GEOG 4101A Two Million years of Environmental Change
Department of Geography and Environmental Studies [0.5 credit]

Course outline: Fall 2018 DRAFT

Instructor:
Dr. Joyce Lundberg, Room A327 LA, 520-2600 Ext. 2571, joyce.lundberg@carleton.ca (**Put GEOG 4101 in the subject**).
Office hours: Fridays 9:30 – 11:00 am, or email me to make an appointment.

Schedule:
Lecture/Seminar: Tuesdays and Thursdays 4:05 pm – 5:25 pm (first class Thursday Sep 6). Location: TBC – tentatively SA 314

Calendar entry:
Multidisciplinary scientific study of the changes in the physical environment of the Earth during the last two million years and methods of studying recent Earth history, with focus on current research.
Prerequisite(s): third year standing in a B.Sc. program, or a third year Science Geography Elective or a third year ERTH course, or permission of the Department. Note: GEOG 3105 is recommended.

Course description:
Over the last 2 million years, severe oscillations of climate have caused great variations in the processes affecting environments all over the world. It is vital that we understand the past in order to understand the present and predict the future. The study of global environmental change over the last 2 million years (the Quaternary period) is at the forefront of research into understanding current environmental problems, particularly climate change. This course will focus on how Quaternary climate change is studied, on research techniques, types of evidence, and geographical changes characteristic of the Quaternary. In order to understand these processes we must use an interdisciplinary approach and will cover such topics as climatic change, sea level change, isotopic studies of ocean cores, ice cores and cave deposits, dating techniques. My aim in teaching this course is that you acquire enough basic understanding to be able to read, and understand the significance of, and appreciate the excitement of the latest research. Your readings and seminars will focus on the most recent published research. New findings and new ideas are coming out of the literature almost faster than we can keep up with. So much of this research into past climate changes has implications for modelling future climate changes. I think it is really important for you to be aware of these ideas, so I emphasize reading of recent journals such as *Nature, Science, Geology*. I also think that it is important for you to do some hands-on work, so we will do one project on tree rings that you will collect from around the campus, and one on ocean cores using the scanning electron microscope.

Course Objectives:
By the end of the course you will hopefully ...
(1) be aware of the nature of Quaternary changes and know the basics of the most pressing concerns/controversies;
(2) understand the major research tools that are being used, their strengths and their weaknesses;
(3) have the foundation that will allow you to critically assess the research process; and
(4) have enjoyed doing some simple practical research.

Recommended Text:
Bradley, R.S. *Paleoclimatology: reconstructing climates of the Quaternary.* 2015, 3rd edition. Academic Press, San Diego

Octopus Books is not able to get this book, but you can buy it on-line (a hard copy or a digital copy if you prefer), or you may be able to get a second-hand copy. Here is a link https://www.elsevier.com/books/paleoclimatology/bradley/978-0-12-386913-5?start_rank=1&sortby=sortByRelevance&imprintname=Academic%20Press&q=paleoclimatology\:%20reconstructing%20climates%20of%20the%20quaternary
Amazon has several; e.g. try this link https://www.amazon.ca/gp/offer-listing/0123869137/ref=sr_1_1_olp?ie=UTF8&qid=1503527740&sr=8-1&keywords=Bradley+Paleoclimatology%3A+reconstructing+climates+of+the+Quaternary.

Useful books include:

Anderson, D.E., Goudie, A.S. and Parker, A.G. 2007. Global Environments through the Quaternary. Oxford University Press. pp. 359. QE696 .G68 2007

Williams, M., Dunkerley, D., Deckker, P, de, Kershaw, P. and Chappell, J. 1998 *Quaternary Environments* 2nd edition. Arnold/Oxford QE720 .Q36 1998

Goudie, A. *Environmental Change*. Oxford, 3rd edition, 1992 QE696 .G68 1992

Bradley, R.S. *Paleoclimatology: reconstructing climates of the Quaternary*. 1999, 2nd edition. Academic Press, San Diego. QC884 .B614 1999 Note: this is only the old, second, edition

Lowe, J.J. and Walker, M.J.C. *Reconstructing Quaternary Environments*, Longman, London and New York. 1997 QE696.L776 1997

Cronin, T.M. Paleoclimates: Understanding climate change past and present. Columbia University Press, New York. 2010. QC884 .C739 2010

These are all available on 4-hour reserve at the library.

cuLearn:
I use "**cuLearn"** to communicate information about the course.

Format:
The early part of the course is designed to introduce you to the basic concepts and methods of Quaternary studies so that you will be able to read and understand any publication on the Quaternary (at least to understand the gist if not the details). This part of the course has to rely rather a lot on lectures from me. However, by about the middle of the term you should be ready to appreciate the exciting nature of this research sphere. The second half of the course will involve a mixture of lectures from me and seminars from you on a topic of current research interest and perhaps controversy. In addition, throughout the term I try to have a couple of visiting speakers. Draft Class Schedule at end of this document.

Evaluation (subject to discussion/change):

Attendance & In-class activities	15%
Seminar	20%
Assignments	35%
Take-home tests	30%

Notes:
1) Make sure you are properly registered. You should ensure that you have the skills required to take the course. It is science course but I expect that few people will have done very much in this field before. So I do everything from scratch (so don't worry if you do not have the specified prerequisites – a good general background in science will be enough).
2) All test papers may be viewed by the student but are retained by the professor.

Criteria for grading include spelling, grammar, format as well as academic content.
Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean.

Academic conduct:
Instructional & Conduct Offences:

Instructional offences include among other activities cheating, contravening examination regulations, plagiarism, submitting similar work in 2 or more courses without prior permission, and disrupting classes. Conduct offences apply in areas of discrimination and sexual harassment. Further information about University regulations which define and regulate these offences is presented in the UG Calendar*:*

http://www.carleton.ca/calendars/ugrad/current/regulations/acadregsuniv14.html

Some of the section on plagiarism is reproduced below, because it is the most common academic offence, and one that can sometimes be committed inadvertently. (Please note that plagiarism also applies to images that you present without acknowledgement).

Plagiarism:

Plagiarism is presenting, whether intentional or not, the ideas, expression of ideas or work of others as one's own. Plagiarism includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source. Examples of sources from which the ideas, expressions of ideas or works of others may be drawn from include but are not limited to: books, articles, papers, literary compositions and phrases, performance compositions, chemical compounds, art works, laboratory reports, research results, calculations and the results of calculations, diagrams, constructions, computer reports, computer code/software, and material on the Internet.

Examples of plagiarism include, but are not limited to:

- submitting a take-home examination, essay, laboratory report or other assignment written, in whole or in part, by someone else;
- using ideas or direct, verbatim quotations, paraphrased material, algorithms, formulae, scientific or mathematical concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another's data or research findings;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own;
- failing to acknowledge sources through the use of proper citations when using another's works and/or failing to use quotation marks.

Requests for Academic Accommodations
You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: http://www2.carleton.ca/equity/

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website: http://www2.carleton.ca/equity/

Academic Accommodations for Students with Disabilities: The **Paul Menton Centre** for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your ***Letter of Accommodation*** at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (*if applicable*). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (*if applicable*) at http://www2.carleton.ca/pmc/new-and-current-students/dates-and-deadlines/

You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www2.carleton.ca/equity/

GEOG 4101 Class Schedule Fall 2018

Lectures: Tuesdays and Thursdays 4:05 pm – 5:25 pm. Location: SA 314 (?)

- The main part of the class is lectures. Schedule is flexible, but here is the list of what I propose to do and the approximate timing.
- One class will be for you to see the Scanning Electron Microscope and another to do some tree coring
- At the end of term, two or three classes will be devoted to your seminar presentation (the time required will depend on the size of the class – each presentation is ~20 minutes).

There is a host of material relevant to Quaternary Geography! We may not get all the topics below covered. Here is the tentative schedule - it is less predictable towards the end of term. I have tried to distribute the various deadlines equitably throughout the term. DRAFT … may change!

Date	**Topic**	**Notes**
Sep 6		Intro to class
Sep 11,13, 18	Intro to Quaternary	Overview of Quaternary changes worldwide. Definitions. Timescale. Cenozoic changes. Nature of climate cycles. Orbital cycles. Impacts of climate cycles worldwide.
Sep 20	Proxies	Overview, Nature of scientific evidence, calibration, requirements
Sep 25	***Tree coring in the field***	***In the soils lab – go straight to Loeb A120***
Sep 27, Oct 2, 4	Evidence from ocean cores	Locations of ocean cores, nature of; non-isotopic evidence (terrigenous, biogenic, CLIMAP); isotopic evidence, controls on isotopes (fractionation, ice volume, vital effects, Raleigh distillation; Dating ocean cores, importance of tuning; Carbonate Compensation Depth; Ice Rafted Debris; Alkenone Undersaturation Index
Oct 9	***SEM demo***	***go straight to Steacie Building, Room 222***
Oct 10		**Tree coring report due, midnight**
Oct 11,16	Evidence from ice cores	Locations of ice cores; non-isotopic evidence (accumulation, dust, bubbles, GHGs); isotopic evidence, fractionation, rainout, meteoric water line, Raleigh distillation; dating ice cores
Oct 18, 30 (study break in the middle)	Evidence from speleothem	Speleothem formation, laminae, dating; evidence from growth rate (case study TAV); isotopic evidence, controls on isotopic composition (O-18, C-13); case study: Monsoons, D-O events ; laminae, case study, Ireland. Other case studies; Norway, Puerto Rico
Oct 31		**Take home test due, midnight**
Nov 1, 6, 8	Dating techniques	Principles of radiometric dating (radioactivity, equilibrium, disequilibrium); precision & accuracy; instruments; C-14 dating, principles, corrections required (fractionation, flux, reservoir effects, etc.); U-Th dating, principles, corrections (detrital contamination, open system
Nov 13, 15	Sea level change	Evidence; Eustasy (geoidal, glacio-, tectono-); Isostasy (glacio-, hydro-); techniques for sea-level reconstruction; Importance of sea level as climate proxy & test of climate forcing; Quaternary sea level changes & CREs, corals, speleothem, dating, intertidal notches
Nov 20, 22	Ocean circulation	Methods for study; structure of oceans; circulation system & controls; surface circulation (currents, Ekman forcing, Langmuir); up- & downwelling; divergences & convergences; Thermohaline circulation; sea ice factory; Deep Waters (NADW, AABW) Intermediate Waters (MIW); Polynyas; Glacial-interglacial changes in circulation.
Nov 25		**SEM report due, midnight.**
Nov 27	Nature of climate change	Climate cycles, Oscillations; D-O events, Greenland Interstadials, Heinrich Events, ENSO, NAO, TAV, Monsoons.
Nov 29, Dec 4, 6	Seminars	**Student seminar presentations,** 20 minutes each
Dec 21		**Take home test due**
Extra topics	Living things	Biomes shifts, Migration, Refugia & evidence for, Case study: Alaska, Human

		colonization, Extinctions, examples & potential causes
Extra topics	Causes of climate change?	Summary of possibilities, questions about solar role, doubts about orbital forcing

Grading:

Participation	Assignments	Tests
15% attendance	15% tree ring report	15% mid-term take home test
20% seminar	20% SEM project	15% end of term take home test