

## 12.377/12.707 The History of Earth's Climate

### **Course description:**

This course explores the geologic record of climate change over the whole of Earth history. Students will examine methods of reconstructing past climates, general features of past climates and climate changes, processes and feedbacks involved in the climate system's response to forcings, and model-based explorations of past climates. The course will include two 1-day field trips to examine the geologic record of climate change in local settings. The class is intended to be suitable for students from a variety of backgrounds, including graduate students in geology/geochemistry and climate dynamics and upper-level undergraduates with at least some familiarity with Earth science.

### **Goals:**

Students will be able to:

1. describe connections between natural archives and inferences about past climates
2. identify and test hypotheses about drivers of past climate changes and consistent patterns of long-term climate
3. assess and assimilate data to build comprehensive understandings of past climates
4. identify and explain aspects of past climate changes that inform our understanding of future climate change

### **Assessments/Grading:**

Participation: Students will be expected to contribute thoughts and questions in class and to participate in class activities. In advance of each class for which reading is assigned, students will submit a short (~4-sentence) summary of the reading(s) and 1-2 questions they would like to have discussed. The reading list will clearly indicate when summaries + questions are expected. Each student will also be responsible for presenting selected readings over the course of the class, either in small groups or to the whole class (with advance notice). (30% of term grade)

Assignments: There will be 6 assignments over the course of the class:

1. 1000-word Perspective piece for Nature/Science
2. Problem set on the long-term carbon cycle
3. 1000-word article review
4. Problem set on orbital changes and paleoclimate model output
5. Report based on data collected on field trips
6. ~2000-word concept proposal for a foundation grant or a project on the implications of the paleoclimate record for future climate change.

The first five assignments will each be worth 10%, and the last (2000 word piece) will be worth 20% of your final grade. Either the assignment scope or the grading expectations will be modified for 12.377 students. (70% of term grade).

*Final exam:* There will be no final exam.

**Topics:**

See list of classes in Excel spreadsheet on Stellar. Topics can be added, expanded or compressed based on student interest.

**Field trips:**

**Hartford Basin, CT: Impact of orbital changes and volcanism on Jurassic climate**

Field measurement of orbital signals in Jurassic lake sediments, plus examination of volcanic deposits from rifting of Atlantic and dinosaur footprints.

**Woods Hole, MA: Field evidence of past glaciations, sediment and ice core archives, dating techniques.** Examination of deposits from the most recent glaciation, study of marine sediment cores from varied environments and climates and ice cores at the Woods Hole Oceanographic Institution's core repository, tour of accelerator mass spectrometer radiocarbon dating facility at WHOI.

**Reading:**

The following textbook is recommended, especially if this material is fairly new to you, but not required. It provides concise summaries of most of the key topics we'll be discussing in class that will prepare you to read journal papers related to the topics.

Bender, M. [Paleoclimate](#). Princeton Primers in Climate, Princeton University Press: Princeton, NJ, 2013.