

# **GEOG 474: Glaciers and Glacial Geomorphology**

Instructor: Dr. Christine Dow

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Office hours: Tuesday 1-3 pm

## **Course description**

The glaciers and ice sheets of the world are changing as a result of human-induced climate warming. Many physical factors contribute to the flow of ice and mass change of glaciers and ice sheets. We begin by introducing these processes and their interactions through topics including glacial hydrology, controls on glacial sliding and different types of glacial systems such as ice sheets and valley glaciers. In addition to important links between glaciers and climate, ice has a dramatic impact on landscapes of the world. In the second half of the course, we will look at glacial geomorphology and how ice has carved and shaped our environment.

## **Course format**

Course location and time: EV1 132, Monday and Wednesday, 2:30-3:50.

Class discussion every second week.

## **Course objectives**

By the end of the course, students will be able to:

1. Explain core concepts of glacial dynamics.
2. Critically analyze the current state of glacial science as it relates to a warming climate.
3. Link landscape features with the glacial processes that caused them.
4. Demonstrate critical thinking through oral presentation and preparation of a research project.

## **Pre-requisites**

Through permission of the instructor and students must be at least level 3A honors.

## **Evaluation**

Midterm 1	20%
Midterm 2	20%
Class participation	5%
Research proposal	5%
Oral presentation	15%
Research paper	35%

## **Class discussion**

There will be a class discussion lasting 30 minutes every second week (with the first one occurring on week two of the term). The discussion will take place in the second lecture slot of the week. Readings and a discussion question will be assigned around the topic of that week on LEARN. A participation grade totaling 5% for the term will be assigned for engagement with the class discussion. Students will be graded for each discussion and if the student is not present they will receive a 0% grade for that discussion.

## **Mid-terms**

Two mid-terms are set for this course. The first covers the first half of the course focusing on glaciology and the second mid-term will cover the second half of the course on glacial geomorphology. The mid-terms will be completed during class time (dates are included within the lecture list).

## **Research projects**

The research project consists of a research proposal (5% of grade), an oral presentation (15% of grade) and a single-authored term paper (35% of grade). Students will choose a topic within glaciology and/or glacial geomorphology for their individual project. The research proposal is a one-page document outlining the research question and the key areas that will be researched. The research project will involve an extensive and critical examination of the relevant literature. The term paper will be no more than 3000 words, not including title, abstract, figure and table captions and references. Term papers should be double spaced and must be referenced correctly with no plagiarism.

The deadline for the research proposal is listed within the lecture schedule below. Research proposals will be submitted directly to the instructor in class. Oral presentations of the research projects will occur in the final week of classes. The research project term paper is due on the last day of class and is to be submitted directly to the instructor. The research project assignments are expected to be completed on time. ***Late assignments will lose 5% in grade per day and will not be taken after 5 days past the deadline, unless a valid doctors note is produced.***

## **Textbook**

Required textbook: Benn, D. and Evans, D. 2010. *Glaciers and Glaciation 2<sup>nd</sup> Edition*. Copies of this textbook are available at the UW Bookstore.

### Other useful textbooks:

Cuffey K., and Patterson, W. 2010. *Physics of Glaciers, 4<sup>th</sup> Edition*. Elsevier.

van der Veen, C. J. 2013 *Fundamentals of Glacier Dynamics, 2<sup>nd</sup> Edition*. Pearson Canada

Bennett M. R and Glasser, 2009 N. *Glacial Geology: Ice Sheets and Landforms, 2nd Edition*. Wiley.

## Lecture schedule

The instructor reserves the right to change the class schedule and lecture order as appropriate.

<b>Week</b>	<b>Date</b>	<b>Topic</b>	<b>Assessment</b>	<b>Reading</b>
1	Jan 4 <sup>th</sup>	<b>Introduction to glaciology</b>		Ch. 1
2	Jan 9 <sup>th</sup> Jan 11 <sup>th</sup>	<b>How to make a glacier</b> <b>Ice mass balance</b>		Ch. 2
3	Jan 16 <sup>th</sup> Jan 18 <sup>th</sup>	<b>Glaciers and climate</b> <b>Glacier hydrology I</b>		Ch. 3
4	Jan 23 <sup>rd</sup> Jan 25 <sup>th</sup>	<b>Glacier hydrology II</b> <b>Ice flow processes I</b>		Ch. 4
5	Jan 30 <sup>th</sup> Feb 1 <sup>st</sup>	<b>Ice flow processes II</b> <b>Glacier dynamics I</b>	<b>Research proposal due</b>	Ch. 5
6	Feb 6 <sup>th</sup> Feb 8 <sup>th</sup>	<b>Glacier dynamics II</b>	<b>Midterm 1</b>	Ch. 6
7	Feb 13 <sup>th</sup> Feb 15 <sup>th</sup> Feb 20 <sup>th</sup>	<b>Greenland</b> <b>Antarctic</b> <b>READING WEEK</b>		Ch. 7
8	Feb 27 <sup>th</sup> March 1 <sup>st</sup>	<b>Sea level and climate</b> <b>Glacial erosion</b>		Ch. 8
9	March 6 <sup>th</sup> March 8 <sup>th</sup>	<b>Large-scale landforms</b> <b>Debris transport</b>		Ch. 9
10	March 13 <sup>th</sup> March 15 <sup>th</sup>	<b>Sediment deposition I</b>	<b>Midterm 2</b>	Ch. 10 (pp. 371-386; 436-440) Ch. 11 (pp. 442-492; 510-535)
11	March 20 <sup>th</sup> March 22 <sup>nd</sup>	<b>Sediment deposition II</b> <b>Paleo-glaciology I</b>		Ch. 12 (pp. 644-671; 707-712)
12	March 27 <sup>th</sup> March 29 <sup>th</sup>	<b>Paleo-glaciology II</b>	<b>Student presentations</b>	
13	April 3 <sup>rd</sup>		<b>Student presentations</b> <b>Term paper due</b>	

## University of Waterloo LEARN Course Environment

This course uses the LEARN course environment for course material dissemination and information exchange. LEARN is a web-based course management system that enables instructors to manage course materials (posting of lecture notes etc.), interact with their students, and provide feedback. YOU NEED TO ENSURE THAT YOU CAN ACCESS LEARN. Note that lecture slides are posted on LEARN prior to each lecture. Assignment materials are also distributed through LEARN.

### *Logging Into LEARN*

Since LEARN is a web-based system, you will need a browser.

Once you have started up your browser, you can access LEARN via: <http://learn.uwaterloo.ca>

### *Checking Your Userid and Password*

Your password can be checked and reset (if needed) by going to:

<https://watiam.uwaterloo.ca/idm/user/login.jsp>

If you still cannot get on LEARN after checking and resetting your password, please confirm with your instructor that you are on the class roster.

### *Getting Help*

Documentation for LEARN is available at:

[http://av.uwaterloo.ca/uwace/training\\_documentation/index.html](http://av.uwaterloo.ca/uwace/training_documentation/index.html)

### **Academic Integrity**

In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. The University's guiding principles on academic integrity can be found here:

<http://uwaterloo.ca/academicintegrity/>

ENV students are strongly encouraged to review the material provided by the university's Academic Integrity office specifically for students: <http://uwaterloo.ca/academicintegrity/Students/index.html>

Students are also expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for their actions. Students who are unsure whether an action constitutes an offense, or who need help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. Students may also complete the following tutorial: <https://uwaterloo.ca/library/get-assignment-and-research-help/academic-integrity/academic-integrity-tutorial>

When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline,

<https://uwaterloo.ca/secretariat-general-counsel/policies-procedures-guidelines/policy-71>

Students who believe that they have been wrongfully or unjustly penalized have the right to grieve; refer to Policy #70, Student Grievance: <https://uwaterloo.ca/secretariat-general-counsel/policies-procedures-guidelines/policy-70>

**Note for students with disabilities:** AccessAbility Services, located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.

**Mental Health:** The University of Waterloo, the Faculty of Environment and our Departments consider students' well-being to be extremely important. We recognize that throughout the term

students may face health challenges - physical and / or emotional. **Please note that help is available.** Mental health is a serious issue for everyone and can affect your ability to do your best work. Counselling Services <http://www.uwaterloo.ca/counselling-services> is an inclusive, non-judgmental, and confidential space for anyone to seek support. They offer confidential counselling for a variety of areas including anxiety, stress management, depression, grief, substance use, sexuality, relationship issues, and much more.

**Religious Observances:** Student needs to inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. See Policy 70 - Student Petitions and Grievances, Section 4, [www.adm.uwaterloo.ca/infosec/Policies/policy70.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm). When in doubt please contact your Undergraduate Advisor for details.

**Appeals:** decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 – (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm)

**Unclaimed assignments:** Unclaimed assignments will be retained until one month after term grades become official in Quest. After that time, they will be destroyed in compliance with UW's confidential shredding procedures <http://www.adm.uwaterloo.ca/infostor/Confidential%20Shredding%20procedures%202008.htm>

**Communications with Instructor and Teaching Assistants:** All communication with students must be through either the student's University of Waterloo email account or via Learn. If a student emails the instructor or TA from a personal account they will be requested to resend the email using their personal University of Waterloo email account.

**Recording lectures:**

- Use of recording devices during lectures is only allowed with explicit permission of the instructor of the course.
- If allowed, video recordings may only include images of the instructor and not fellow classmates.
- Posting of videos or links to the video to any website, including but not limited to social media sites such as: Facebook, Twitter, etc., is strictly prohibited.

**Co-op interviews and class attendance:** Co-op students are encouraged to try and choose interview time slots that result in the least amount of disruption to class schedules. When this is challenging, or not possible, a student may miss a portion of a class meeting for an interview. Instructors are asked for leniency in these situations; but, a co-op interview does not relieve the student of any requirements associated with that class meeting.

When a co-op interview conflicts with an in-class evaluation mechanism (e.g., test, quiz, presentation, critique), class attendance takes precedence and the onus is on the student to reschedule the interview. CECA provides an interview conflict procedure to manage these situations. Students will be required to provide copies of their interview schedules (they may be printed from JobMine) should there be a need to verify class absence due to co-op interviews.