

GEOLOGY

DEPARTMENT OFFICE

Darwin Hall 116
(707) 664-2334
www.sonoma.edu/geology

DEPARTMENT CHAIR

Matthew J. James

ADMINISTRATIVE COORDINATOR

Gayle Walker

Faculty

Thomas B. Anderson
Matthew J. James
Daniel B. Karner
Matty Mookerjee
Walt Vennum

Programs Offered

Bachelor of Science in Geology
Bachelor of Arts in Geology
Minor in Geology
Secondary Education Teaching Credential Preparation

Geology is the study of the materials, structures, processes, and history of the earth. Philosophically, it allows us to realize our place in the physical universe within the enormity of geologic time. Practically, it leads to understanding of earth processes, the formation of rocks and minerals, and the energy supplies and materials that support our civilization.

The evolution of modern geologic thought was based on field studies; thus, geology is primarily a field science. The basis for field analysis is a firm background in the principles of geology. The department is committed to undergraduate training that includes a well-balanced treatment of geologic principles, with an emphasis on field studies. Students take a fundamental curriculum that concentrates on the analysis of rocks and minerals, geologic mapping, and report writing. Techniques of field study are part of the fundamental curriculum. Six field-mapping classes are required. Required courses in physics, chemistry, and mathematics support understanding of geologic principles.

Careers in Geology

Within the general field of geology, students may choose from major programs that lead to either the B.A. or B.S. preprofessional degrees. The B.S. and B.A. degrees provide an excellent background for graduate school and for work in geology in such fields as engineering geology, environmental geology, hydrology, and mineral exploration. Many of our geology graduates work for consulting firms with specialties in one or more of these areas. Because of

the selectivity involved in choosing a program that meets their own particular interests and goals, students must consult with a departmental advisor about their plan of study and their course load each semester.

Bachelor of Science in Geology

This plan is intended to give the student basic professional competence in geology. It provides an excellent foundation for graduate school or a professional career for those students who have or desire a strong background in mathematics.

<i>Degree Requirements</i>	<i>Units</i>
General education	51
Major requirements	46
Supporting courses	26
General electives	1

Total units needed for graduation 124

Major Core Requirements

GEOL 205 Mineralogy	2
GEOL 303 Advanced Principles of Geology	4
GEOL 304 Geologic Mapping and Report Writing	1
GEOL 305 Optical Mineralogy	3
GEOL 307 Igneous and Metamorphic Petrology	4
GEOL 308 Igneous and Metamorphic Field	1
GEOL 411 Sedimentary Petrology	4
GEOL 412 Sedimentary Petrology Field	1
GEOL 413 Paleontology	4
GEOL 417 Structural Geology	4
GEOL 418 Structural Geology Field	1
GEOL 420 Field Geology	4
GEOL 427 Advanced Field Geology	4

Total units in the major core 37

Major Electives

Choose 9 units of upper-division geology electives in consultation with an advisor.

Total units in major electives 9

Required Supporting Courses

CHEM 115AB, 116AB General Chemistry	10
PHYS 114 Introduction to Physics I	4
PHYS 116 Introductory Laboratory	1
PHYS 214 Introduction to Physics II	4
PHYS 216 Introductory Laboratory	1
MATH 161 Calculus I with Analytic Geometry	4
MATH 211S Calculus II with Analytic Geometry (MATH 211 is the 4-unit version of 211S and is highly recommended)	2

Total units in supporting courses 26

Total units in the major 72

Sample Four-year Plan for Bachelor of Science in Geology*

Freshman Year:: 28 Units	
<i>Fall Semester (14 Units)</i>	<i>Spring Semester (14 Units)</i>
GEOL 102 (3)	GEOL 105** (3)
CHEM 115A/116A (5)	CHEM 115B/116B (5)
GE (6)	GE (6)
Sophomore Year:: 33 Units	
<i>Fall Semester (17 Units)</i>	<i>Spring Semester (16 Units)</i>
GEOL 303 (4)	GEOL 413 (4)
GEOL 304 (1)	GEOL 414 (1)
GEOL 205 (2)	MATH 211S (2)
MATH 161 (4)	GE (9)
GE (6)	
Junior Year:: 31 Units	
<i>Fall Semester (16 Units)</i>	<i>Spring Semester (15 Units)</i>
GEOL 305 (3)	GEOL 307 (4)
PHYS 114 (4)	GEOL 308 (1)
PHYS 116 (1)	PHYS 214 (4)
GEOL 417 (4)	PHYS 216 (1)
GEOL 418 (1)	GE (3)
GE (3)	Elective (2)
Senior Year:: 30 Units	
<i>Fall Semester (14 Units)</i>	<i>Spring Semester (16 Units)</i>
GEOL 411 (4)	GEOL 420 (4)
GEOL 412 (1)	Geology Elective (3)
Geology Elective (3)	Geology Elective (3)
GE (6)	GE (6)
Senior Summer:: 4 Units	
GEOL 427 (4)	
Total semester units:: 124	
* The B.A. degree in geology is identical to the BS, except that MATH 211S is not required, and PHYS 210AB and PHYS 211AB (Algebra Physics) are substituted for PHYS 114, 116, 214, and 216 (Calculus Physics).	
** Course not required, but strongly recommended.	
Students are strongly encouraged to take GE courses in the summer and in January intersession to the extent possible.	

Bachelor of Arts in Geology

This plan is intended to give the student basic professional competence in geology, suitable as a foundation for either graduate school or a professional career. The geology course content is the same as in the BS degree, but the calculus and physics requirements are less rigorous.

<i>Degree Requirements</i>	<i>Units</i>
General Education	51
Major Requirements	46
Supporting Courses	22
General Electives	7

Total units needed for graduation 120

Major Core Requirements

GEOL 205 Mineralogy	2
GEOL 303 Advanced Principles of Geology	4
GEOL 304 Geologic Mapping and Report Writing	1
GEOL 305 Optical Mineralogy	3
GEOL 307 Igneous and Metamorphic Petrology	4
GEOL 308 Igneous and Metamorphic Field	1
GEOL 411 Sedimentary Petrology	4
GEOL 412 Sedimentary Petrology Field Course	1
GEOL 413 Paleontology	4
GEOL 417 Structural Geology	4
GEOL 418 Structural Geology Field	1
GEOL 420 Field Geology	4
GEOL 427 Advanced Field Geology	4

Total units in the major core 37

Major Electives

Choose 9 units of upper-division geology electives in consultation with an advisor.

Total units in major electives 9

Required Supporting Courses

CHEM 115AB, 116AB General Chemistry	10
PHYS 209AB, 210AB General Physics with Laboratory	8
MATH 161 Calculus I with Analytical Geometry	4

Total units in supporting courses 22

Total units in the major 68

Minor in Geology

Completion of a minimum of 20 units from Geology Department courses will constitute a minor in geology. Six of the 20 units must be upper-division. Students should consult with an advisor in the Geology Department regarding required courses.

Secondary Education Teaching Credential Preparation

Geology students must demonstrate competence in the natural sciences by passing the subject matter examination required by the California Commission on Teacher Credentialing. One part of the examination will test breadth of knowledge in biology, chemistry, physics, astronomy, and geology. Another part of the examination will test depth of knowledge in a particular area, such as geology. The B.A. Or BS degree in geology is recommended to prepare for

the part of the examination that tests depth of knowledge in geology. For recommended course selection to help prepare for the part of the examination that tests breadth of scientific knowledge, please see the Teaching Credential section of this catalog.

For more information, please contact Professor Dan Karner, Darwin Hall 336A, 707 664-2334.

Geology Courses (GEOL)

Classes are offered in the semesters indicated. Please see the Schedule of Classes for most current information and faculty assignments.

102 OUR DYNAMIC EARTH: AN INTRODUCTION TO GEOLOGY (3) FALL, SPRING

Lecture, 2 hours; laboratory, 3 hours. A study of the minerals, rocks and landforms that make up our earth in the context of the dynamic forces that form them and the external forces that break them down. Emphasis on local geology, including earthquakes and other environmental aspects. Laboratory study of minerals, rocks, and maps. Required one-day weekend field trip. Fee required. Satisfies GE, category B1 (Physical Sciences) and GE laboratory requirements.

105 THE AGE OF DINOSAURS (3) FALL, SPRING

Lecture, 3 hours. The life and death of dinosaurs as evidenced by the fossil record will be studied to show how geology and biology combine in the discipline of paleontology. The evolution of dinosaurs over a 150 million-year time span sets the stage to investigate several interesting and ongoing controversies surrounding dinosaurs, including: why dinosaurs became extinct, the metabolism of dinosaurs, and the relationship between birds and dinosaurs. Satisfies GE, category B1 (Physical Sciences).

107 INTRODUCTION TO EARTH SCIENCE (3) FALL

This course studies the operation of the Earth system and its solar system home. It introduces the fundamental aspects of 4 major areas: astronomy; geology, including plate tectonics, and the planetary history of the Earth and its moon; physical oceanography; and weather and climate. There is no lab. The course is designed to prepare students for the earth science and astronomy parts of the CSET examination. The prerequisite is that a student must be enrolled in the AMCS, Libs, CALS, or ENSP credential program. This class is not allowable as a prerequisite for upper-division Geology courses.

110 NATURAL DISASTERS (3) FALL, SPRING

A course to examine the interaction between natural processes and human activities, and the often costly and fatal results. Course emphasis will be on the principles underlying natural disasters such as earthquakes, volcanic eruptions, landslides, floods, severe weather, coastal processes, asteroid impacts, fires, great dyings, and population growth. Many examples will be drawn from the northern California area. Extensive Internet work for current information. Course content may vary with instructor. Satisfies GE, category B3 (Physical Sciences, Specific Emphasis).

120 REGIONAL FIELD GEOLOGY (3) SPRING

Lecture, 1 hour; 10-day required field trip. Field study of rocks, minerals, and landforms, and the processes that form them. A 10-day field trip to the Death Valley area is taken during spring vacation. Fee required. Satisfies GE, category B3 (Physical Sciences, Specific Emphasis) and laboratory requirements. Prerequisites: GEOL 102 or concurrent enrollment; students must be in good physical condition.

205 MINERALOGY (2) FALL

Lecture 1 hour; laboratory, 3 hours. Principles of crystal chemistry, properties and origin of common rock-forming minerals. Laboratory sessions emphasize hand specimen mineral identification through determination of both physical and chemical characteristics. Prerequisites: completion of or concurrent enrollment in GEOL 303 and CHEM 115A/116A.

301 NATURAL HISTORY OF THE HAWAIIAN ISLANDS (3) FALL, SPRING

Lecture, 3 hours. The origin and evolution of the flora and fauna of the most isolated archipelago in the world; geologic history and context of volcanic oceanic islands; conservation biology efforts to save the rare and endangered species of Hawaii. Satisfies GE, category B3 (Physical Sciences Specific Emphasis). Prerequisite: GEOL 102, or BIOL 115 or 123.

303 ADVANCED PRINCIPLES OF GEOLOGY (4) FALL

Lecture, 3 hours; laboratory, 3 hours. Advanced treatment of the principles, methods, and tools of geology emphasizing the materials that constitute the earth and the processes that act or have acted on them. Required of all prospective geology majors; recommended for those strongly interested in science. Satisfies GE, category B3 (Physical Sciences, Specific Emphasis) and laboratory requirements. Prerequisite: GEOL 102; strong science background recommended.

304 GEOLOGIC MAPPING AND REPORT WRITING (1) FALL

Field studies and report preparation done in conjunction with GEOL 303. Required weekend field trips. Prerequisites: concurrent enrollment in GEOL 303; students must be in good physical condition.

305 OPTICAL MINERALOGY (3) FALL

Lecture, 1 hour; laboratory, 6 hours. Introduction to crystallography and the principles of optical mineralogy. Laboratory exercises are devoted to understanding the properties of crystal lattices and the fundamentals of mineral identification with the petrographic microscope. Prerequisites: MATH 107 and completion of or concurrent enrollment in GEOL 205 and 303.

306 ENVIRONMENTAL GEOLOGY (3) FALL, SPRING

Lecture, 3 hours. Study of geological principles and processes as they relate to our natural environment emphasizing interaction between human activities and the geological environment. Major topics include the nature and behavior of rocks and soils; earthquakes and their associated hazards; landslides, slope stability, and building construction; groundwater and pollution; stream processes and flooding; shoreline processes and coastal development; engineering geology and construction of highways and dams; and development of natural resources, conservation, and ecology. Specific content varies year to year, depending on instructor. Prerequisite: GEOL 102 or consent of instructor.

307 IGNEOUS AND METAMORPHIC PETROLOGY (4) SPRING

Lecture, 2 hours; laboratory, 6 hours. A study of the origin, properties, classification, and occurrence of igneous and metamorphic rocks. Laboratory exercises in the classification and description of minerals, textures, and structures of the more common rock types. Laboratory work will emphasize both hand specimen analysis and microscopic petrography. Prerequisites: GEOL 305 and completion of or concurrent enrollment in CHEM 115B/116B.

308 IGNEOUS AND METAMORPHIC PETROLOGY FIELD COURSE (1) SPRING

Field studies done in conjunction with GEOL 307. Required weekend field trips. Fee required. Prerequisites: GEOL 304 and concurrent enrollment in GEOL 307. Students must be in good physical condition.

323 HYDROLOGY (3) SPRING

Lecture, 3 hours. Water as a natural resource, the hydrologic cycle, distribution of water on the earth. Atmospheric water, soil water, runoff, and groundwater as related to water supply and use. Applications to problems of flood control, water management, and water pollution, with special emphasis on California and Sonoma County. Prerequisites: GEOL 102 or consent of instructor; MATH 106 or 107.

326 STRATIGRAPHY AND EARTH HISTORY (4) SPRING, ODD YEARS

Lecture, 3 hours; laboratory, 3 hours. The principles of stratigraphy and historical geology will be discussed, with special emphasis given to the application of these principles to the geologic development of North America. The geologic history of California will be treated in detail. The use of sedimentary rocks, fossils, and structural and tectonic principles will be discussed, especially as they relate to

our understanding of historical geology. Laboratory work will include a study of sedimentary rocks and their properties, fossils and their occurrence and distribution, the construction and interpretation of various types of stratigraphic maps, and detailed studies of selected maps representative of the various geologic provinces of North America. Required field trip. Prerequisite: GEOL 303 or consent of instructor.

395 COMMUNITY INVOLVEMENT PROGRAM (1-4) FALL, SPRING

CIP involves students in community problems such as tutoring, aiding in school science classes, and advisement of county agencies. A total of 6 units of CIP credit may be applied toward a degree. May be taken by petition only. Not applicable to the geology major.

396 INTERNSHIP IN GEOLOGY (1-4) FALL, SPRING

Professional geologic work for a geologic firm or agency. Forty-five hours of work per unit. Not applicable to the geology major. Prerequisites: GEOL 303 and consent of instructor.

406 X-RAY MINERALOGY (2) FALL, ODD YEARS

Lecture, 1 hour; laboratory 3 hours. Introduction to the use of x-ray diffraction techniques. Prerequisites: CHEM 115A/116A and GEOL 305 or concurrent enrollment, and consent of instructor.

410 GEOPHYSICS (3) SPRING, ODD YEARS

Lecture, 2 hours; laboratory 3 hours. The principles of physics as they are related to the earth. Physical basis for the methods of geophysical investigation: seismology, gravity, magnetics, and electromagnetics. Application of geophysical methods to geological problems such as oil exploration and plate tectonics. Fieldwork and analysis of geological problems using geophysical instruments. Extensive use of computer. Required field trips. Prerequisites: GEOL 102 or 303, MATH 161 and PHYS 114.

411 SEDIMENTARY PETROLOGY (4) FALL

Lecture, 3 hours; laboratory, 3 hours. The description, classification and origin of sedimentary rocks. Discussion of weathering and origin of sediment; sediment transportation and sedimentary structures; clastic and nonclastic classification; and petrology. Hand specimen and thin section petrography and other techniques for studying sedimentary rocks will be used in the laboratory. Prerequisites: GEOL 307 and 308.

412 SEDIMENTARY PETROLOGY FIELD COURSE (1) FALL

Field studies done in conjunction with GEOL 411. Required weekend field trips. Prerequisites: GEOL 308 and concurrent enrollment in GEOL 411. Students must be in good physical condition.

413 PALEONTOLOGY (4) SPRING

Lecture, 3 hours; laboratory 3 hours. The study of fossils in their geological context. Topics include taxonomy, morphology, evolution, biogeography, extinction, and biostratigraphy of the main groups of invertebrate, vertebrate, and plant fossils. Laboratory work will include becoming familiar with stratigraphically important fossil groups and the use of fossils in solving both geological and biological problems. Prerequisite: GEOL or 303 for majors, GEOL 102 for non-majors.

414 PALEONTOLOGY FIELD COURSE (1) SPRING

Field studies done in conjunction with GEOL 413. Required weekend field trips. Prerequisites: GEOL 303 for majors, GEOL 102 for non-majors, and concurrent enrollment in GEOL 413. Students must be in good physical condition.

417 STRUCTURAL GEOLOGY (4) FALL

Lecture, 3 hours; laboratory, 3 hours. Introduction to theoretical and experimental rock deformation; description and genesis of folds, faults, and related minor structures; interior structure of the earth, plate tectonics, and regional structural history. Prerequisites: GEOL 303, 304, and MATH 107.

418 STRUCTURAL GEOLOGY FIELD COURSE (1) FALL

Field studies done in conjunction with GEOL 417. Required weekend field trips. Prerequisite: previous or concurrent enrollment in GEOL 417. Students must be in good physical condition.

420 FIELD GEOLOGY (4) SPRING

Lecture, 1 hour; 12 days of fieldwork. Principles of geologic mapping, interpretation of geologic maps, preparation of field reports. Fee required. Prerequisites: GEOL 411, 412, 417, and 418. Students must be in good physical condition.

422 GEOCHEMISTRY (3) SPRING, ODD YEARS

Lecture, 3 hours. Introductory cosmochemistry and origin of the elements; meteorites; the earth as a chemical system, chemistry of processes at the surface of the earth; mineral crystal chemistry; introduction to geochronology and stable isotope variations in nature; thermodynamics and its geological application; geochemical prospecting. Prerequisite: GEOL 303, CHEM 115AB/116AB, MATH 161, or consent of instructor.

425 ECONOMIC GEOLOGY (4) SPRING, ODD YEARS

Lecture, 3 hours; laboratory, 3 hours. Classification, origin and alteration of metallic ore deposits. Laboratory sessions on hand sample identification of ore and alteration minerals and petrographic analysis of selected ore suites. Prerequisites: previous or concurrent enrollment in GEOL 307 and CHEM 115B/116B.

427 ADVANCED FIELD GEOLOGY (4) SUMMER

A minimum of five weeks of detailed mapping in igneous, metamorphic, and sedimentary rocks, and the preparation of field reports and geological maps. Students may also complete this course at another university, but should do so only in consultation with the Geology Department. Students must demonstrate equivalence in terms of field hours and course content to GEOL 427. Prerequisite: senior standing in geology. GEOL 420 strongly recommended.

495 SPECIAL STUDIES (1-4) FALL, SPRING

Individual study, under guidance of an advisor of an advanced field, laboratory, or literature problem. Students must qualify and adhere to the department policy on independent study as outlined below. Prerequisite: approval of advisor.

Department Policy on Independent Study

1. The student must have a 3.00 or higher grade point average.
2. The student must have demonstrated ability to work independently and do quality work in field classes.
3. The student must have submitted a detailed proposal of work to do, schedule, and results expected.
4. The student must have a faculty sponsor who is willing to advise the project and will set up a schedule of meetings for this purpose. This will be reported on the standard University Special Studies form and signed by the student, faculty advisor, and department chair.
5. A copy of all documents and two copies of the final paper or report will be filed with the department office before a grade will be assigned.

496 SELECTED TOPICS IN GEOLOGY (1-3)

An intensive study of an advanced topic in geology. May be repeated for additional credit with new subject matter. Prerequisite: adequate preparation for topic under consideration. Additional fee may be required.

498 GEOLOGY PRACTICUM (1-4)

Application of previously studied theory through supervised instructional work experience in geology, generally as a teaching assistant in geology laboratory classes. Intended for professional growth. May be repeated for up to a total of 4 units. Not applicable for the geology major or minor. Prerequisites: upper-division standing in geology and consent of instructor. Student needs to have passed the course that he/she will be a teaching assistant in with a grade of B or better. To be a teaching assistant in GEOL 102 laboratory student needs to have received a grade of B or better in GEOL 303.