prerequisite:* Geology 110 or 120 or 125 or 229 or consent of instructor. *Fee:* \$50.

### **418 Introduction to Geographic Information Systems**

**Fall**

**Staff**

**3 credits**

A geographic information system (GIS) is a powerful computer tool designed for exploring, creating, and displaying spatial information. GIS has become the primary way in which spatial information is managed and analyzed in a variety of fields. Any data that has a spatial component (including most data in the Earth and environmental sciences) can potentially benefit from a GIS. Lectures will examine the applications and the conceptual framework for computer GIS, and lab exercises will teach students to use GIS software. The final third of the course is dedicated to individual projects. *Prerequisite:* consent of instructor.

### **420 Structural Geology**

**Fall**

**Pogue**

**4 credits**

The description and analysis of intermediate- to large-scale rock structures. Topics include the analysis and graphical representation of stress and strain in rocks, deformation mechanisms, fabric development in metamorphic

rocks, the geometry and mechanics of folding and faulting, and structures related to intrusive bodies. Geologic map interpretation and cross-section construction are used to analyze the structural geology of selected regions. Three lectures and one three-hour lab per week; field trip(s). *Prerequisites:* Geology 227 and 270.

### **430 Cordilleran Tectonics**

**Spring**

**Pogue**

**3 credits**

An in-depth study of the tectonic events that shaped the western United States. A review of plate tectonic theory emphasizing plate interactions and orogenesis and the tectonic evolution of the western U.S. beginning with the amalgamation of Precambrian basement and ending with the development of the San Andreas transform and Cascadia subduction systems. Each week two class periods are devoted to lectures, discussions and student presentations. The third class period is reserved for practical exercises, particularly geologic map interpretation. There is one required weekend field trip. *Prerequisite:* Geology 227.

### **460 Geochemistry**

**Not offered 2023-24**

**3 credits**

An investigation of Earth's systems and environmental problems using the principles of equilibrium, thermodynamics, diffusion, oxidation-reduction, solution chemistry, and isotope geochemistry. Skills will include discussion of primary scientific literature, statistical analysis of geochemical data, conditions of mineral formation via mineral equilibria models, and calculation of rock ages by radioactive decay. Themes of assigned readings may include carbon sequestration, water quality, or spent nuclear fuel disposal. May incorporate use of analytical equipment such as the Scanning Electron Microscope and Portable X-Ray Fluorescence Spectroscopy.

*Prerequisites:* Geology 110 or 120 or 125, and Chemistry 126 or 140, or consent of instructor. *Recommended pre- or corequisites:* Geology 270 and Chemistry 126.

### **470 Senior Seminar**

**Fall**

**Nicolaysen**

**1 credit**

Seminar on various topics in the earth sciences. Topics covered in each year are chosen by the instructors, and may include the history of geology, geologic controversies, and ethical issues related to the profession of geology. Students are expected to complete assigned readings and make an oral presentation. Required of all senior geology majors and combined majors.

### **480 Field Mapping**

**Not offered 2023-24**

**1-4 credits**

An advanced course in geological field methods. In a typical course students make maps in stratified and crystalline terranes, with rocks in varying degrees of deformation. Maximum of nine credits. *Prerequisites:* Geology 227, 420, and consent of department. *Note:* Geology 480 is not regularly offered by Whitman College. Students wishing to complete major requirements with a field experience should plan to complete an approved summer field course offered by another collegiate institution. *Fee:* variable depending on location, scholarships available.

### **490 Senior Research**

**Fall, Spring**

**Staff**

**1-3 credits**

A project involving field and laboratory research in the geological sciences. Written and oral reports are required during the senior year. Maximum of six credits. *Prerequisite:* consent of instructor.

### **498 Honors Thesis**

**Fall, Spring**

**Staff**

**2-3 credits**

Designed to further independent research or projects leading to the preparation of an undergraduate thesis. Required of and limited to senior honors candidates in geology. *Prerequisite:* admission to honors candidacy.