THE UNIVERSITY OF WESTERN ONTARIO
Department of Geography
GEOGRAPHY 3352B/9200B: Paleolimnology and Global Environmental Change
Winter 2016

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Office Hours: Dr. Katrina Moser will be available for consultation on Thursdays 12:30-1:30pm and Oscar Senar will be available Tuesdays 10:00-11:00am.

Lectures: Wed. 11:30-1:30, SSC 1302

Labs/Tutorials: Thurs. 10:30-12:30 SSC 1302

Field Trips: Students are required to attend one Saturday field trip which will be held **Saturday Feb. 6 from 9am-4pm**. This is a critical and mandatory part of the course and attendance is required.

Course Prerequisites: One of Geography 2310A/B, 2320A/B or 2330A/B, or at least 3rd year standing in an Environmental Science or Earth Sciences program, or Biology 2483A, 2484A, 2485B or permission of the instructor. Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

INTRODUCTION:
Paleolimnology is the reconstruction and interpretation of past environments using physical, chemical and biological indicators contained in lake sediments. In the last two decades the field of paleolimnology has undergone rapid expansion. This course is a detailed examination of current methods and theories in paleolimnology. Lecture topics will include a review of:

- dating methods
- paleolimnological techniques, including a detailed survey of a variety of paleoindicators

- current issues in paleolimnology
- paleolimnology and global environmental change.

Labs will provide students with a hands-on experience of field and lab techniques used by paleolimnologists.

BASIS FOR COURSE:
This course provides students with a "hands-on" learning experience in one area of environmental science, Paleolimnology. Students will learn how research questions and hypothesis are developed and then tested. A one day field trip provides students with the opportunity to survey sites and collect data to test a hypothesis. During the field trip, which provides the basis for the course. Depending on weather, students will either retrieve sediments (mud) from the bottom of a lake or do a survey of lakes in the area. In both cases students will learn to make and record limnologic observations and measurements. Sediments retrieved during the field trip or from previous years, will become the basis for lab assignments and for a final report which is submitted on the last day of class. Lectures provide the background materials necessary for understanding and interpreting the data collected by students.

OBJECTIVES:
There are content and technical goals for this course.

Content
The main content objectives of this course are:

1. to provide students with an understanding of the importance of a long-term perspective in environmental research;
2. to provide students with a strong foundation and understanding of the most recent theories and methodologies in Paleolimnology;
3. to provide students with an understanding of the contributions of Paleolimnology to our understanding of global environmental change

Technical
The main technical objectives of this course are:

1. to provide students with an understanding of the scientific method
2. to provide students with an opportunity to make field observations and measurements and assess the accuracy and precision of the measurements
3. to provide students an opportunity to use the observations to test hypotheses
4. to provide students with an overview of paleolimnological techniques and an opportunity to practice these techniques.

CLASSES:
There will be one 2 hour lecture and one 2 hour lab per week. One **mandatory** Saturday field trip is planned.

COURSE TEXT:
The required course textbook will be Smol, J.P. 2008. *Pollution of Lakes and Rivers: A Paleoenvironmental Perspective Second Edition*. Blackwell Publishing, Oxford.

Below I have listed a few books that I have also found useful which will be available on reserve in the library.

Paleolimnology References
1. Last, W.M. and Smol, J.P. (editors), 2001. Tracking environmental change using lake sediments. Kluwer, Boston. **4 volumes**. **QE39.5P3T73 2001**
An excellent set of books reviewing many paleolimnological techniques. Useful for paleoindicator assignments.
2. Pienitz, R., Smol, M.S.V. Douglas and Smol, J.P. (editors), 2004. Long-term environmental change in Arctic and Antarctic lakes. Kluwer, Boston. **QH98.L66 2004**
A review of Arctic and Antarctic Paleolimnology. Useful for Arctic and Antarctic lake depositional environment assignment.
3. Cohen, A.S. 2003. Paleolimnology: The history and evolution of lake systems. Oxford University Press, New York. **QE39.5.P3 C63 2003**
Upper undergraduate to graduate level text on paleolimnology written from a geologic rather than biologic perspective. Useful for many paleoindictor topics (Chapter 9, 10 and 11 and some depositional environment topics (Chapter 2).

Limnology References
1. Hutchinson, G. E., 1957. A treatise on limnology, 1. J. Wiley & Sons, New York.**QH98.H97 1957**
A classic! Excellent review of stratification and chemical processes.
2. Wetzel, R. G., 2001. Limnology: Lakes and River Ecosystems, 3rd edition. Academic Press, London. **QH96.W47 2001**
The best textbook available about Limnology.

Biological References
1. Lipps, J. H., 1993. Fossil Prokaryotes and Protists. Blackwell Scientific Publishers, Cambridge. **QE719.5.F67 1993**
This is a helpful book for some paleoindicator assignments or if you want additional reading on diatoms.
2. Stoermer, E.F. and Smol, J.P. (editors), 1999. The diatoms: applications for the environmental and earth sciences. Cambridge University Press, Cambridge. **QK569.D54D536 1999**
An excellent review of how diatoms have been used to address environmental and earth science problems – super book!

Quaternary References
1. Bradley, R.S., 1999. Paleoclimatology: Reconstructing climates of the Quaternary, 2nd edition. Harcourt and Academic Press, New York. **QE884.B614 1999**
Many paleoindicators are covered in this book. It is especially useful for isotopes, radiometric

dating and pollen analyses. (Upper undergraduate to graduate level)

EVALUATION:

There will be five components to students' evaluation:

1. Depositional Environments (10%)
Students will work in groups to prepare and make a short presentation (~10-15 minutes) about one particular type of depositional environment (i.e., Arctic, Alpine and Antarctic lakes, Boreal lakes, saline lakes, tropical lakes, meromictic lakes, glacial lakes, tectonic lakes, fluvial lakes, coastal lakes, volcanic lakes, karst lakes, the Great Lakes). **Please consult with Dr. Moser once you have selected a topic to get some starting references.** Further information, including a grading rubric, will be provided when the project is assigned.

2. Paleoindicator Poster Presentations (10%)
Students will be required to make a poster presentation (~10-15 minutes) about a paleoindicator of their choice (excluding diatoms). Students may work individually or in groups. Paleoindicators which may be selected include Chrysophycean algae, chironomids, Cladocera, molluscs, Protozoa, freshwater sponges (Porifera), freshwater ostracodes, phytoliths, biogeochemical signals (e.g. algal pigments, biogenic silica), charcoal, elemental geochemistry, contaminants, sedimentary characteristics, etc. Students must consult with Dr. Moser about their choice of paleoindicator. Further information, including a grading rubric, will be provided when the project is assigned.

3. Field and Lab Exercises (15%)
During the class a field trip will be held in the London area. If weather permits, we will work from lake ice to collect a sediment core, which will form the basis of subsequent lab exercises. If weather does not permit or there is insufficient ice we will do a survey of lakes in the area, and we will work on a core collected previously. Short weekly to biweekly assignments will introduce students to a variety of paleo techniques including some of the following, site selection, field methods, sediment dating, core analyses, subsampling and pollen, diatom, loss-on-ignition, chryosphyte and charcoal analyses. Attending and actively participating in field trips and labs is critical to your success in the course. Although, the lab assignments make up a small percentage of your final grade, feed back on these assignments is critical to writing an excellent final report.

4. Final Report (20%)
A final report will be submitted at the end of class that summarizes your findings on analyses of a sediment core collected during a field trip. The field trip and labs provide the data for your report. Lab assignments will help you to interpret the data and prepare your report.

5. Mid-Term (15%)

One quiz will be given during the class worth 15% of the final grade and will be comprised of multiple choice, fill in the blank and short answer questions. No electronic devices will be allowed during quizzes. The quiz is designed to help you prepare for the final exam.

6. Final Exam (30%)
This will be a similar format to the quizzes.

SUMMARY OF EVALUATION

Depositional Environment Presentation…….10%
Paleoindicator Presentation…….....10%
Lab Assignments……15%
Mid-Term….....15%
Final Report……20%
Final Exam……..30%
TOTAL.....100%

Evaluation for those registered in Geography 9200B will be the same as above, but will also include a term paper or project (to be determined in discussions with Katrina Moser), which will be worth 20% of your grade. The final exam will only be worth 20% and the lab assignments 10% to adjust for the term paper.

You are expected to attend all lectures, labs/tutorials, and the field trip, and to complete the assigned readings. The final exam (scheduled by the Registrar) will be 3 hours in length. Exam questions will be based on all material covered in lectures, labs, the field trip, and assigned readings. All assignments must be typed and handed in on time.

Statement on Use of Electronic Devices

No calculators will be required or permitted in the exams. Students who require electronic assistance with language translation must obtain prior approval from the instructor.

Penalties

Exams: In accordance with university policy, missed exams cannot be made up except on written medical grounds and notification prior to exam date.
Assignments: Late assignments will have a penalty of 10% per day. Assignments submitted more than 5 days late will not be accepted. Exceptions can be made for documented medical and other significant reasons beyond your control (see subsequent sections).

Non-medical Absences

Non-medical absence from the midterm requires prior approval of the instructor or approval by the Dean's office (appropriate documentation will be required by the Faculty Dean's Office for approval if it is not obtained prior to the midterm).

Medical Absences

Students seeking academic accommodation on medical grounds for any missed tests, exams, participation components and/or assignments worth **10% or more** of their final grade must apply to the Academic Counselling office of their home Faculty and provide documentation. Academic accommodation cannot be granted by the instructor or department.

For UWO Policy on Accommodation for Medical Illness and a downloadable SMC see:
http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf
Downloadable Student Medical Certificate (SMC): https://studentservices.uwo.ca under the Medical Documentation heading
When medical illness affects work worth **less than 10%** of the total course grade (i.e. an assignment), please contact the course instructor for academic accommodation (documentation not required).

University Statement on Academic Offences

"Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf."

"Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating."

Mental Health

If you or someone you know is experiencing distress, there are several resources here at Western to assist you. Please visit the site below for more information on mental health resources: http://www.uwo.ca/uwocom/mentalhealth/.

GEOGRAPHY 3352A/9200B: Paleolimnology and Global Environmental Change

DATE	SUBJECT	READINGS, ASSIGNMENTS, NOTES
Jan. 6	LECTURE 1: Course Introduction What is Paleolimnology?	Smol Chapter 2
Jan. 7	LECTURE 2: Water	LAB TOUR
Jan. 13	LECTURE 3: Thermal Stratification and Redox	Smol Chapter 1 **Depositional Environments Sign Up**
Jan. 14	LAB 1: Thermal Stratification	
Jan. 20	LECTURE 4: Lakes and Sediments	Smol Chapter 3
Jan. 21	LAB 1: Thermal Stratification (Con't)	
Jan. 27	LECTURE 5: Dating	Smol Chapter 4 **LAB ASSIGNMENT 1 DUE**
Jan. 28	**DEPOSITIONAL ENVIRONMENTS PRESENTATIONS DUE**	
Feb. 3	LECTURE 6: Paleoindicators	Smol Chapter 5
Feb. 4	LECTURE 7: Interpreting Paleolimnological Data	Smol Chapter 6
Feb. 6	FIELD TRIP 9:00am-4:00pm	
Feb. 10	LAB 2: Data Analysis Review	
Feb. 11	**MIDTERM**	
Feb. 15-19	**READING WEEK – NO CLASSES**	
Feb. 24	LECTURE 8: Landscape Change and Erosion	Smol Chapter 12 **LAB ASSIGNMENT 2 DUE**
Feb. 25	LAB 3: Loss-On-Ignition and Chla	
March 2	Lecture 9: Eutrophication	Smol Chapter 11
March 3	**PALEOINDICTAOR PRESENTATIONS DUE**	
March 9	Lecture 10: Atmospheric Pollution and Acidification	Smol Chapter 7 and 8
March 10	LAB 4: Microscopes and Diatoms	**LAB ASSIGNMENT 3&4 DUE**
March 16	LECTURE 11: Diversity and Species Invasions	Smol Chapter 13
March 17	LAB 5: Chironomids and Pollen	**LAB ASSIGNMENT 5 DUE**
March 23	LAB 6: Lab Reports and Data Analysis	WORKING LAB
March 24	LECTURE 12: Climate Change	Smol Chapter 14
March 30	LECTURE 13: The Future	Smol Chapter 16 &17
March 31	LECTURE 14: Review	**Final Reports Due**