Geology

Overview

Geology is the study of the origin and evolution of the earth, utilizing the principles of mathematics, chemistry, physics and biology. The concept of geologic time and the principles of uniformitarianism help geologists to understand the processes that shape the earth and its environments. Geologists study rocks, minerals and fossils in an effort to draw conclusions about both the earth's observable surface processes that meet the eye, and the earth's interior.

Program Maps

Geology, A.S. Degree (/crc/main/doc/programs/program-maps/geol-as-degree-ho.pdf)
Geology, A.S.-T Degree (/crc/main/doc/programs/program-maps/geol-as-t-degree-ho.pdf)
Geology, A.S.-T Degree, IGETC (/crc/main/doc/programs/program-maps/geol-as-t-degree-ho-igetc.pdf)

DeanBanafsheh Amini (/about-us/contact-us/faculty-and-staff-directory/banafsheh-amini)
Department ChairScott Crosier (/about-us/contact-us/faculty-and-staff-directory/scott-crosier)

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Associate Degrees for Transfer

A.S.-T. in Geology

The Associate in Science in Geology for Transfer Degree (AA-T) is designed to provide a seamless transfer pathway for students interested in pursuing at least one Geology degree option in the California State University (CSU) system. Students must complete the core curriculum and electives to meet a total of 60 transferable units with a minimum 2.0 GPA, which includes the CSU General Education Breadth or the Intersegmental General Education Transfer Curriculum (IGETC) pattern. Students must also earn a grade of C or better in all the courses for the major as described in the Required Program. Upon successful completion of the degree requirements, students will be guaranteed admission to the CSU system with junior status and will not have to repeat lower division coursework. Students are encouraged to meet with a counselor to develop their educational plans as degree options and general education requirements vary for each university.

Catalog Date: June 1, 2020

Degree Requirements

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>UNITS</th>
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<tbody>
<tr>
<td>GEOL 300</td>
<td>Physical Geology</td>
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<td>5</td>
</tr>
<tr>
<td>Total Units</td>
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The Associate in Science in Geology for Transfer (AS-T) degree may be obtained by completion of 60 transferable, semester units with a minimum 2.0 GPA, including (a) the major or area of emphasis described in the Required Program, and (b) either the Interssegmental General Education Transfer Curriculum (IGETC) or the California State University General Education-Breadth Requirements.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- Understand the culture and practice of science. (PSLO 1)
- Evaluate how nature and humans exist in various dimensions of space and time. (PSLO 2)
- Integrate geoscience technologies and information resources. (PSLO 3)
- Analyze critical geoscience issues facing the world today. (PSLO 4)
- Communicate geoscience concepts and information effectively in various forms (e.g., verbal, written, graphic). (PSLO 5)
- Assess the use and limits of natural resources. (PSLO 6)
- Analyze the impacts of natural processes on humanity. (PSLO 7)

Career Information
The AS-T in Geology can provide students with the foundational knowledge necessary for transfer to a 4-year Bachelor of Art or Science (BA or BS) degree program. Career opportunities for students who have earned Bachelor’s degrees in Geology include but are not limited to Geologist (for private industry or the government), Environmental Planner or Consultant, Earth Science Educator (middle school through university), Paleontologist, Petrologist, Land Use and Natural Resource Management, Cartographer/Stratigrapher, Park Naturalist, Hydrologist, GIS Specialist, and Oceanographer. Some careers may require additional training. NOTE TO TRANSFER STUDENTS: The Associate Degree for Transfer program is designed for students who plan to transfer to a campus of the California State University (CSU). Other than the required core, the courses you choose to complete this degree will depend to some extent on the selected CSU for transfer. In addition, some CSU-GE Breadth or IGETC requirements can also be completed using courses required for this associate degree for transfer major (known as “double-counting”). Meeting with a counselor to determine the most appropriate course choices will facilitate efficient completion of your transfer requirements. For students wishing to transfer to other universities (UC System, private, or out-of-state), the Associate Degree for Transfer may not provide adequate preparation for upper-division transfer admissions; it is critical that you meet with a CRC counselor to select and plan the courses for the major, as programs vary widely in terms of the required preparation.

Associate Degrees

A.S. in General Science

Areas of Study include:

- Physical Anthropology
- Astronomy
- Biology
- Chemistry
- Engineering
- Physical Geography
- Geology
- Physics

Eighteen (18) units of transfer level course work in science is required. Two laboratory courses must be included: one in the physical sciences and one in the biological sciences. Courses may be selected from astronomy, biology, chemistry, geology, physical geography, physical anthropology, and physics. The student, in consultation with a counselor, should choose science courses to meet his or her program, transfer, or general education requirements.

Students interested in transferring to a four-year university with a science major are encouraged to complete a science AS or AS-T degree such as Anthropology, Biology, Chemistry, Engineering, Geography, Geology, or Physics. This General Science degree may not include the majors-level transfer courses needed for many science majors. Students are strongly recommended to see a counselor for guidance.

Catalog Date: June 1, 2020

Degree Requirements

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<tr>
<th>COURSE CODE</th>
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<td>BIOL 307</td>
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<td>BIOL 430</td>
<td>Anatomy and Physiology (5)</td>
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<td>B. Physical Science with Lab:</td>
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<td>CHEM 306</td>
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<td>ENGR 304</td>
<td>How Things Work (3)</td>
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<td>Heat, Waves, Light and Modern Physics (4)</td>
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C. Additional Science Courses:

A minimum of 11 units from the following:

11

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<td>The New Plagues: New and Ancient Infectious Diseases Threatening World Health (3)</td>
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<td>BIOL 352</td>
<td>Conservation Biology (3)</td>
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<td>Natural History Field Study (0.5 - 4)</td>
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<td>Physical Geography: Exploring Earth's Environmental Systems (3)</td>
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</table>

Total Units: 18

Courses used in A or B above will not count towards C, except units exceeding the 4 or 3 unit minimum in A and B. For example, a student completing the 5 unit CHEM 309 under B could apply 2 of those units towards C. A total of 18 science units is required.

The General Science Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See CRC graduation requirements.

Student Learning Outcomes
Upon completion of this program, the student will be able to:

- explain the core perspectives of the scientific method and apply it to at least one scientific discipline. (SLO 1)
- solve introductory problems of a conceptual and/or numerical nature of at least one scientific discipline. (SLO 2)
- accurately apply the basic vocabulary and concepts of at least one scientific discipline verbally and in writing (SLO 3)
- recognize the use and misuse of scientific concepts in society including politics and the media. (SLO 4)

### A.S. in Geology

This degree is designed to meet common lower division requirements for a major in Geology.

All CRC Geology courses satisfy lower division General Education requirements for the A.A., A.S., B.A., and B.S. degrees. For transfer students earning a Baccalaureate Degree in Geology, satisfactory completion of the CRC Geology curriculum provides a solid foundation and the standard prerequisites for upper division coursework. Geology majors planning to transfer to four-year institutions should take GEOL 300, 301, 310, and 311.

**HIGHLIGHTS**

- Comprehensive lower division course offerings, including a Physical Laboratory, Mineral Laboratory, and Field Course
- Dynamic geologic environment near the Sierra Nevada, San Andreas Fault, and Sacramento Delta
- Internships available with State of California, County of Sacramento, and Federal Land Management Agencies
- A Mathematics, Engineering and Science Achievement (MESA) program

**Catalog Date:** June 1, 2020

### Degree Requirements

<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>UNITS</th>
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<td>CHEM 400</td>
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**Total Units:** 28

The Geology Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See CRC graduation requirements.

### Student Learning Outcomes

Upon completion of this program, the student will be able to:

- **<strong>SLO 1:</strong> Understand the culture and practice of science.</strong>
- **<strong>SLO 2:</strong> Evaluate how nature and humans exist in various dimensions of space and time.</strong>
- **<strong>SLO 3:</strong> Integrate geoscience technologies and information resources.</strong>
- **<strong>SLO 4:</strong> Analyze critical geoscience issues facing the world today.</strong>
- **<strong>SLO 5:</strong> Communicate geoscience concepts and information effectively in various forms (e.g., verbal, written, graphic).</strong>
- **<strong>SLO 6:</strong> Assess the use and limits of natural resources.</strong>
- **<strong>SLO 7:</strong> Analyze the impacts of natural processes on humanity.</strong>

### Career Information

Geologist (for private industry or the government); Environmental Planner or Consultant; Earth Science Educator (middle school through university); Paleontologist; Petrologist; Land Use and Natural Resource Management; Cartographer/Stratigrapher; Park Naturalist; Hydrology; GIS Specialist; Oceanographer. Most career options require additional college study.

### Geology (GEOL) Courses

#### GEOL 300 Physical Geology

**Units:** 3  
**Hours:** 54 hours LEC  
**Prerequisite:** None.  
**Advisory:** Concurrent enrollment in GEOL 301.  
**Transferable:** CSU, UC  
**General Education:** AA/AS Area IV; CSU Area B1; IGETC Area 5A  
**C-ID:** C-ID GEOL 100  
**Catalog Date:** June 1, 2020

Physical Geology introduces the composition and dynamics of Earth from the atomic scale of minerals to the global scale of plate tectonics. Major themes include the composition of minerals and rock, volcanism, Earth structures, earthquakes, erosion and surface processes, geologic time, geologic hazards, and plate tectonics. This course analyzes human interactions with geologic processes and the physical environment. Successful completion of physical geology prepares the student to recognize, understand, and appreciate the physical processes which continually change Earth over geologic time.

### Student Learning Outcomes
Upon completion of this course, the student will be able to:

- **SLO#1:** Apply the Scientific Method to evaluating geologic processes.
- Examine scientific inquiry as a platform for exploring our world objectively.
- Illustrate a historical instance in geology where scientific ideas were improved upon through inquiry using the scientific method.
- **SLO#2:** Evaluate temporal and spatial dimensions in which Earth originated and exists.
- Discuss the basic narrative of Earth origin and ocean and atmospheric development based on known scientific evidence.
- Use basic concepts and tools of geologic time -- uniformity, geometric principals of relative age dating, radiometric dating -- to solve problems of geologic timing.
- Analyze the standard geologic time scale as a means for organizing Earth history.
- **SLO#3:** Examine how we can determine Earth's interior and surface compositions.
- Synthesize data from geophysics, seismology, and petrology to produce a comprehensive view of Earth's interior layered structure.
- Recognize what minerals are and how to identify important rock forming varieties.
- Define and give examples of igneous, sedimentary, and metamorphic rocks.
- Identify environmental influences on rock formation based on textural, compositional, and structural features in the rock.
- Evaluate the importance, availability, and rate of usage of those natural resources which are geologic in nature.
- **SLO#4:** Apply plate tectonic theory to formulate geologic settings for physical processes.
- Discuss evidence that contributed to the development of plate tectonics.
- Evaluate divergent, convergent, and transform boundaries and describe the characteristics of each.
- Identify the main features of ocean floor topography.
- Evaluate how volcanic activity, mountain building, and earthquakes are related to each other.
- Contrast and assess evidence of orogenesis and explain how continents grow by accretion.
- **SLO#5:** Assess the potential threats of geologically-related natural disasters.
- Recognize and appraise the hazards associated with earthquakes.
- Evaluate the conditions that generate floods and landslides.
- Assess how long and short term predictions are for major natural disasters.
- Explain some environmental disasters that humans can potentially create.
- **SLO#6:** Evaluate the various depositional and erosional features associated with different agents of erosion -- wind, glaciers, rivers, gravity, and waves.
- Critique how features of these environments can indicate climate change.
- **SLO#7:** Communicate geologic concepts and information effectively in various forms (e.g., verbal, written, graphic).
- Research credible sources of geologic information.

### GEOL 301 Physical Geology Laboratory

**Units:** 1

**Hours:** 54 hours LAB

**Prerequisite:** None.

**Corequisite:** GEOL 300 (may be taken previously)

**Transferable:** CSU, UC

**General Education:** CSU Area B3; IGETC Area SC

**Catalog Date:** June 1, 2020

This course provides "hands-on" experience with the tools and skills discussed in Physical Geology (GEOL 300). Lab topics include mineral and rock identification, map and air photograph interpretation and landform identification, and introduction to the study of geologic maps and cross-sections.

### Student Learning Outcomes

Upon completion of this course, the student will be able to:

- **SLO#1:** Apply the Scientific Method to evaluating Earth science processes.
- Note how the scientific method is followed in various experiments.
- Evaluate a data set with conscious reference to the scientific method.
- **SLO#2:** Examine Earth's interior and solid surface compositions.
- Identify rock and minerals specimens in hand samples to determine their geologic origin.
- Deduce the properties and compositions of Earth's interior layers based on various types of evidence observed at Earth's surface.
- Interpret the geologic processes which produce specific rock types.
- **SLO#3:** Apply plate tectonic theory to formulate geologic settings for physical processes.
- Discuss how earthquakes are connected to tectonic settings.
- Calculate rates of plate motion and sea floor spreading.
- Distinguish between different plate boundaries and the rock types produced by tectonic processes.
- Compare and contrast the rate of seafloor spreading and explain the physiographic features produced.
- Evaluate the affect of hot spots on continent and ocean-floor evolution.
- **SLO#4:** Evaluate temporal and spatial dimensions in which Earth history is explored.
- Assess the time-event sequence on a geologic column by utilize both relative and absolute time.
- Assemble a geologic map and evaluation the relative and absolute time sequencing.
- **SLO#5:** Assess the impact of earthquake activity at a human scale.
- Calculate and model the speed of P and S waves to derive an earthquake's epicenter.
- Analyze the factors that cause earthquake destruction and how serious damage can be avoided.
- **SLO#6:** Confirm the effects of surface geologic processes on terrain landscape.
- Construct and interpret topographic maps and compute gradient from them.
- Inspect and evaluate aerial/satellite photos and determine the geologic structures present.
Recognize, describe, and illustrate groundwater processes and the formation of karst topography.

Illustrate, examine, and interpret erosional and depositional features produced by stream, glacial, and wind processes.

GEOL 305 Earth Science

This course is an introductory course covering major topics in geology, oceanography, meteorology, astronomy, scientific method, and philosophy of science. This course is designed for non-science majors. This course is not open to students who have received credit for GEOL 300 or GEOL 310.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

1. Apply the Scientific Method to evaluating Earth science processes.
2. Examine scientific inquiry as a platform for exploring our world objectively.
3. Illustrate historical instances where scientific ideas were improved upon through inquiry using the scientific method.
4. Evaluate temporal and spatial dimensions in which Earth originated and exists.
5. Discuss the basic narrative of Earth origin and ocean and atmospheric development based on known scientific evidence.
6. Compare and contrast Earth as a planet to other planets and objects in the Solar System.
7. Use basic concepts and tools of geologic time -- uniformity, geometric principals of relative age dating, radiometric dating -- to solve problems of geologic timing.
8. Apply plate tectonic theory to formulate geologic settings for physical processes.
9. Discuss evidence that contributed to the development of plate tectonics.
10. Analyze how plate tectonic theory explains the development and break up of continents, and of the growth and shrinkage of oceans.
11. Identify the main features of ocean floor topography.
12. Evaluate how volcanic activity, mountain building, and earthquakes are related to each other.
13. Examine how we determine Earth's interior and solid surface compositions.
14. Synthesize different data sets to produce a comprehensive view of Earth's interior layered structure.
15. Discuss how different minerals form in different environments to produce the three categories of rocks.
16. Deduce past surface environments from textures and features in sedimentary rocks.
17. Investigate how different aspects of atmospheric change contribute to weather and climate.
18. Describe Earth's atmosphere's origin, composition, and structure.
19. Delineate the various factors that affect how Earth is heated.
20. Assess how changes in the atmosphere's moisture/humidity content with temperature bring about observable changes in weather.
21. Evaluate how changes in atmospheric pressure produce different weather results.
22. Explain how changes in the atmospheric characteristics mentioned above produce different weather systems.
23. Survey Earth's basic marine processes.
24. Explain the formation of three basic types of water movements (tides, currents, waves) and how they affect human activity.
25. Investigate the characteristic physical properties ocean water.
27. Analyze the causes and impacts of global warming and global climate change.
28. Assess how earthquakes are a danger to humans.
29. Examine how human activity contributes to or mitigates beach erosion.

GEOL 306 Earth Science Laboratory

This course emphasizes scientific methods and systematic laboratory procedures. Topics include weather analysis, rock and mineral identification, study of geologic concepts by means of topographic maps, and exercises in astronomy and oceanography. One field trip may be required. Not open to students who have received credit for GEOL 300 or GEOL 301.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

1. Apply the Scientific Method to evaluating Earth science processes.
2. Note how the scientific method is followed in various experiments.
3. Evaluate a data set with conscious reference to the scientific method.
4. Evaluate temporal and spatial dimensions in which Earth originated and exists.
5. Construct a model of the solar system in order to observe characteristics of distance among the planets and sun.
● Relate Earth, Sun, and Moon motions to observable phenomena on Earth, such as tides and lunar phases.
● Describe the position and motion of the planets using key constellations as reference.
● Explain why the moon exhibits all of its phases and surface textures.
● Investigate methods for determining the ages and sequences of geologic events.

"SLO#3: Apply plate tectonic theory to formulate geologic settings for physical processes."</STRONG>

● Calculate rates of plate motion and sea floor spreading.
● Discuss how earthquakes are connected to tectonic settings.
● Relate igneous activity to the tectonic context of the area.

"SLO#4: Examine how we determine Earth's interior and solid surface compositions."</STRONG>

● Identify rock and minerals specimens in hand samples to determine their geologic origin.
● Deduce the properties and compositions of Earth's interior layers based on various types of evidence observed at Earth's surface.

"SLO#5: Investigate how different components of atmospheric change contribute to weather and climate."</STRONG>

● Analyze how noon-time sun angle and duration of sunlight influence the distribution of heat on Earth.
● Compute the quantity of water vapor in the atmosphere and evaluate its significance on weather trends.
● Measure atmospheric pressure and evaluate its affect on weather trends.
● Integrate the above atmospheric measurements to determine conditions for weather storms.

"SLO#6: Survey Earth's basic marine processes."</STRONG>

● Define the prominent sea floor features of ocean floor topography.
● Show how wind and gravitational forces produce wave, current, and tidal effects.
● Assess the effect of salinity and temperature on density of seawater.

"SLO#7: Collect, measure, and/or analyze geologic information using common instruments and tools."</STRONG>

● Collect and analyze data using common meteorological instruments (e.g., thermometer, barometer, sling psychrometer), geomorphic instruments (e.g., stereoscopic imagery, stereoscope) and mapping tools (e.g., latitude/longitude, scale, USGS quad maps).

GEOL 310 Historical Geology

Units: 3
Hours: 54 hours LEC
Prerequisite: GEO 300 or 305; An introductory geology or earth science course.
Advisory: CSU Area B1; IGETC Area 5A
Transferable: None.
General Education: AA/AS Area IV; CSU Area Bt; IGETC Area SA
C-ID: C-ID GEOL 110
Catalog Date: June 1, 2020

This course explores the origin and geologic history of Earth and the evolution of its plant and animal inhabitants. Plate tectonic theory is used to explain changes in composition and structure of rocks in Earth's crust from the formation of Earth to the present. Emphasis is placed on the formation of sedimentary rocks for the purpose of understanding how they and the fossils contained within them record changes in Earth environment and processes. Evolution and extinction are studied to understand how they reflect environmental changes in Earth's ocean, atmosphere, and surface. Present day Earth processes are used as a model to understand past activity.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

● "SLO#1: Apply the Scientific Method to evaluating Earth history."</STRONG>

● Evaluate the Scientific Method as a means to acquire and verify knowledge.
● Explain specific instances where the Scientific Method advanced how geologists understand Earth history (e.g., uniformity, catastrophism, faunal succession).
● Show instances where the Scientific Method identifies gaps or limits in our knowledge of Earth history (e.g., stratigraphic unconformities, lack of fossil specimens).

"SLO#2: Evaluate temporal rates and spatial scales of geologic processes in Earth history."</STRONG>

● Explain and apply methods used to determine the numerical and relative ages of geologic events.
● Analyze how the Geologic Time Scale is constructed, and place significant events in Earth history within that timeline.
● Correlate changes in fossil distribution, isotopic ratios, elemental concentration in rocks to changes in sea level, climate change, and atmospheric composition in Earth history.
● Predict possible short term and long term trends for Earth's future environment (climate trends, sea level, atmospheric composition) based in part on the past geologic record.

"SLO#3: Assess theories of evolution and extinction and the logic and evidence leading to their development and application."</STRONG>

● Discuss Darwin's basic theory of evolution in the context of the development of scientific thinking of the time.
● Critique subsequent modifications that have been made to our understanding of Darwinian evolution (e.g., DNA analyses, punctuated equilibrium).
● Identify key fossils that are characteristic of particular periods in the geologic time scale.
● Validate evolutionary changes in life forms and ecosystems to changes in Earth environment, with specific focus on types of extinction events (e.g., meteorite impact) and periods of diversification in life forms (e.g., "Cambrian explosion").

"SLO#4: Apply plate tectonic theory to formulate past, present, and future changes on Earth."</STRONG>

● Examine how tectonic environments and processes have changed throughout Earth history.
● Illustrate how paleomagnetism is used to locate the positions of crustal fragments in the past.
● Deduce how rock sequences and units indicate specific mountain building events which add crust to continental masses.
● Construct a general history of ocean basin development from specific examples identified in Earth history (e.g., Tethyan, proto-Atlantic).
● Formulate a tectonic and geologic history of California and North America from geologic features found in the region.

GEOL 311 Historical Geology Laboratory
Laboratory studies will accompany and complement GEOL 310, Historical Geology. Use of sedimentary rocks, fossils, geologic maps, and cross sections will aid in interpreting ancient environments, tectonic settings, and geologic history. Other concepts addressed include age relations and correlation of rock and time units, and introduction to fossil identification and biostratigraphy. At least one field trip or an appropriate alternative activity will be required as an introduction to sedimentary environments and field methods in geology.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- **SLO#1**: Evaluate temporal rates and spatial scales of geologic processes in Earth history.
- **SLO#2**: Explain and apply methods used to determine the numerical and relative ages of geologic events.
- **SLO#3**: Correlate changes in fossil distribution, isotopic ratios, elemental concentration in rocks to changes in sea level, climate change, and atmospheric composition in Earth history.
- **SLO#4**: Evaluate sedimentary environments through geologic time.
- **SLO#5**: Resolve lithologic changes within a sedimentary basin.
- **SLO#6**: Correlate strata over multiple stratigraphic sections.
- **SLO#7**: Incorporate fossil evidence to decipher geologic history.
- **SLO#8**: Identify major groups and key examples of fossils and their ages.
- **SLO#9**: Use index fossils to constrain the age of a geologic event.
- **SLO#10**: Extrapolate cross-sections from geologic maps.
- **SLO#11**: Interpret geologic history from map information.
- **SLO#12**: Apply plate tectonic theory to formulate past, present, and future changes on Earth.
- **SLO#13**: Examine how tectonic environments and processes have changed throughout Earth history.
- **SLO#14**: Deduce how rock sequences and units indicate specific mountain building events which add crust to continental masses.

GEOL 330 Introduction to Oceanography

The course will provide an introduction to the basic principles and practices of oceanography. Topics will be presented in terms of the applications of physics, geology, chemistry, and biology to a study of the world's oceans. Specific topics will include planetary science and earth origin, the geologic timescale, geography and location systems, matter, marine provinces, sediments, seismology, plate tectonics, seawater composition, geochemical distributions, deep ocean circulations, winds and surface circulation, waves, tides, estuarine environment, biological production, nekton, plankton, and benthic organisms.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- **SLO#1**: Apply the scientific method to evaluating Earth processes.
- **SLO#2**: Evaluate the Scientific Method as a means to acquire and verify knowledge.
- **SLO#3**: Explain specific instances where the Scientific Method advanced how Earth scientists understand ocean processes.
- **SLO#4**: Evaluate temporal rates and spatial scales of Earth process.
- **SLO#5**: Discuss the basic narrative of Earth origin and ocean development based on known scientific evidence.
- **SLO#6**: Compare rates of change of ocean processes, including sea level, ocean chemistry, and temperature variations.
- **SLO#7**: Apply plate tectonic theory to formulate past, present, and future changes on Earth.
- **SLO#8**: Explain how exploration of features of marine geology refined plate tectonic theory.
- **SLO#9**: Analyze how plate tectonic theory explains the development of oceans, their growth, and their shrinkage and collapse.
- **SLO#10**: Identify the main features of ocean floor topography.
- **SLO#11**: Assess how Earth processes affect the physical environments and resources of living organisms, and analyze evidence that living organisms have changed their physical environments.
- **SLO#12**: Categorize different marine communities based on depth, available sunlight, salinities, and temperatures.
- **SLO#13**: Assess evidence of global climate change and how ocean processes are involved.
- **SLO#14**: Evaluate instances in which human activity caused positive and negative effects on ocean environments.
- **SLO#15**: Describe how winds help to determine direction of major currents.
- **SLO#16**: Explain how winds affect wave dimensions.
- **SLO#17**: Investigate how coasts form in interactions of waves with various rocks.
- **SLO#18**: Explain how storms strengthen over water, weaken over land.
- **SLO#19**: Relate how temperature differentials between land and water generate certain kinds of breezes.
GEOL 390 Field Studies in Geology

This course covers the study of geologic principles and processes of specific areas (mountains, deserts, great valley, coastal region, etc.). A multi-day field trip and camping may be required. For specific details, see the course description(s) listed in the schedule.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- examine the surrounding physical and/or human environment and formulate explanations for the geologic patterns and processes observed. (SLO 1)
- apply concepts and processes discussed in lecture to the real world. (SLO 2)
- compose field notes and collect and analyze field data.
- integrate geologic information with other disciplines (geography, biology, ecology, urban studies, anthropology, history, economics, cultural studies, and others), as appropriate, in order to develop a comprehensive view of landscapes and processes. (SLO 3)

GEOL 495 Independent Studies in Geology

An independent studies project involves an individual student or small group of students in study, research, or activities beyond the scope of regularly offered courses. See the current catalog section of "Special Studies" for full details of Independent Studies.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- SLO #1: Actively engage in intellectual inquiry beyond that required in order to pass a course of study (College Wide Learning Outcome – Area 4).
- Discuss and outline a proposal of study (that can be accomplished within one semester term) with a supervising instructor qualified within the discipline.
- Design an independent study (to be completed individually or by collaboration of a small group) to foster special knowledge, skills, and experience that are not available in any one regularly scheduled course.
- Use information resources to gather discipline-specific information.
- SLO #2: Utilize modes of analysis and critical thinking to apply theoretical perspectives and/or concepts in the major discipline of study to significant problems and/or educational activities (College Wide Learning Outcome – Area 3).
- Analyze and apply the knowledge, skills and experience that are involved in the independent study to theoretical perspectives and/or concepts in the major discipline of study.
- Explain the importance of the major discipline of study in the broader picture of society.
- SLO #3: Communicate a complex understanding of content matter of the major discipline of study (College Wide Outcome – Area 3).
- Demonstrate competence in the skills essential to mastery of the major discipline of study that are necessary to accomplish the independent study.
- SLO #4: Identify personal goals and pursue these goals effectively (College Wide Outcome – Area 4).
- Utilize skills from the "academic tool kit" including time management, study skills, etc., to accomplish the independent study within one semester term.

GEOL 499 Experimental Offering in Geology

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