GEOL 106 *Earth Science Inquiry*

Inquiry-based investigations in Earth science to help students develop understanding of fundamental concepts and the process of scientific investigation. This course is designed for prospective elementary teachers and middle-level science majors, but is open to all students.

**Meeting time** MTTh 11:00 am–12:50 pm

This is an integrated lecture-lab course. In other words, we will be *doing stuff* during all of the class meetings, engaging in what might be called lab activities, largely in groups.

**Location** Science II, Room 207

**Course materials** There is no textbook, but you will need a 3-ring binder that is dedicated to this course. I also recommend that you bring several colored pencils or pens with you to class every day.

**Instructor** Anne Egger

annegger@geology.cwu.edu

509-963-2870

Science II 337

**Office hours** T 3:00-5:00 pm, but send an email if you’d like to meet another time

**Overview**

Earth science is the study of our home planet, from its origins to the way we interact with it today. Much of what we know about Earth—its history and the processes that shape it—comes from detailed observations at a range of scales, from satellite images to microbes. Learning about Earth and how we know what we know, therefore, means learning how to observe, look for patterns, and interpret those patterns in light of the complexity of the Earth system. As future teachers and citizens, you will find yourselves in the position of helping others understand that complexity in the future. **My primary goal for this course is to empower you to teach Earth science** by giving you the opportunity to engage in learning Earth science through inquiry.

That primary goal has several outcomes embedded within it, shown in the table below.

|  |  |
| --- | --- |
| **Learner Outcomes***By the end of this course, you will be able to…* | **Assessments***You will demonstrate your abilities through…* |
| Apply appropriate scientific investigative techniques to address questions about relevant Earth science concepts. | In-class activities, out-of-class assignments |
| Collect, analyze, and interpret quantitative and qualitative data to address questions about relevant Earth science concepts. | In-class activities, out-of-class assignments |
| Apply Earth science concepts and processes to personal and societal issues. | Out-of-class assignments, engineering project, final project |
| Articulate how your own ideas and understanding change and develop, and how the structure of the learning environment and curriculum facilitates these changes. | Reflections, reading questions |
| Find and utilize a variety of resources to learn and communicate about Earth science events and processes. | Out-of-class assignments, final project |

# Assessments

In-class activities

Most days in class will involve working on an activity in small groups. You will accumulate this work in your three-ring binder. Although this work will not be graded day-to-day, the binders will be collected periodically and assessed on the basis of completion and thoughtfulness (approximately 5 points per activity).

Reading questions

There is no textbook for this course; all readings will be available through links on Canvas. Readings for class will be concise, with information that you will need to participate in the work we do. For most readings, you will answer a few short questions in Canvas prior to class. All **answers to reading questions will be due in Canvas by 9:00 am**—two hours before class starts—so that we have time to look at your responses and address any confusion or misconceptions. There will be approximately two of these per week.

Out-of-class assignments

Out-of-class assignments follow on group activities in class and give you the opportunity to apply what you’ve learned to a new situation, reflect on what you’ve learned, and communicate using scientific language. These will be completed individually. There will be five of these assignments, and they will take a variety of different formats, but all will be worth 20 points. They will be **due in Canvas by class time**.

Final project

The final project will involve a poster presentation of a geologic event that has occurred during human history or prehistory. We will develop the project in several stages: (1) turning in a topic of interest with results of some initial research, (2) discussing your project with others who have similar topics, (3) turning in and presenting your poster. The poster presentation will take place during our final exam time.

Pre- and post-assessment of Earth science literacy

This is a multiple choice and short essay test that you will take at the beginning and end of the quarter to assess your Earth science literacy gains.

**Final grades**

Your final grade is based on the total number of points, and will follow a traditional grading scale (90-100% 🡪 A- to A; 80-89% 🡪 B- to B+; 70-79% 🡪 C- to C+; 60-69% 🡪 D- to D+; <60% 🡪 F).

**Connections to NGSS and PESB**

The content and structure of this course is directly tied to the Next Generation Science Standards (NGSS), which were used to develop the Professional Educator Standards Board (PESB) middle-level science endorsement competencies. The NGSS comprise disciplinary core ideas, science and engineering practices, and cross-cutting concepts. We cannot cover everything you need to know from the NGSS in a single course, but we offer suggestions for how you can fill the content gaps through other courses.

The **disciplinary core ideas** we will cover in this course (to varying degrees) are:

* The history of planet Earth
* Earth’s systems
	+ Earth materials and systems
	+ The roles of water in Earth’s surface processes
	+ Plate tectonics and large-scale system interactions
	+ Weather and climate
* Earth and human activity
	+ Natural resources
	+ Natural hazards
	+ Human impacts on Earth systems
	+ Global climate change

*We will not cover disciplinary core ideas in the universe and its stars or Earth and the solar system, which are better addressed in PHYS 101 (astronomy).*

We will make use of all of the **science and engineering practices** described in the NGSS:

* Ask questions (for science) and define problems (for engineering)
* Develop and use models
* Plan and carry out investigations
* Analyze and interpret data
* Use mathematics and computational thinking
* Construct explanations (for science) and design solutions (for engineering)
* Engage in argument from evidence
* Obtain, evaluate, and communicate information

We will also cover all of the NGSS **cross-cutting concepts**, but we will focus in particular on:

* Patterns
	+ Graphs, charts, and images can be used to identify patterns in data
	+ Patterns can be used to identify cause-and-effect relationships
	+ Patterns in rates of change and other numerical relationship can provide information about natural and human-designed systems
	+ Macroscopic patterns are related to the nature of microscopic and atomic-level structure
* Systems and system models
	+ Systems may interact with other systems; they may have subsystems and be a part of larger, complex systems;
	+ Models can be used to represent systems and their interactions–such as inputs, processes, and outputs–and energy, matter, and information flows within systems;
	+ Models are limited in that they only represent certain aspects of the system under study.

The NGSS also have a strong focus on **engineering** design and connections to engineering, technology, and applications of science. In this course, we will address the influence of science, engineering, and technology on society and the natural world. *SCED 301 has a significant engineering component.*

**Class Policies**

1. Engage. During class time, we will be working, so come to class on time and ready to engage in science with the instructors and your peers.
2. Be responsible. We expect you to work hard in this class and take responsibility for showing up on time, turning off your cell phone, and turning in assignments on time. Late assignments will be penalized 10% each day, up to 50%. Exceptions may be made for extenuating circumstances we discuss *in advance*.
3. Be ethical. Scientists follow a code of ethics that we expect you to follow as well. Copying others’ work is not acceptable. If you turn in an assignment that is not your own work, you will receive a zero for that assignment. Please document your sources on all assignments.
4. Budget your time. Success in this course requires effort and time. I anticipate about two hours of study/work time for each hour of class, but you may need to spend more or less time than that. Please budget your time to accommodate the workload.
5. Cultivate your growth mindset. Your beliefs about your own abilities and intelligence strongly influence your motivation, effort, and the way that you approach challenges. We will assess your mindset at the beginning of the course so that you can see what you need to do to cultivate your growth mindset.

**Disability Accommodation Statement**

Students with disabilities who wish to set up academic adjustments in this class should give one of us a copy of their “Confirmation of Eligibility for Academic Adjustments” from the Disability Services Office as soon as possible so we can discuss how the approved adjustments will be implemented in this class. Students without this form should contact Disability Support Services at 509-963-2171 (TDD: 509-963-2143).

**Tentative schedule**

|  |  |  |
| --- | --- | --- |
| **Date** | **Topics and activities** | **What’s due** |
| 1: **Nature and methods of Earth science****Learning outcomes*** Describe the methods used by Earth scientists and how they differ from and are similar to the methods used in other scientific disciplines.
* Define data, interpretation, and evidence, giving examples from the Earth system.
* Determine the relative order of events in Earth history and place them in the context of absolute geologic time to gain a sense for deep time.
* Define systems terminology in the context of the Earth system.
* Draw and describe a basic systems diagram.
 |
| **Th 1/5** | Nature of Earth science  |  |
| **M 1/9** | Geologic time and an introduction to systems | **Reading:** The Practice of Science;Description in Scientific Research**Canvas:** Pre-assessments; Mindset assessment; Answers to reading questions |
|  |
| 2: **Plate tectonics and the rock cycle****Learning outcomes*** Describe the difference between a map and a cross-section and how they are used to display data.
* Describe and explain the distribution of earthquakes, volcanoes, topography, and age of the seafloor around the world.
* Explain the concept of plate tectonics, including types of plate boundaries and the characteristics of those boundaries.
* Draw and describe the rock cycle and how it relates to plate tectonics and the Earth system.
* Assess the hazards associated with volcanoes and make connections to plate tectonics.
 |
| **T 1/10** | Plate Tectonics Jigsaw | **Canvas:** Systems vocabulary quiz  |
| **Th 1/12** | Plate Tectonics Jigsaw | **Reading:** The Origins of Plate Tectonic Theory; Plates, Plate Boundaries, and Driving Forces**Canvas:** Answers to reading questions |
| **F 1/13** |  | **Canvas:** Nature and methods reflection |
| **M 1/16** | *No class – MLK day* |
| **T 1/17** | Plate tectonics within the Earth system | **Reading:** Earth Structure**Canvas:** Answers to reading questions |
| **Th 1/19** | Rock cycle | **Reading:** The Rock Cycle**Canvas:** Answers to reading questions |
| **M 1/23** | Volcanic hazards | **Reading:** Watch video, find volcanoes mentioned on map**Canvas:** Answers to video/map questions |
|  |
| 3: **Earthquakes and engineering****Learning outcomes*** Describe and explain the global and regional distribution of earthquakes.
* Describe the difference between shaking intensity and magnitude; hazard and risk.
* Navigate online resources for accessing real-time and historical data about earthquakes.
* Describe how engineering can provide options to mitigate the risks associated with earthquakes.
* Design a solution to minimize the risk of building collapse in an earthquake using an iterative, team-based approach.
 |
| **T 1/24** | Exploring earthquake data globallyIntroduction to design challenge | **Canvas:** Tectonics sketches |
| **Th 1/26** | Factors that affect shaking, planning for engineering project | **Reading:** Nisqually issue of Washington Geology**Canvas:** Answers to reading questions |
| **M 1/30** | Building engineering project | **Canvas:** Discussion with design team |
|  |
| 4: **The hydrologic cycle and surface processes****Learning outcomes*** Draw and describe how water moves through Earth’s various reservoirs, including fluxes, processes, and time scales.
* Analyze patterns in sea surface temperature, wind speed, and air temperature to derive circulation patterns in the atmosphere and ocean.
* Experiment with the processes that result in erosion at Earth’s surface.
* Describe how rivers change along their length and over time as a result of interactions between Earth’s hydrosphere and geosphere.
* Develop a strategy for informing communities about hazards associated with rivers and flooding.
 |
| **T 1/31** | Earth’s hydrosphereIntroduce systems diagrams | **Reading:** The Hydrologic Cycle**Canvas:** Answers to reading questions |
| **Th 2/2** | Ocean and atmosphere circulation:Exploring climate animations | **Reading:** Factors that Control Earth’s Temperature; The Composition of Earth’s Atmosphere**Canvas:** Answers to reading questions, Engineering design reflection |
| **M 2/6** | Interactions between hydrosphere and geosphere: Weathering, erosion, transport, and deposition | **Reading:** Factors that Control Regional Climate**Canvas:** Answers to reading questions |
| **T 2/7** | Interactions between hydrosphere and geosphere: Exploring river systems |  |
| **Th 2/9** | Interactions between hydrosphere and geosphere: When rivers floodIntroduce final projects | **Reading:** Using graphs and visual data **Canvas:** Answers to reading questions |
|  |
| 5: **Climate change over time****Learning outcomes*** Analyze the characteristics of rocks to determine what type of climate they formed in.
* Use the rock and sediment records to describe Earth’s long-term climatic history.
* Use ice core and atmospheric measurements to describe Earth’s recent climate history.
* List the factors that influence Earth’s climate and describe how they influence climate.
* Use models to predict Earth’s climate in the future.
* Develop a systems diagram of Earth’ climate, including inputs and outputs, reservoirs, and feedback mechanisms.
 |
| **M 2/13** | Examining long-term records in the field: Craig’s Hill | **Reading:** Basics of Depositional Environments**Canvas:** Reading questions |
| **T 2/14** | Examining long-term records: How rocks record past climate  |  |
| **Th 2/16** | Examining medium-term records: Jigsaw climate readings | **Reading:** The Carbon Cycle**Canvas:** Reading questions; Informational brochure |
| **M 2/20** | *No class: Presidents’ Day* |  |
| **T 2/21** | Examining short-term records: Ice cores, atmospheric CO2, and population | **Canvas:** Final project proposal |
| **Th 2/23** | Future climate scenarios: A very very simple model, picturing complex systems | **Reading:** Modeling in Scientific Research, IPCC executive summary**Canvas:** Reading questions |
|  |
| 6: **Natural resources****Learning outcomes*** Relate the occurrence of natural resources to plate tectonics processes.
* Create a systems diagram that connects carbon-based energy resources and climate.
* Describe how we use non-fuel mineral resources and the impacts of this use.
* Describe practices that can help humans minimize their impact on soil as a resource.
 |
| **M 2/27** | Exploring the global distribution of natural resources  | **Canvas**: Climate systems diagram |
| **T 2/28** | Energy resources: Carbon and climate | **Reading:** TBA**Canvas**: Reading questions |
| **Th 3/2** | Non-energy resources: Minerals, mining, and environmental justice | **Canvas**: Draft of poster with key components |
| **M 3/6** | Soil resources | **Reading:** Soil factors (see group assignments)**Canvas**: Reading questions |
| **T 3/7** | Systems diagramming |  |
| **Th 3/9** | Small group discussions of final project topics | **Canvas**: Final Poster |
|  |
| **Finals week** |
| **W 3/15** | 10:00-12:00 Poster presentation | **Canvas:** Final reflection; post-assessments |