

Introduction to Environmental Earth Science

University of Northern Iowa – Spring 2025

C. E. Heinzl, Ph.D.

Logistics - EarthSci 1400

Location = Latham 133

Time = **Lecture** - M, W, F 9 to 9:50 **Lab** - Thursday 9:30-11:20

Office hours= M,W,F 10-11, Th 11:30-12:30, and individually scheduled

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Text = Environmental Science and Sustainability, 2nd ed. Sherman & Montgomery

Final = **Wednesday, May 14, 2025, 10-11:50, Latham 133**

Credits: Four - This course meets the Course Credit Hour Expectation outlined in the Course Catalog. You should expect to work approximately 2 hours per week outside of class for every course credit hour, (so about 8 more hours per week).

Learning objectives

When students have finished this course, they will be able to...

- Explain geological, hydrogeological & meteorological foundations of Earth's environments.
- Characterize interactions between humans, other organisms and environmental settings.
- Recognize the difference between opinion and scientific knowledge and be able to apply scientific reasoning to support your decisions.
- Describe how humans, positively or negatively, affect their landscapes then identify and communicate pathways toward environmental sustainability.

Course Description

EARTHSCI 1400. Introduction to Environmental Earth Science — 4 hrs.

Introduction to the physical, biological, and cultural components of the natural world around us. The primary focus is on global-scale understanding of environmental issues using a scientific approach. Discussion, 3 periods. Prerequisite(s): Students must have satisfied university entrance requirements in English and Mathematics. (Variable)

(Mar 10-14)

Weekly Schedule – Ideally do the readings for each week before that week starts.

Week 1 (Jan 20-24) No class Jan 20 (MLK Day), Concepts and Principles, Sustainability Alter-Ego Project

Lab: *Sustainability Tool Kit: Observations, Measurements and Data Management* Reading: Text Ch. 1 and 2

Week 2 (Jan 27-31) Matter, energy and change

Lab: *Time, equilibrium and change in and through complex systems* Reading: Text Ch. 3

Week 3 (Feb 3-7) Human population and ecological biodiversity

Lab: *Landscapes and Keystone species/Interrelationships between biology & geology*, Reading: Ch. 4 & 6

Week 4 (Feb 10-14) Conservation

Lab: *Natural Resources and Tragedy of the Commons* Reading: Text Ch. 5

Week 5 (Feb 17-21) Systems & Cycles: Plate tectonics, Oceanography, Limnology

Lab: *Oceanography and Limnology – Energy exchange, circulation and chemistry* Reading: Ch. 10 & 11

Week 6 (Feb 24-28) Hydrologic system – Watersheds to groundwater

Lab: *Ground to surface water, a vital recourse under distress* Reading: Text Ch. 7

Week 7 (Mar 3-7) Minerals, rocks and mining **EXAM 1, Friday March 7**

Lab: *Minerals and rocks – Physical/Chemical properties, uses, hazards* Reading: Text Ch. 9

Week 8 (Mar 10-14) Landscapes, soils, agriculture and our food system

Lab: *Soil the foundation of life on Earth – Land use practices & sustainability* Reading: Text Ch. 9 and 12

Week 9 (Mar 17-21) **Spring Break**

Week 10 (Mar 24-28) Environmental health, law and geology

Lab: *Natural resources – Health, hazards and law* Reading: Text Ch. 17

Week 11 (Mar 31-Apr 4) Energy Alternative fuel energy development, use and hazards

Lab: *Energy capture, storage & adaptations* Reading: Text Ch. 13 & 14

Week 12 (Ap 7-11) Waste generation and disposal

Lab: *UNI waste audit, mitigation and better ways forward* Reading: Text Ch. 15

Week 13 (Ap 14-18) Air quality

Lab: *Measuring, characterizing and mitigating air quality* Reading: Text Ch. 8

Week 14 (Ap 21-25) Sustainable economics, policies and regulations

Lab: Developing Reading: Text Ch. 2 & 20

Week 15 (Ap 28-May 2) Climate change, Decision making and the Quest for environmental reciprocity

Lab: *Sustainable decision making and reciprocity* Reading: Text Ch. 11 &18

Week 16 (May 5-9) Open TBD

Lab: Open

Final: Wednesday, May 14, 2025, 10-11:50, Latham 133

Estimated point distribution (subject to change)

Labs 14 @ 10 pts	140
Quizzes 12 @ 10 pts	120
Midterm Exam	80
Final Exam	100
Homework	40
Lifestyle Project	80
Participation*	40
Total points	600

*Participation – There are a total of 20 points possible for participation. Points may be earned by attending class, asking questions, and participating in discussions. Points may be lost by having unexcused absences and/or not participating.

Grading procedures and policies A >93%, A->90% ; B+>87%, B >83%, B->80% ; C+>77%, C >73%, C->70% ; D+>67%, D >63%, D->60% ; F < 60%

If you earn 93% of the total points you are guaranteed a grade of A. The lower limit for each grade range will not move up. A curve will not be used in this class. **There will be no make-up exams after the scheduled exams are given.** Should you have a scheduled conflict, please visit with me at least two weeks before the exam date. An unexcused absence during an exam will lead to an automatic zero. If there is an emergency, we will work together on a solution.

Class Attendance and Participation

Course questions will reflect and cover class 1) discussions, 2) field and lab activities, 3) text/journal readings, and 4) small group activities. Anything I say/discuss is fair game for a quiz or exam. Attendance is essential. If you listen, ask questions, take very good notes, and study for tests chances for earning a good grade are high! And the general guidelines of UNI's attendance policy will be employed, <https://policies.uni.edu/306>).

UNI - Statements for Non-discrimination and Accessibility

UNI Information and regulations regarding Free Speech, Equity, Accessibility, The Learning Center and potential issues that may impact course schedules... <https://provost.uni.edu/syllabus-statements>

Additional recommendations from UNI's Center for Excellence in Teaching & Learning

Course materials, accessibility and opportunities for enhanced success

a. Textbook – Environmental Science and Sustainability, 2nd ed. Sherman & Montgomery, We will also use handouts, articles and current events to guide our learning. It is important to attend class, obtain and read these documents, ideally before lectures and/or labs.

b. Course webpage – You will have access to some course materials and additional learning resources through the following webpage - <https://www.exploreiowageology.org>

c. UNI-E-Learning – <https://elearning.uni.edu/>, This software will be used to help you keep track of your course progress - primarily scores from homework, quizzes, tests, etc.

d. Optional resources: 1) Environmental Geology, Ed Keller, 2) The Age of Sustainable Development, Jeffrey Sachs, 3) World Changing A users guide for the 21st century, Alex Steffen

Quotes to ponder...

Only when the last tree has died and the last river has been poisoned and the last fish has been caught will we realize that we cannot eat money - **19th century Cree Native American**

"While the farmer holds the title to the land, actually, it belongs to all the people because civilization itself rests upon the soil." - **Pope John Paul** *quoted in the Des Moines Register*, July 8, 1979

A great book begins with an idea; a great life with determination! - **Louis L'Amour**

We could, you know. We can live anyway we want. People take vows of poverty, chastity, and obedience – even silence – by choice. The thing is to stalk your calling in a certain skilled and supple way, to locate the most tender spot and plug into that pulse. - **Annie Dillard**

The purest essence of the energy of the Earth coalesces into rock. Within the size of a fist can be assembled the beauty of a thousand cliffs. Rocks large enough to set up in great courtyards, small enough to set up on a small stand... - **DuWan**, 1133A.D. From the preface by Kong Chuanto, a famous catalog of rocks written by The Hermit of Cloudy forest (Royal Museum, Toronto)

"A thing is right only when it tends to preserve the integrity, stability and beauty of the community; and the community includes the soil, water, fauna and flora, as well as the people."
- **Aldo Leopold**, *A Sand County Almanac*, 1949

Never regard your study as a duty, but as the enviable opportunity to learn to know the liberating influence of beauty in the realm of the spirit for your own personal joy and to profit of the community to which your latter work belongs. - **A. Einstein**

Earth provides enough to satisfy every man's need, but not every man's greed."
- **Mohandas K. Gandhi** quoted in EF Schumacher, *Small is Beautiful*

There maybe people who feel no need for nature. They are fortunate, perhaps. But, for those of us who feel otherwise, who feel something is missing unless we can hike across land disturbed only by our foot steps or see creatures roaming freely as they have always done, we are sure there should be wilderness. Species other than man have rights, too. Having finished all the requisites of our proud, materialistic civilization, our neon-lit society, does nature, which is the basis for our existence, have the right to live-on? Do we have enough reverence for life to concede to wilderness this right? Do you think we have it in us? - **Margaret (Mardy) E. Murie**

"Fantasy and despair are tempting, but history can helps us resist them. The past accomplishments of conservation were not inevitable, and neither are its predicted failures. We can move forward by understanding the story of struggle and survival we already have – and seeing the possibilities in what remains to be written" - **Michelle Nijhuis**, *Beloved Beasts*, p. 7

"We need acts of restoration, not only for polluted waters and degraded lands, but also for our relationship to the world. We need to restore honor to the way we live, so that when we walk through the world we don't have to avert our eyes with shame, so that we can hold our heads up high and receive the respectful acknowledgment of the rest of the earth's beings." – **Robin Wall Kimmerer**, *Braiding Sweetgrass*

Geology's 'Big ideas'

1. Geologists use repeatable observations & testable ideas to understand & explain our planet.

1.1 Earth scientists find solutions to society's needs. Earth scientists work on challenging problems that face humanity on topics such as climate change and human impacts on Earth. Earth scientists successfully predict hazards to humans and locate and recover natural resources, making possible the flourishing of humans on Earth.

2. Earth is 4.6 billion years old.

2.1 Earth's rocks and other materials provide a record of its history. Earth scientists use the structure, sequence, and properties of rocks, sediments, and fossils to reconstruct events in Earth's history. Decay rates of radioactive elements are the primary means of obtaining numerical ages of rocks and organic remains. Understanding geologic processes active in the modern world is crucial to interpreting the past.

3. Earth is a complex system of interacting rock, water, air, and life.

3.1 The four major systems of Earth are the geosphere, hydrosphere, atmosphere, and biosphere. The geosphere includes a metallic core, solid and molten rock, soil, and sediments. The atmosphere is the envelope of gas surrounding Earth. The hydrosphere includes the ice, water vapor, and liquid water in the atmosphere, the ocean, lakes, streams, soils, and groundwater. The biosphere includes Earth's life, which can be found in many parts of the geosphere, hydrosphere, and atmosphere. Humans are part of the biosphere, and human activities have important impacts on all four spheres.

4. Earth is continuously changing.

4.1 Earth's geosphere changes through geological, hydrological, physical, chemical, and biological processes that are explained by universal laws. These changes can be small or large, continuous or sporadic, and gradual or catastrophic.

5. Earth is the water planet.

5.1 Water is found everywhere on Earth, from the heights of the atmosphere to the depths of the mantle. Early in Earth's history, surface water accumulated through both out-gassing from its interior and the capture of some extraterrestrial ice. Water vapor in the atmosphere condensed and rained out as the planet cooled.

6. Life evolves on a dynamic Earth and continuously modifies Earth.

6.1 Fossils are the preserved evidence of ancient life. Fossils document the presence of life early in Earth's history and the subsequent evolution of life over billions of years.

7. Humans depend on Earth for resources.

7.1 Earth is our home; its resources mold civilizations, drive human exploration, and inspire human endeavors that include art, literature, and science. We depend upon Earth for sustenance, comfort, places to live and play, and spiritual inspiration.

8. Natural hazards pose risks to humans.

8.1 Natural hazards result from natural Earth processes.

These hazards include earthquakes, tsunamis, hurricanes, floods, droughts, landslides, volcanic eruptions, extreme weather, lightning-induced fires, sinkholes, coastal erosion, and comet & asteroid impacts.

9. Humans significantly alter the Earth.

9.1 Human activities significantly change the rates of many of Earth's surface processes. Humankind has become a geological agent that must be taken into account equally with natural processes in any attempt to understand the workings of Earth's systems. As human populations and per capita consumption of natural resources increase, so do our impacts on Earth's systems.

Climate Principles - You shouldn't leave this class without!

Principle #1 Humans can take actions to reduce climate change and its impacts.

Actions taken by individuals, communities, states, and countries all influence climate. Practices and policies followed in homes, schools, businesses, and governments can affect climate. Climate-related decisions made by one generation can provide opportunities as well as limit the range of possibilities open to the next generation. Steps toward reducing the impact of climate change may influence the present generation by providing other benefits such as improved public health infrastructure and sustainable built environments.

Principle #2 The Sun is the primary source of energy for Earth's climate system.

Sunlight reaching the Earth can heat the land, ocean, and atmosphere. Some of that sunlight is reflected back to space by the surface, clouds, or ice. Much of the sunlight that reaches Earth is absorbed and warms the planet.

Principle #3 Climate is regulated by complex interactions among components of the Earth system.

Earth's climate is influenced by interactions involving the Sun, ocean, atmosphere, clouds, ice, land, and life. Climate varies by region as a result of local differences in these interactions.

Principle #4 Life on Earth depends on, is shaped by, and affects climate.

Individual organisms survive within specific ranges of temperature, precipitation, humidity, and sunlight. Organisms exposed to climate conditions outside their normal range must adapt or migrate, or they will perish.

Principle #5 Climate varies over space and time through both natural and man-made processes.

Climate is determined by the long-term pattern of temperature and precipitation averages and extremes at a location. Climate descriptions can refer to areas that are local, regional, or global in extent. Climate can be described for different time intervals, such as decades, years, seasons, months, or specific dates of the year.

Principle #6 Our understanding of the climate system is improved through observations, theoretical studies, and modeling.

The components and processes of Earth's climate system are subject to the same physical laws as the rest of the Universe. Therefore, the behavior of the climate system can be understood and predicted through careful, systematic study.

Principle #7 Human activities are impacting the climate system.

The overwhelming consensus of scientific studies on climate indicates that most of the observed increase in global average temperatures since the latter part of the 20th century is very likely due to human activities, primarily from increases in greenhouse gas concentrations resulting from the burning of fossil fuels.

Principle #8 Climate change will have consequences for the Earth system and human lives.

Incidents of extreme weather are projected to increase as a result of climate change. Many locations will see a substantial increase in the number of heat waves they experience per year and a likely decrease in episodes of severe cold. Precipitation events are expected to become less frequent but more intense in many areas, and droughts will be more frequent and severe in areas where average precipitation is projected to decrease.

Ocean Literacy

Principle 1. The Earth has one big ocean with many features.

The ocean is the defining physical feature on our planet Earth—covering approximately 70% of the planet's surface. There is one ocean with many ocean basins, such as the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, Southern, and Arctic.

Principle 2. The ocean and life in the ocean shape the features of Earth.

Many earth materials and biogeochemical cycles originate in the ocean. Many of the sedimentary rocks now exposed on land were formed in the ocean. Ocean life laid down the vast volume of siliceous and carbonate rocks.

Principle 3. The ocean is a major influence on weather and climate.

The interaction of oceanic and atmospheric processes controls weather and climate by dominating the Earth's energy, water, and carbon systems.

Principle 4. The ocean made Earth habitable.

Most of the oxygen in the atmosphere originally came from the activities of photosynthetic organisms in the ocean. This accumulation of oxygen in Earth's atmosphere was necessary for life to develop and be sustained on land.

Principle 5. The ocean supports a great diversity of life and ecosystems.

Ocean life ranges in size from the smallest living things, microbes, to the largest animal on Earth, blue whales.

Principle 6. The Ocean and humans are inextricably interconnected.

The ocean affects every human life. It supplies freshwater (most rain comes from the ocean) and nearly all Earth's oxygen. The ocean moderates the Earth's climate, influences our weather, and affects human health.

Principle 7. The ocean is largely unexplored.

The ocean is the largest unexplored place on Earth—less than 5% of it has been explored. The next generation of explorers and researchers will find great opportunities for discovery, innovation, and investigation.

Great Lakes Literacy (Limnology)

Principle 1. Great Lakes, bodies of fresh water with many features are connected to each other & the ocean.

The Great Lakes system includes five Great Lakes (Superior, Huron, Michigan, Erie and Ontario), Lake St. Clair and the connecting channels, along with many harbors and bays. Each lake has distinctive basin features, circulation and ecology.

Principle 2. Natural forces formed the Great Lakes; The lakes continue to shape their watersheds features.

Ancient igneous and metamorphic rocks form portions of the upper Great Lakes basin. Other rocks underlying the present-day Great Lakes and surrounding watershed are sedimentary, originating during a time when shallow tropical seas covered the basin. Many of the rocks now exposed on land were deposited and shaped during the advance and retreat of glaciers.

Principle 3. The Great Lakes influence local and regional weather and climate.

The Great Lakes affect weather and climate by impacting the basin's energy and water cycles. Changes in the Great Lakes' water circulation, water temperatures and ice cover can produce changes in weather patterns.

Principle 4. Water makes the Earth habitable; fresh water sustains life on land.

Fresh water has unique properties. Its density and electrical conductivity (a measure of salinity) are lower than that of salt water.

Principle 5. The Great Lakes support a broad diversity of life and ecosystems.

Life in the Great Lakes ranges in size from the smallest blue-green bacteria, such as Microcystis, to the largest animal that still lives in the Great Lakes, lake sturgeon.

Principle 6. The Great Lakes and humans in their watersheds are inextricably interconnected.

The Great Lakes affect many human lives. They supply fresh water to more than 40 million people. They are a source of drinking water and food, as well as mineral and energy resources.

Principle 7. Much remains to be learned about the Great Lakes.

Exploration and understanding of Great Lakes interactions and links among diverse ecosystems and people are ongoing. Such exploration offers great opportunities for inquiry and investigation.

Principle 8 Great Lakes are socially, economically & environmentally significant to the region, nation & planet.

The Great Lakes are a source of inspiration, recreation, rejuvenation and discovery. They are also an important element in the heritage of many cultures.

Final - BIG IDEA - Becoming an earth scientist is extremely meaningful and can lead to many rewarding careers!

Source materials =

Geology – www.earthscienceliteracy.org

Climate – www.cleanet.org

Ocean - www.oceanliteracy.net

Great Lakes - <https://www.cqll.org/for-educators/great-lakes-literacy-principles/>

United Nations – Sustainability Development Goals (SDGs) <https://sdgs.un.org/goals>

