ERS412H5 Climate Through Time – Winter 2019

The goals of this course are to discuss the geologic record of climate change and present an overview of the methods used to reconstruct the earth's climate history and the techniques used to determine the timing of environmental changes. Topics to be addressed will include paleoclimatic reconstructions, climate and climatic variation, dating methods, and climate proxies. In addition, periods of past climate change will be highlighted with particular emphasis on climate change during the recent past. This will be put into perspective with modern day and future global change. [36L]
Exclusion: ESS205H1, 461H1; EESB03H3
Prerequisite: **Two of:** ERS201H5, ERS202H5, ERS203H5

Instructor:
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Earth Sciences, Dept. of Chemical and Physical Sciences
Office hours: Tuesday 10-11a.m/Wednesday 11 a.m.-noon or by appointment

Class Schedule:
Lectures: noon-1 p.m. Tuesday, Room DH3000, 9-11 a.m. Wednesday, Room DH3000

Marking Scheme:

Term test 1	25%	February 6th
Term test 2	25%	March 13th
Term test 3	25%	April 3rd
Term paper	20%	March 19th (in class)
Exercises	5%	all due in class

Late penalty on term paper: 20% of full mark/day after 19/03

Missed Term Tests, Quizzes, or Labs:
There will be no make up tests or exercises. A missed test or exercise will only be excused for cases in which the absence was entirely beyond your control (e.g. medical reasons, personal affliction), but only if proper documentation is submitted. In this case remaining tests and exercises will be reweighted accordingly (e.g. if one test has been missed, the two remaining tests together will count for 75% of grade).

There will be no prior announcement as to when exercises will be conducted. It is your responsibility to attend class regularly.

Medical Excuses: Within ONE WEEK of missed test/quiz/lab you must submit the following to me: (1) A University of Toronto Student Medical Certificate, filled out by your doctor, and (2) a detailed letter from you requesting consideration including your name, student number, email address, date of missed test, and how it prevented you from completing your work.
Non-medical excuses: BEFORE YOUR ABSENSE, submit a letter requesting consideration including the following information: name, student number, email address, date of expected absence and a detailed description of the reason for the absence. If your absence arises in an emergency, this letter may be submitted up to ONE WEEK after the absence. Valid excuses include: emergency care of a child, parent or other family member and funerals. Reasons involving personal commitments such as vacation travel, work and routine medical appointments will not be considered.

Term paper:
The rationale for doing a paper is to demonstrate an increased amount of knowledge in your chosen subject. In addition, it will train you in scientific report writing. The paper should demonstrate knowledge of scientific principles that pertain to your subject.

Term paper topics:
- By **early February** each student will be emailed a paper topic dealing with a subject related to Climate through Time.

- Length 3 pages (12 point, 1.5 spaced) plus or minus 1/4 page, departure from this length restriction will result in 10% penalty for each ¼ page (this includes abstract, a maximum of 2 figures (each no larger than 1/3 of a page) and no more than 5 references, but does not include cover page)

- Paper will include an abstract (200 words plus/minus 10%), an introduction stating objectives of research, and main body with major findings and list of references cited.

- All statements presented in this report are to be properly referenced; this includes citations within the text itself. This paper is to be a synthesis IN YOUR OWN WORDS of your subject material; where direct quotes are made source must be properly referenced.

- A "References Cited" section that lists those materials that you actually used and cited is to be given at the end. In text citations must be in the format AUTHOR (YEAR), if two authors AUTHOR and AUTHOR (Year), of >2 authors AUTHOR et al. (YEAR). Abstract does not contain citations. Citation procedures and the "references cited" section are to follow exactly the format used by the Geological Society of America (bottom of page http://www.geosociety.org/documents/gsa/pubs/GSA_RefGuide_Examples.pdf). Citations have to appear in text and match bibliography at end of paper. Most of your statements are not based on your own work but the work of others – this must be cited at the end of every sentence or sequence of sentences. Citations from places like Discovery Channel, BBC news or information from websites is not allowed (e.g. no reference to http:/www…..). All Figures must be numbered and referenced. Do not use statements such as “Researchers have found…”, but rather say: NameofResearcher (Year) has found….

- Marking scheme applied to term paper: Abstract (10%), Introduction stating objectives of research (15%), main body with major findings (50%), Citation/references (10%), Formatting, grammar, style (15%)

Literature:
No textbook is required for this class even though it is highly recommended to consult the below book, which is on reserve at the library. A handout will be posted on Quercus for each lecture, containing an outline of topics discussed as well as the most relevant figures. It is your responsibility to follow the lectures and fill in relevant information on the handouts provided.

William F. Ruddiman, Earth's Climate: Past and Future Third Edition, 2014, ISBN-10: 1-4292-5525-0; ISBN-13: 978-1-4292-5525-7

Useful internet resources:
www.iodp.org – The Integrated Ocean Drilling Program
http://www.ncdc.noaa.gov/data-access/paleoclimatology-data - National Oceanographic and Atmospheric Administration Climate and Paleoclimate Research

http://www.whoi.edu/page.do?pid=7016 –Woodshole Oceanographic Institution, Climate and Ocean Research
http://www.ldeo.columbia.edu/ - Lamont-Doherty Earth Observatory, Climate and Ocean Research

Course outline:

1. Topic Overview, Sources of information of past climates
2. Topic Components of the climate system
3. Topic Orbital parameters influencing climate
4. Topic The Toolbox: Geochemistry, Paleontology, Dating
5. Topic Archean and Snowball Earth
6. Topic Paleozoic Climate
7. Topic Mesozoic Climate
8. Topic The Cretaceous greenhouse climate
9. Topic Paleocene-Eocene Thermal Maximum
10. Topic Causes of cooling during the last 55 Ma
11. Topic Quaternary Climates
12. Topic Humans and Climate