# GEOS 210: Historical Geology

(or, **Evolution of the Earth**)

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class: 8:00-9:00 MWF
lab: 8:00-9:50 T

**Textbook (must be purchased through *Perusall*!)**
*Earth System History* 4e, Stanley and Luczaj

## Course overview:

The Earth is an ever-changing system consisting of many components and interactions between those components. Unlike the physical and chemical processes governing short-term, smaller, and simpler systems (which often can be worked out by direct experiment), the Earth itself is too large, too important, and changes too slowly to be "experimented upon" in a direct fashion. If we want to find out more about how the Earth works, we must turn to natural experiments that have already been performed for us in Earth history.

The process of doing this is in a sense the *inverse* of experimental science: instead of doing an experiment and seeing the outcome, we look at the "outcome" of the experiment and try to infer the causes. This inverse problem in historical geosciences is very similar to the inverse problem a detective faces when trying to determine what happened at a crime scene: examine the evidence, then work backwards to the crime itself. Geologists are detectives, trying to work out what happened to produce the Earth as we know it today.

In this class, you will first train to be a detective by learning (or in some cases reviewing) some of the basic geologic, chemical, physical, and biological processes that govern how the Earth works. We will then use that knowledge to make inferences about Earth history that are grounded in evidence from rocks, chemistry, geophysics, and fossils. Along the way, you'll learn how to identify basic groups of fossils, how to interpret geologic age and isotopic data, how to relate one group of rocks in one location to another group of rocks at a different location, and how to piece all this information together into a coherent picture of Earth system evolution.

Rocks are the Earth's memory. Like most of our memories, Earth's memory is often faded, and sometimes altered. And there are certainly many events that the Earth has forgotten. Geologists have worked out a lot of Earth's history from the record that has already been explored. But there is still a lot to do! You won't learn everything about Earth history in this course. Like most of your courses, you'll only be scratching the surface. But I hope that what you learn from this course will give you a greater appreciation for what we know and what we don't, how the Earth works, and how and why it has evolved through time.

**At the end of this course, you should be able to:**

1. Make useful observations.
2. Recall, explain, and apply what you've read.
3. Describe Earth systems and how they evolved through time.
4. Recognize evidence for Earth system changes.
5. Interpret geologic history from geologic data.
6. Evaluate causes of Earth system changes.

## Structure of the course

This class will treat Earth history from a systems standpoint. There is definitely a focus on geology, but aspects of the chemical, biological, hydrological, climatic, and physical evolution of the Earth will be treated as well. Class time will mostly be used for interactive enhancements such as Q & A, discussion, thought experiments, problem-solving, and lab assignments.

The course is divided into two parts. Part one focuses on Materials, Processes, and Principles of Earth history. Much of part one will be review for all of you. Part two focuses on the story of Earth history, from 4.6 Ga to the present. Most of this will be entirely new for you. An ideal course schedule is on the last page of this syllabus. We may deviate from this ideal schedule as the semester progresses, but I will always keep you informed of where we are and what you should be doing.

The course has three main components:

**Reading.** You will be reading the textbook for the course using *Perusall* (a social e-reader). You must purchase the book for the course through the *Perusall* platform (linked to the Moodle page for the class). Thereafter, you'll be reading and annotating the text using the *Perusall* e-reader. See the following page for details. A primary requirement for the course is that you ***must complete all reading on time***. Reading assignments and their due dates will be posted on Moodle and in Perusall. *You are required to learn the course content on your own from the reading*. Read snd annotate carefully, so that you'll be ready for…

**Class time.** This course will mostly be taught in a "flipped classroom" style. There will only be limited lecture, at least in the first half of class. For the most part I will be giving you problems to solve and questions to discuss as individuals or in small groups. For you to be an active participant, you must not only have done the reading, but to have done it as though you'll be tested on what you've read. Your participation and attendance will be measured by in-class activities, and that will become part of your participation grade.

**Labs.** Lab assignments will consist of a variety of samples or problem sets related to the course content. Some labs will be "do-able" within the class period; others will spill over into homework. Completion of lab assignments is also worth 20% of your grade.

## Examinations and assessment

There will be two midterm exams, a lab exam, and a final exam in this course. All exams will be given during the class period, as indicated in the attached schedule. Exams will be largely based upon the material in the reading, with special attention paid to the topics we focus on in class. The lab final will be mainly fossil ID. 20% of your grade is participation (both *Perusall* and in class).

**Grading:**

20% Perusall + in-class participation
20% Completed lab assignments
30% Midterm exams
20% Final exam
10% Lab final exam

**Grading scale:**

| | |
|---|---|
| A 93-100% | C 76-74% |
| A- 92-90% | C- 73-70% |
| B+ 89-87% | D+69-67% |
| B 86-84% | D 66-64% |
| B- 83-80% | D- 63-60% |
| C+ 79-77% | F <60% |

# How Perusall Works

*Perusall* helps you master readings faster, understand the material better, and get more out of your classes. To achieve this goal, you will be collaboratively annotating the textbook with others in your class. The help you'll get and provide your classmates will get you past confusions quickly and will make the process more fun. While you read, you'll receive rapid answers to your questions, help others resolve their questions (which also helps you learn), and advise the instructor how to make class time most productive. You can start a new annotation thread in *Perusall* by highlighting text, asking a question, or posting a comment; you can also add a reply or comment to an existing thread. Each thread is like a chat with one or more members of your class, and it happens in real time. Your **goals** in annotating each reading assignment are *to stimulate discussion by posting good questions or comments* and *to help others by answering their questions*.

Research shows that by annotating thoughtfully, you'll learn more and get better grades, so here's what "annotating thoughtfully" means: Effective annotations *deeply engage points in the readings, stimulate discussion, offer informative questions or comments, and help others by addressing their questions or confusions*. To help you connect with classmates, you can "mention" a classmate in a comment or question to have them notified by email (they'll also see a notification immediately if online), and you'll also be notified when your classmates respond to your questions.

For each assignment *Perusall* will evaluate the annotations you submit on time (see below). Based on the overall body of your annotations, you will receive a score for each assignment as follows:

3 = demonstrates exceptionally thoughtful and thorough reading of the entire assignment

2 = demonstrates thoughtful and thorough reading of the entire assignment

1 = demonstrates superficial reading of the entire assignment OR thoughtful reading of only part of the assignment

0 = demonstrates superficial reading of only part of the assignment

**How many annotations do I need to enter?**

Annotations should reflect the effort you put in your study of the text. It is unlikely that that effort will be reflected by just a few thoughtful annotations per assignment. On the other extreme, 30 per assignment is probably too many, unless a number of them are superficial or short comments or questions (which is fine, because it is OK to engage in chat with your peers). Somewhere in between these two extremes is about right, and thoughtful questions or comments that stimulate discussion or thoughtful and helpful answers to other students' questions will earn you a higher score for the assignment. Note, also, that to lay the foundation for understanding the in-class activities, you must familiarize yourself with each assignment *in its entirety*. Failing to annotate the entire assignment will result in a lower score.

**What does "on time" mean?**

The work done in class depends on you having done the reading in advance, so it is necessary to complete the reading and post your annotations before the deadline to receive credit. To encourage continued discourse, I will provide a reply window after each deadline during which you can continue to reply, for full credit, to questions posted by others. However, the number of additional points you can earn after the deadline is capped at the credit you receive for annotations made on that assignment before the deadline.

# Ideal course schedule

| Week of: | Notes | Reading | Lab |
|---|---|---|---|
| Jan 30-Feb 3 | | Ch 1-2: Earth system; Rocks and Minerals review | Geologic Timescale |
| Feb 6-10 | | Ch 3-4: Diversity of Life & Ecology | Biostratigraphy, magnetostratigraphy, chemostratigraphy |
| Feb 13-17 | | Ch 5: Sedimentary Environments | Lithostratigraphy and Relative dating |
| Feb 20-24 | | Ch 6: Correlation and Dating | Radiometric dating |
| Feb 27-Mar 3 | **Exam 1, Mon February 27** | Ch 7: Evolution and the Fossil Record | Evolution |
| Mar 6-10 | | Ch 8-9: Tectonics | Tectonics |
| Mar 13-17 | | Ch 10: Geochemical Cycles | Isotopes |
| Mar 20-24 | | Ch 11-12: Precambrian | Protists, Problematica, Pseudofossils |
| **SPRING BREAK (March 25 -April 2)** | | | |
| Apr 3-7 | | Ch 13-14: Early & Middle Paleozoic | Corals, Sponges, Bryozoans |
| Apr 10-14 | **Exam 2, Mon April 10** | Ch 15: Late Paleozoic | Brachiopods |
| Apr 17-21 | | Ch 16: Early Mesozoic | Graptolites, Echinoderms |
| Apr 24-28 | | Ch 17-18: Cretaceous-Paleogene | Arthropods, Mollusks |
| May 1-5 | | Ch 19-20: Neogene | Glacial landforms |
| May 8-11 | | Wrap-up | **Fossil Exam** |

***Final Exam: Tuesday, May 16, 8:30-11:30 am***