CAS GE to LE Core Application

Preparer(s)

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Section I. CAS GE to LE Core Application Cover Sheet

Department/Program: Geology

Effective year and term for implementation of action: [2016]Fall

Current Course Information

Prefix:	Number:	Credits:
GEOL	110	4

Catalog Title: Physical Geology

Section II. Application for Inclusion in the Liberal Education Core

A. This course addresses the following Liberal Education Core Learning Outcome(s) (check all that apply):

Knowledge	☑ K1	☐ K2	☐ K3	☐ K4
Skills	☐ S1	☐ S2	☐ S3	
Responsibility	☐ R1	☐ R2	☐ R3	
Integration	☑ I1			

B. Provide the requested information for each identified learning outcome.

Knowledge 1 (K1): Describe and evaluate models of the natural and physical world through collection and scientific analysis of data, and through the use of mathematical or computational methods.

1. Describe the content of the experience and especially the relationship between the content and the identified learning outcome. If it is appropriate, estimate the percentage of time spent in the experience on the identified outcome.

Physical Geology (Geology 110) will satisfy the learning outcomes in both Knowledge 1 (K1) and Integration 1 (I1). Physical Geology is the study of earth structure, composition, and processes, and the interactive relationship between the lithosphere, hydrosphere, atmosphere and biosphere. Topics include, but are not limited to, plate tectonics, volcanism, earthquakes, hydrogeology, earth resources and climate change. Geology is a science of observation and development of testable hypotheses, and this course emphasizes the methods of scientific investigation. A detailed investigation of geologic processes requires the integration of concepts derived from chemistry, physics, and biology, and an understanding of geospatial technology, oceanography, atmospheric science, and other disciplines.

This course stresses the interdisciplinary nature of geology, and follows a progressive format that involves an introduction to the origin of the earth and our current understanding of tectonic processes. This is followed by an examination of earthquakes and volcanoes, and the impact these natural phenomena have on society. The course then progresses into surficial processes, demonstrating the intertwined nature of interactions between the lithosphere, hydrosphere, atmosphere and biosphere. This leads directly into an analysis of societal issues such as energy use, resource depletion and climate change. The integrated nature of the scientific and social science concepts covered in the course makes it difficult to isolate exactly how much time is spent on K1 vs. I1 outcomes, but the specific rubric elements for both K1 and I1 are explained below.

2. Describe the opportunities that the experience will offer students to meet the identified outcome. Your description can include pedagogy used, example assignments, broad discussion of the learning environment for the experience, etc.

This is a lecture and laboratory course that provides several different avenues for students to meet the identified outcomes. The course emphasizes experiential activities, including geologic field experiences, hands-on laboratory activities, tours of local water and wastewater facilities, debates, group projects and discussions.

An interactive lecture format is used to encourage student participation. Current events, such as earthquakes, volcanoes, tsunamis and energy and climate-change issues, are specifically integrated into lectures to provide linkages to real world phenomena. Student cognitive development is assessed by the use of frequent brief quizzes, reflection papers, and questionnaires associated with videos. Every effort is made to provide direct linkages between material discussed in lecture and laboratory activities.

The primary emphasis in the course is development of conceptual understanding of earth processes. Rote memorization is avoided, and students are encouraged to utilize a broad, integrative approach to earth science.

3. Identify and provide a rationale for the presence of all prerequisites.

No prerequisites exist for this course.

4. Describe the student work for the identified outcome that will be collected, assessed and results submitted to the University Assessment Committee for purposes of assessment of our Liberal Education Core. Examples of student work include student papers, in-class writing, exams, field experiences, oral presentations, etc.

Be sure to refer to the outcome rubric elements in relation to the student work that will be assessed. If there are aspects of your course that align with a selected learning outcome but are not well-reflected in its rubric, provide relevant commentary.

Student assessments are based on a variable combination of periodic lecture examinations, laboratory examinations, group activities and writing assignments. Student understanding of the fundamental concepts in earth science will be assessed using mechanisms such as class projects, field laboratory reports, and semester portfolios. Laboratory exercises are progressive, with the skills and knowledge gained in one laboratory experience necessary for successful

completion of successive exercises. The student is challenged to develop scientific hypotheses based on observation and experimentation.

The primary assessment mechanism will be project-based. The projects will focus on an integrated, integrative approach to fundamental scientific issues, such as climate change, resource depletion, societal energy use or understanding the nature of scientific models in the prediction of catastrophic events such as earthquake and volcanic eruptions (Element K1A). The central theme will vary, but the primary focus will be on the student grasp of the scientific method, focusing on observations, development of testable hypotheses, and iterative testing and reformulation of the model (Elements K1B, C, D, and E).

The specific assessment tool utilized to evaluate the Knowledge 1 Learning Outcomes will vary between instructors. Examples of student work that will be utilized for the assessment include:

Element K1A: Models of climatic change are examined in detail in both lecture and laboratory exercises. Climate change and society's reaction to it forms the basis for a targeted debate that examines the issue from all sides, which requires an in-depth examination of the strengths and weaknesses of different climate change scenario, during which the students understand the limits of scientific models and learn about the concept of scientific bias. Student cognition has been assessed in previous offerings through the use of essays, laboratory assignments and group discussions.

Element K1B: The origin of plate tectonic theory and subsequent models of crustal motion and growth are examined in detail. Students analyze topographic, geochronologic, sedimentologic, paleomagnetic and heat flow data sets derived from examination of the earth's oceanic crust to understand the logic and validity of current plate tectonic models. This analysis forms the basis for a series of laboratory exercises that guide discussion and reflection throughout the semester (see attached artifact: Discovering Plate Boundaries).

Element K1C: Models of both plate motion and climate change are assessed during the course utilizing laboratory exercises. Students utilize data collected by a variety of scientific organizations over the course of several decades to evaluate the validity of different scientific models. In one exercise, students examine historic global temperature data to evaluate contradictory interpretations of global warming, which leads to the realization that scientific data must be evaluated carefully and highlights the potential for biased interpretations based on model-driven interpretations of data sets.

Element K1D: Students collect scientific data in a number of different laboratory exercises, including sedimentologic/stratigraphic data, documentation of cross-cutting relations, and groundwater data during field exercises, and climatic, topographic, geochronologic and petrographic data during a number of laboratory exercises.

Element K1E: Student evaluation of both climatic and plate tectonic data sets requires the student to critically evaluate scientific variables (e.g. temperature, oxygen isotope, geochronologic data) that vary in both time and space. The students need to integrate these varied data sets in order to evaluate the validity (or lack thereof) of proposed scientific models. Examination of any single data set can lead to non-unique interpretations, and the students must decide which data sets to integrate and how to do so in order to assess the validity of current models. This data analysis and evaluation is conducted during a series of laboratory exercises, reports and discussion sessions.

5. Provide additional information on the learning experience such as:

- **Sample readings**
- **Topical outline and timetable**
- **Learning outcomes**
- **A brief description of the experience (300 words maximum)**

• Sample readings
Readings are derived from the textbook (Marshak, Portrait of a Planet or Grotzinger and Jordan, Understanding Earth). Topical readings from the general science literature, such as Scientific American are required. Web-based exercises, including exercises derived from the NSF-supported Science Education Resource Center (SERC) at Carleton College (http://serc.carleton.edu/index.html), and specially designed educational experiences incorporating academic and governmental (NASA, NOAA, USGS) websites are integrated throughout the semester.
• Topical outline and timetable
See attached syllabus
• Learning outcomes
The primary learning outcomes developed in this course include an understanding of:
-the structure of the earth
-plate tectonics
-earthquakes
-volcanoes
-hydrogeology
-the interdependent nature of interaction between the lithosphere, hydrosphere, biosphere and atmosphere
-societal issues, including climate change, energy use and resource depletion

• A brief description of the experience (300 words maximum)
Physical Geology serves as an introduction to the earth system, including the origin of the earth, its internal structure, plate tectonic activity, surficial processes, and the driving forces that control the evolution of the system. The interaction between the lithosphere, hydrosphere, atmosphere and biosphere is a central focus. Geologic processes such as earthquakes, volcanoes and groundwater are examined in detail. The origin, development, depletion, and environmental consequences associated with economic mineral deposits and energy resources are highlighted. Global issues involving human interaction with the environment, such as climate change and resource depletion are examined in detail.

This course focuses on the interdisciplinary nature of the geological sciences, and utilizes an integrated approach to the science of the earth system. Laboratory experiences focus on hands-on activities designed to engage students in the scientific method and the process of observation, development of hypotheses and testing of those hypotheses. Field trips to local geologic features, water treatment facilities, groundwater well nests and other sites of geoscience interest form a crucial component of the course. Group discussion and debate is specifically integrated, and the course content frequently involves a detailed examination of current events, such as earthquakes, volcanic eruptions, tsunamis and major environmental issues.

6. Considering existing department/program resources, please provide answers to the following:

How many sections of the experience will be offered in the fall semester? approximately 8-10

How many sections of the experience will be offered in the spring semester? approximately 8-10

What will be the average size for each section of the experience? 22 students

Integration (I1): Apply knowledge, skills or responsibilities gained in one academic or experiential context to other contexts.

1. Describe the content of the experience and especially the relationship between the content and the identified learning outcome. If it is appropriate, estimate the percentage of time spent in the experience on the identified outcome.
Physical Geology is the study of earth structure, composition, and processes, and the interactive relationship between the lithosphere, hydrosphere, atmosphere and biosphere. Geology is a science of observation and development of testable hypotheses, and this course emphasizes the methods of scientific investigation. A detailed investigation of geologic processes requires the integration of concepts and methodologies employed in chemistry, physics, and biology, and an understanding of geospatial technology, oceanography, atmospheric science, and other disciplines. The relevance of modern geologic studies to societal concerns such as climate change, resource extraction, environmental pollution and regional water depletion makes the course an ideal vehicle for the Integrative Learning Outcome.

There is generally a rather limited understanding of the linkage between earth science and one's daily existence. However, issues such as energy policy, resource use and depletion and environmental change are increasingly common in the news and becoming more important to society as a whole. Physical Geology allows a student to connect their personal experiences to the earth sciences by explicitly linking those experiences to their scientific origin. For example, current events such as the price of energy, the Keystone pipeline debate and the rapid expansion of sand mining in western Wisconsin are all directly linked to Physical Geology, and exploring these connections will place personal experience into an academic and scientific context (Element I1A). The integrative nature of Physical Geology is emphasized in the course, and explicit connections between lithospheric processes and their interaction with biology, chemistry, physics, oceanography and atmospheric science are fundamental to the course (Element I1B).

The goal of the course is to introduce the student to earth processes and their importance to society so that the student may utilize an integrated knowledge of geology, biology, chemistry and physics to guide decisions and activities that they will be faced with throughout their lives and careers. This represents a transfer of knowledge - one of the major goals of a liberal education (Element I1C).

2. Describe the opportunities that the experience will offer students to meet the identified outcome. Your description can include pedagogy used, example assignments, broad discussion of the learning environment for the experience, etc.
Physical Geology utilizes an interactive lecture and discussion format integrated with laboratory experiences that provide direct linkages between the earth sciences and a wide range of other disciplines (e.g. biology, chemistry, physics, sociology, political science, economics and many others). Discussions commonly center on linking student experiences and observations with their geologic origin (e.g. climate change, energy use, resource extraction) to provide direct linkages between student experience and science (Element I1A). Laboratory exercises and field trips highlight the integrative nature of the science and its linkage to other disciplines and career pathways (Element I1B; see attached artifact Eau Claire protocol).

Discussion and debate topics are designed to focus student attention on the broad societal context of earth science. An example of this methodology is a group project modeled after the Kyoto Protocol on Climate Change, where each group of students represents one particular component of the debate (e.g. ExxonMobil, United States, Sierra Club). Each group is responsible for a detailed assessment of the scientific validity of the group they represent, which requires an integrated investigation into the science of climate change. These results are compiled and presented during a class debate, with active interaction and argumentation between the parties. The debate is followed by a reflection paper that requires a detailed evaluation of the strengths and weaknesses of the student's assigned group, and a discussion of the validity of the current argument and its impact on future climate change. Mastery of the content, and successful performance in the debate, require the student to apply knowledge, skills, and methodologies gained in a variety of academic contexts and experiences to the problem of climate change (Element I1C).

3. Identify and provide a rationale for the presence of all prerequisites.
There are no prerequisites for this course.

4. Describe the student work for the identified outcome that will be collected, assessed and results submitted to the University Assessment Committee for purposes of assessment of our Liberal Education Core. Examples of student work include student papers, in-class writing, exams, field experiences, oral presentations, etc.

Be sure to refer to the outcome rubric elements in relation to the student work that will be assessed. If there are aspects of your course that align with a selected learning outcome but are not well-reflected in its rubric, provide relevant commentary.
Student assessments are based on a variable combination of periodic lecture examinations, laboratory examinations, group activities and writing assignments. The proportion of each assessment mechanism is dependent on the individual instructor. In all cases, student understanding of the fundamental concepts in earth science will be assessed using mechanisms such as class projects, field laboratory reports, and semester portfolios.

The specific assessment tool utilized to evaluate the Integrative Learning Outcome will vary between instructors. Examples of student work that will be utilized for the assessment include:
Element I1A: Students are encouraged to develop an understanding of the connections between their own experiences and the earth sciences by identifying geologic issues in the news, utilizing a variety of news sources, such as the New York Times. Time is set aside to address these topics at the beginning of the class period, and these topics commonly form the basis for extended discussions. Particularly relevant topics (natural disasters, resource issues, energy topics) are used for reflective writing assignments in which the students are required to put the event into a geologic as well as a personal context. The course specifically takes advantage of current events to draw connections between earth science and student experiences, such as the economic impact of natural disasters, the political aspects of climate change legislation or the historical context of resource depletion.

Element I1B: Student essays, lecture examinations and laboratory exercises are used to assess student understanding of the linkage between earth science and other disciplines. Assignments are designed specifically to highlight the integrative nature of the science. For example, climate change is examined using biologic methodologies that are utilized to evaluate global climatic changes, such as the use of benthic invertebrates to evaluate ocean acidification, examination of diatom oxygen isotopes to assess water temperature fluctuation patterns, or the application of vegetation dynamics to predict changes in terrestrial biodiversity. It is critical for student's to understand the multidimensional aspect of climate change, which requires recognizing the need to integrate numerous scientific methodologies to effectively model the nature of the problem. This rubric element will be assessed utilizing a reflection essay that requires the student to describe the impact of one climatic event (i.e. desertification, ocean warming) on other different portions of the earth system. A second example is a climate debate in which students are placed into opposing scientific camps and required to assess the economic, political, sociological and psychological benefits and detriments of proposed climate legislation.

Element I1C: The ability of a student to apply skills, knowledge and methodologies learned in Physical Geology to other academic or experiential contexts is assessed through the use of debates, discussion sessions and reflective writing assignments. These exercises are designed to specifically place different aspects of geology (natural disasters such as earthquakes and hurricanes, resource depletion, climate change) into a broader disciplinary context, in order to illustrate that geology has a fundamental impact of many components of the student (and graduate) experience. Writing assignments encourage students to view geologic phenomena through the lens of their own discipline, and to recognize that a seemingly distant event (e.g. Hurricane Katrina) may have a direct impact on their chosen field (e.g. the dramatic impact on the educational system in New Orleans). Student activities are designed to illustrate the complex, multi-dimensional (and multi-disciplinary) nature of geologic phenomena, and student assessment is based on the ability of the student to demonstrate an understanding of the linkage between geologic events and other disciplines (ideally their own). If the students are unfamiliar with their discipline or undeclared, they are asked to explore the linkage from the perspective of a discipline we have discussed in detail, such as political science or economics. One particularly instructive assessment tool is a reflection essay given at the end of the climate change debate (see attached artifact EC Protocol congress) that requires the student to integrate data and methodologies from geology with data and methodologies of another discipline to develop a defensible position on climate change and to present that position to their congressman.

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Attachments

Eau Claire protocol2012 jbm.pdf	Download	9/30/2015 12:34 PM	Geology
ecprotocol-congress.pdf	Download	9/30/2015 1:04 PM	Geology
GEOL 110 Lab--Discovering Plate Boundaries.pdf	Download	9/25/2015 10:46 AM	College of Arts & Sciences 1
GEOL 110 syllabus.docx	Download	3/6/2014 4:39 PM	College of Arts & Sciences

General Notes and Comments:

Date of Department/Program Approval (Include all department/program names and approval dates as appropriate):

10-12-15

College Curriculum Committee or Equivalent Action:

10/22/2015 ◉ Approved ○ Denied

University Liberal Education Committee Action:
◯ Approved ◯ Denied