Geology 9576B Course Outline

1. Course Information

Course Information
Geology 9576B. Glaciers, Ice and Climate – Winter 2026
Types of glaciers. Glacial dynamics and budgets. Glacial ice movement. Erosional and depositional glacial landforms. Glacial sediments, facies, and environments. Sea-ice, ice shelves, and fjords. Lakes and bogs. Paleosols, wind-blown sediments, and loess deposits. Periglacial and permafrost processes and landforms, with a focus on the Canadian Arctic. Quaternary timescale and glaciations. Quaternary climate change: short-term and long-term factors. Interpretation of Quaternary environments: Biological evidence. Dating methods. Deep-sea sedimentary record and oxygen isotopes. Ice-core stratigraphy. Climate in the Holocene. Climate-human interactions. Ancient glaciations. Development of geophysical models using glacial tills and their real-world application. Glacial deposits and resources.

Lectures: Tuesday, Thursday, 9:30-10:30
Laboratories: Thursday, 10:30-1:30

List of Prerequisites
Prerequisite(s): 0.5 course from Environmental Science 1021F/G, Earth Sciences 1022A/B, Earth Sciences 2200A/B, Geography 3350A/B, and registration in Year 3 or above, any module, or permission of the Department.

Unless you have either the prerequisites for this course or written special permission from the Department of Earth Sciences to enroll in it, you may be removed and withdrawn from this course in accordance with university policy. This may be done after the add/drop deadline of the academic term, and the course will be marked as withdrawn (WDN) on your academic record. This decision may not be appealed.

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Alina Shchepetkina	ashchep@uwo.ca		N/A	Open door
TA: Sarah Kup	skup@uwo.ca		N/A	TBD

Students must use their Western (@uwo.ca) email addresses when contacting their instructors and TAs.

3. Course Syllabus, Schedule, Delivery Mode

Both lectures and laboratories will be conducted in person. The weeks of Jan 19, 2026 and Jan 26, 2026, two lectures will be conducted by Dr. Bruce Hart, and two lectures will be presented by the TA/ via Zoom by the course instructor. There will be a guest lecture by Dr. Gordon Osinski on periglacial and permafrost processes and landforms, with a focus on the Canadian Arctic, and by Dr. Sheri Molnar on how a seismic geologist interprets Quaternary Geology for predicting earthquake-related hazards (shaking amplification, landslides, liquefaction), and building 3D earth structure models.

Lectures: Tuesday, Thursday, 9:30-10:30
Laboratories: Thursday, 10:30-1:30

Much of the surface of Canada is covered by Quaternary sediments deposited by glaciers. In this course, we will take a holistic look at glaciers. **First**, we will look at how glaciers form, where they are found, and how they grow, shrink, and move. **Secondly**, we will talk about glacial erosional and depositional forms, how we can reconstruct glacial movements, which environments exist within a glacial system, and which type of deposits are being left by them (i.e., geomorphological and sedimentological evidence). **Thirdly**, we will examine the Quaternary period when the majority of glaciations happened: its timescale, fossil animal and plant evidence used to reconstruct the Quaternary environments and ecology, dating methods, and associated climate changes. **Finally**, we will broaden the picture by discussing ancient glaciations, human-climate interactions, use of geophysical models using glacial till, and practical use of glacial deposits for aquifers, sewage reservoirs, sources of construction materials, and mineral exploration in glaciated terranes. During the labs, practical exercises will be undertaken to characterize and interpret glacial materials.

Laboratory sessions: Labs will be marked and are due to TA by the beginning of the next lab period (you have one week total to work on the lab). If there is no lab that week, the lab is due at the nearest lecture to the instructor. Late labs will be subject to 10% penalty per day. The lab solutions will be discussed if necessary, and the class members will be asked to contribute to the solution to each problem. All laboratories are required, but if a student has a valid reason for missing a lab, one lab can be missed, and the lab mark will be pro-rated based on the completed labs. Lab material will be uploaded to the OWL website before the lab. Some laboratory sessions will be devoted to the preparation of a paper on a chosen topic. The paper is to be written following the format of the journal "Quaternary Science Reviews". Each paper will be reviewed first by an appointed classmate, and then, by the course instructor. Each student will deliver their findings to the class in a 7-minute presentation, held in lab time. If a student misses the presentation, the whole presentation mark will be subtracted (7%), unless a medical certificate is provided. In that case, the presentation will be scheduled for a later date in front of the instructor and TA.

Learning Outcomes:
Upon successful completion of this course, students should be able to:
1. Identify the main types of glaciers, and how they form, grow, shrink, and move.
2. Relate the main glacial environments and processes to resultant glacial deposits.
3. Have a working knowledge of the Quaternary timescale, glacial-interglacial cycles, and causes of short-term and long-term climate change.
4. Describe the fossil animal and plant evidence currently used to reconstruct Quaternary environments and ecology.
5. Have a basic understanding of past glaciation events and their distribution.

6. Describe the human impact on climate change and glacial landforms.
7. Explain the use of glacial deposits in mineral exploration, water, and aggregate resources.

The main lecture topics are outlined below. Please note that some topics may require more than one session and may extend into subsequent weeks; therefore, the lecture schedule is tentative (!).

Week	**Main Topics in Lectures** **TUESDAY & THURSDAY**	**Lab Sessions** **THURSDAY**
1	Tu. 06/01. Course introduction. Syllabus. Cryosphere. Snow and ice. Location of glaciers.	
	Th. 08/01. Classifications of glaciers (geomorphology and thermal regime). Glacial growth, shrinkage, budget. Glacial movement.	Th. 08/01. Identification of glacier types, environments, and glacial budgets. Use of ArcMap and Google Earth.
2	Tu. 13/01. Glacial erosion and erosional landforms. Indicators of glacial movement	
	Th. 15/01.Glacial depositional forms. Geomorphology.	Th. 15/01. Glaciology and Ice Movement.
3	Tu. 20/01. Glacial sediments. Terminology. Glacial facies. Till classification and fabric. Sedimentary structures. (Lecture by Dr. Bruce Hart)	
	Th. 22/01. Glacial sedimentology. Field and laboratory methods. (Lecture by Dr. Bruce Hart)	Th. 22/01. Glacial Geomorphology. 5 pm: You will have to choose and submit on OWL the topic for the term paper and presentation. Late submission 5% per day (from assignment mark).
4	Tu. 27/01. Periglacial environments: Glacio-marine. Sea ice and ice shelves. Fjords. Icebergs. IRD. (Lecture by TA/Zoom)	
	Th. 29/02. Periglacial environments: Lakes and bogs. Pluvial lakes. Lake-level change and paleoclimate. (Lecture by TA/Zoom)	Th. 29/01. Lithology and glacial history of the London area.
5	Tu. 03/02 Periglacial environments: Periglacial and permafrost processes and landforms, with a focus on the Canadian Arctic (Lecture by Dr. Gordon Osinski)	
	Th. 05/02. Periglacial environments: Wind-blown sediments and loess.	Th. 05/02. Lithofacies
6	Tu. 10/02. Quaternary timescale. Glacial-interglacial stages and stadials. New developments in Quaternary science.	
	Th. 12/02. Quaternary climate change: long-term and short-term factors. Milankovitch cycles.	Th. 12/02. **Mid-term test**
7	Tu. 17/02. **Spring break**	
	Th. 19/02. **Spring break**	Th. 19/02**. Spring break**

8	Tu. 24/02. Interpretation of Quaternary environments and ecology: pollen, spore, and diatoms.	
	Th. 26/02. Interpretation of Quaternary environments and ecology: marine mollusca, foraminifera, radiolaria, coccolithophores, and dinoflagellates. Biomarkers.	Th. 26/02. Library time: term paper preparation.
9	Tu. 03/03. Dating methods: radiocarbon, fission track, luminescence	
	Th. 05/03. Dating methods: Cosmogenic radionuclides, dendrochronology, varve chronology, lichen, ice core chronology	Th. 05/03. Library time: term paper preparation. 5 pm: Email the first draft of the paper to the reviewer (CC the instructor). Late submission 10% per day (from assignment mark).
10	Tu. 10/03. Deep-sea and oxygen isotope record. Global correlations.	Tu. 10/03. 5 pm: Reviewers email the edited paper and referee form to the author for edits (CC the instructor).
	Th. 12/03. Ice-core stratigraphy and dating.	Th. 12/03. Revision of the term paper. Preparation of presentation. 5 pm: submit reviewed term paper on OWL. Late submission 10% per day (from assignment mark).
11	Tu. 17/03. Climate in the Holocene. Climate-human interactions.	
	Th. 19/03. Ancient glaciations. Snowball Earth.	Th. 19/03. Glacial conference: Prepare 7-min presentations on your essay topic, 3 min for questions. Submit presentation on OWL by 18/03 (7 PM). Late submission 10% per day (from assignment mark). Missed presentation penalty 7% (from course mark).
12	Tu. 24/03. Catch-up	
	Th. 26/03. Development of geophysical models using glacial tills (Lecture by Dr. Sheri Molnar)	Th. 26/03. Practical uses of glacial deposits
13	Tu. 31/03. Glacial deposits and resource distribution	
	Th. 02/04. Glacial deposits and resource distribution. Glacial geology of London area	Th. 02/04. Landfill disposal site
14	Tu. 07/04. Catch-up	
	Th. 09/04. Catch-up, Review, or free time, as necessary.	Th. 09/04. Q&A final exam prep.
15		**Final exam: date and place TBD**

Classes begin: January 5, 2026
Spring Reading Week: February 14 – 22, 2026
Classes end: April 9, 2026
Exam period: April 12 – 30, 2026

4. Course Materials

Main textbook: Lowe, J. and Walker, M., 2015. *Reconstructing Quaternary Environments*. This is an excellent introductory textbook written in simple and clear language. It provides an overview of field and lab techniques for palaeoenvironmental investigation and examines the various forms of evidence used to establish the history and scale of environmental changes during the Quaternary.

Other textbooks: *Past Glacial Environments*, 2nd Edition, edited by John Menzies and Jaap J.M. van der Meer. This book is available for download from the library: https://www-sciencedirect-com.proxy1.lib.uwo.ca/book/9780081005248/past- glacial-environments. This textbook provides many specific case studies and is written by various authors. It is not an easy read and can be rather overwhelming. May serve as supplementary reading. Other supplementary reading materials include: Tarbuck, E.J., Lutgens, F. K., Tsujita, C.J., Hicock, S. R., 2014. *Earth: An Introduction to Physical Geology*. Chapter 12.

Costs of Textbooks and Other Learning Materials/Activities
This course's main textbook (3d edition) can be purchased as a paperback ($100), e-book ($100), or hardback ($208) from here: https://www.routledge.com/Reconstructing-Quaternary-Environments/Lowe-Walker/p/book/9780131274686 (free shipping 7-14 business days)
New and pre-owned versions of this textbook are also available on e-Bay as cheap as USD 30+shipping. Also, a few copies should be available from Western Bookstore.

Technical Requirements: install Google Earth and ArcMap on your laptops for some of the labs, as well as Mentimeter for fun in-class quizzes.

All course material will be posted to OWL: https://westernu.brightspace.com/

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Technical Requirements
Make sure you have access to a laptop for some of the labs. Stable internet connection and Zoom might be needed for two of the lectures.

5. Methods of Evaluation

Grading Scheme and Assessment Dates
The overall course grade will be calculated as listed below:
Assignments (7) 21%

Quizzes (3)	3%
Term paper (1)	22%
Term paper review (1)	2%
Midterm Test	15%
Presentation, Q&A	7%
Final Exam	30%

Pop quizzes – on random dates throughout the course, at the beginning of the class (not possible to re-schedule for later if missed).
Mid-term test, written on lab time (Th, 12/02)
Glacial conference, on lab time (Th, 19/03)
Final Exam: written (3h). Date and classroom: TBA.

5a. Journal-style term paper

This is to be written as a journal-style paper. Follow the format of the journal "Quaternary Science Reviews" (marks will be deducted if this format, including references, is not adhered to).
The guide for authors can be found here: https://www.elsevier.com/journals/quaternary-science-reviews/0277-3791/guide-for-authors.
Chosen term paper topics and 8-10 mandatory references (post 2010) will have to be emailed to instructor by 5 pm on Th. 22/01 (late submissions will be penalized, 5% per day). Students are encouraged to procure and cite additional references on the assigned topic. The submitted references can be substituted for more applicable ones, if necessary, at the time of paper submission.

The paper should consist of a Title, Author Information, Abstract, Keywords, and Introduction, followed by the main body of the text (including figures), Conclusions, and References. The length of the text and figures should not exceed 8 pages (References not included), using a 12 pt. font (Times Roman, Helvetica or Courier), 1.5 spacing, and "normal" margins. There should be 2-3 figures (with figure captions included below the figure) illustrating the data. The figures should be properly explained and cited in the text (e.g., Fig. 1 or Figs. 1-3). All material must be properly referenced (cited) in the text and the list of references should be included in the journal format.

The marks will be allocated based on the depth of topic understanding, simplicity of the language, logic of arguments, grammar, punctuation, etc. The marking rubric for the essay is Title and Author Information (5%), Abstract (10%), Keywords (2%), Introduction (10%), Main Body (40%), Conclusions (10%), References (10%), Overall Writing Style, Flow, and Logic (13%).

Format: All papers should have a title page with the title, author's name, instructor's name, student and course numbers. Papers must follow "Quaternary Science Reviews" format, including references. See https://www.elsevier.com/journals/quaternary-science-reviews/0277-3791/guide-for-authors (particularly pages 7–12 of the pdf).
Abstract: Summarizes the main facts and interpretations presented in the essay. It should be comprehensible without reference to the main document. No References should be cited in the Abstract. Less than 200 words.
Introduction: Set the background to the study, identify what the main problem is, why this problem is important, and then outline how you will address this problem in the essay.
Main Body: Think about the order of presentation of data and ideas. If methods need describing (for an essay this normally is not the case), this should come first. Present all the data first, these are the observations and facts. Then interpret and integrate the data. The interpretation should be consistent with the problem that is identified in the Introduction.

Conclusions: This should summarize the interpretations from the main body of the paper. A minimal amount of data should be repeated here, no citations allowed. Conclusions are different from the abstract, the latter summarizes the entire paper, including data, whereas the former only summarizes the interpretations.

The first draft of the paper will be assigned to one of your classmates who will review the paper to check for logic, clarity of expression, and attention to detail. The instructor will randomly appoint a referee for you. You will then revise the paper according to your referee's suggestions (in Word, Tracking tool ON). The *FINAL* copy of the paper with Tracking ON plus the Referee form will be submitted for marking. The referee will receive credit for doing a careful and helpful review.
* For Tracking in Word: Tab "Review" – "Track changes" – "ON". Please put your name as a user: Word – Preferences – User Information – Name: XXX ("Author" is by default).
TIMELINE: The first draft of the paper is emailed to the reviewer (CC the instructor) by 5 pm Th. 05/03. The reviewer is to revise and edit the first draft (in Word, use comments and tracking tool!). The reviewer will additionally fill in the Referee form. The revised draft and Referee form are emailed to the author (CC the instructor) by 5 pm Tu 10/03.
The final version of the essay +Referee form are due at 5 pm Th. 12/03 submitted via OWL. 10% per day from assignment mark will be deducted if the paper is handed in late.

TOPICS include but are not limited to: 1) Antarctica and climate change, 2) Ice streams and their identification criteria; 3) Quaternary geology of southern Ontario; 4) Construction and permafrost; 5) Permafrost on other planetary bodies; 6) Impact crater glaciation (comparison of Mars and Earth features); 7) Till and prospecting for gold; 8) Waste disposal sites in Quaternary deposits; 9) Glaciers on Mars; 10) Meteorites and ice sheets; 11) Quaternary history of the largest glacial Lake Agassiz; 12) Drumlins in Canada; 13) Loess deposits; 14) Eskers in Canada.

Use of Generative AI Tools
There is currently no university-wide policy governing the use of generative artificial intelligence (AI) tools in coursework or assessments. For this course, the limited use of generative AI tools (e.g., ChatGPT, Copilot, Gemini) is **selectively permitted** for the term paper **solely to improve clarity, grammar, and readability of a few sentences written by the student**, particularly to help refine academic or journal-style language.
All ideas, interpretations, analyses, structure, and content of the paper must be entirely the student's own work. Generative AI tools may **not** be used to generate original content, develop arguments, interpret data, summarize literature, or write sections of the paper.
Students remain fully responsible for the accuracy, originality, and integrity of their submitted work. Any misuse of generative AI beyond these defined boundaries will be treated as an academic integrity violation.

General information about missed coursework
Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs,* posted on the Academic Calendar: https://uwo.ca/univsec//pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:
https://registrar.uwo.ca/academics/academic_considerations/
All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this and, therefore, always require formal supporting documentation:

- Final examinations scheduled during official examination periods (Defined by policy)
- Mid-term test (Defined by policy)
- Presentation and Q&A

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

Evaluation Scheme for Missed Assessments
When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under Special Examinations), especially for those who miss multiple final exams within one examination period.

6. Additional Statements

6.1 Religious Accommodation

When a recognized religious holiday or observance conflicts with an examination, test, or other scheduled academic obligation, students must request accommodation via the University's Student Absence Portal (SAP). This request should identify the conflict and specify which course component(s) (e.g. test, midterm, exam) are affected.

Students are encouraged to submit the SAP request as early as possible, but no later than two weeks before any examination, or one week before any mid-term test or quiz, to allow sufficient time for adjustment.

The SAP request serves as official notification to both the course instructor and the Academic Advising Office, in accordance with University policy:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

The Faculty of Science considers religious accommodations as scheduling conflicts. Instructors should provide either a make-up exam or an earlier sitting of the same exam to accommodate the student.

For more information on recognized religious holidays, please visit the Diversity Calendar posted on the Equity, Diversity & Inclusion website - https://www.edi.uwo.ca

6.2 Academic Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.

6.3 General Academic Policies

The website for Registrar Services is https://www.registrar.uwo.ca/.

Use of @uwo.ca email: In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formally known as "appeals")

Policy on Request for Relief from Academic Decision:
https://uwo.ca/univsec//pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf
Procedures on Request for Relief from Academic Decision (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_requests_for_relief_procedure.pdf

6.4 Scholastic Offences

Policy on Scholastic Offences:
https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Graduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/graduate_scholastic_offence_procedure.pdf

Use of Electronic Devices During Assessments

In courses offered by the Faculty of Science, the possession of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, and wireless earbuds or headphones.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at your desk, on your person, or within reach during an assessment will be treated as a *scholastic offence*, even if the device is not in use.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

6.5 Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, exam conflicts, and many other academic-related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts, at:

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. If you have any questions regarding accommodations, you may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

Learning-skills counsellors at Learning Development and Success (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/.