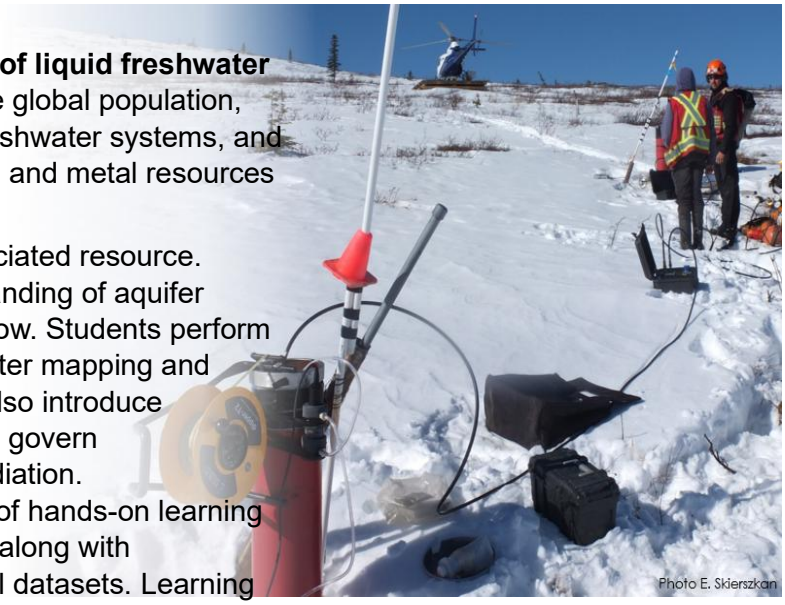
ERTH 3205 Hydrogeology
Course Outline | Fall 2026

Overview:

Welcome to hydrogeology!



Groundwater is the largest reservoir of liquid freshwater on Earth! It supplies water to half of the global population, sustains critical biological habitats in freshwater systems, and transports contaminants, hydrocarbons, and metal resources in the subsurface.

ERTH 3205 introduces this underappreciated resource. Emphasis includes conceptual understanding of aquifer materials and physics of groundwater flow. Students perform quantitative analyses used in groundwater mapping and groundwater resource evaluation. We also introduce processes of contaminant transport that govern contaminated site evaluation and remediation. Laboratory exercises include a mixture of hands-on learning experiences in groundwater monitoring along with quantitative analyses of hydrogeological datasets. Learning outcomes are developed to equip students with fundamental skills and knowledge needed in basic hydrogeological practice.

Instructor

Elliott Skierszkan, PhD
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Teaching Assistants

Taylor Belansky (PhD student): taylorbelansky@cmail.carleton.ca
Jacob Szaranksi (MSc student): JACOBSZARANSKI@cmail.carleton.ca

Class Schedule

In-person lectures and laboratories:

Lectures	Wednesdays 11:35 AM – 13:25 AM HP 3120
Labs	Wednesdays 14:35 PM – 17:25 PM HP 2130 (group A1) & HP2120 (group A2)

Lab participation is mandatory. Labs are not held every week, you will be notified ahead of time when they are scheduled. Assignments will last 1 to 2 weeks and will be due at the start of the following lab timeslot.

Lab assignments involve solving practical problems pertaining to groundwater flow, hands-on groundwater monitoring activities in the field and the laboratory, and groundwater-resource evaluation. They will regularly require spreadsheet-based calculations.

Office Hours

Elliott Skierszan: Wednesday after class, or by appointment.

TAs: TBD

Grading Schema

Lab assignments	30 %
Quiz	10 %
Mid-term exam	25 %
Final exam	35 %

Exam Format

Exams will be run as Two-Stage exams that include an individual and a group component*. The group component will include a repetition of some of the questions included in the individual component. If a student's individual grade on the group component is lower than on the individual component, the marks obtained from the individual component will be used****. In other words, students will have the opportunity to improve their learning and improve the score of their individual component with the group component, with no possibility of losing marks by participating in the group component.***

I provide a detailed exam cheat-sheet that includes all the formulae used in quantitative hydrogeology. Emphasis is given on correct application of formulae and conceptual understanding of hydrogeological fundamentals.

Late Policy

Assignments

Grace Period: all students are allowed 4 days of grace period for submitting late assignments penalty-free, no questions asked, over the course of the term. To use these grace-period days, email your TA's and cc the professor letting them know of your intention to use them.

Beyond this grace period, late submissions will be penalized 10 % daily to a maximum of 50 % without a legitimate excuse. Submissions will not be accepted after graded assignments have been returned.

Missed Exams

If you think you might miss an exam, please contact me as soon as possible to arrange alternative options.

Midterm: A missed midterm exam will be available for deferral if appropriate reason is provided within 3 days of the missed exam. If deemed acceptable, a re-write will be scheduled.

Final: A formally scheduled final exam will take place during the exam period. A deferred final exam is subject to the university's approval, as per the official deferral process. Instructors cannot grant final exam deferrals.

Course website

Brightspace will serve as the hub for all course materials, including posting lectures and assignments and a forum for questions about course materials. Students will be required to use Brightspace to communicate with the instructor and the TA.

Textbook and Reference Material

The course draws heavily on material from the book *Groundwater* by Allan R. Freeze and John G. Cherry. This book is commonly found on bookshelves of practicing hydrogeologists. The entire textbook is freely available only by the authors via The Groundwater Project: gw-project.org/books/groundwater/.

The Groundwater Project also publishes multiple free online textbooks that provide hydrogeology fundamentals and which usefully complement lecture material https://gw-project.org/book-category/.

Applied Hydrogeology by C.W. Fetter Jr. is another excellent resource. There are affordable second-hand versions at online bookstores (e.g., Amazon) that range in price but are typically less than $100.

Pre-Requisites

ERTH 1002 or GEOG 2013, MATH1007.

Learning Outcomes

The course introduces the physical principles of groundwater flow. It builds on students' basic knowledge of bedrock and surficial geology and introduces how a fluid exists and flows within Earth materials. At the end of this course, students will have developed a theoretical and practical understanding of groundwater occurrence and flow. Students will be able to:

1. Explain the occurrence, distribution, and societal importance of groundwater within the hydrological cycle.
2. Apply the principles of porous-media flow, including hydraulic head, Darcy's Law, hydraulic conductivity, and aquifer properties, to quantify groundwater movement in the subsurface.
3. Interpret hydrogeological data and construct conceptual models describing groundwater flow systems, groundwater-surface water interactions, and hydrostratigraphic controls on flow.
4. Analyze the influence of geological heterogeneity, anisotropy, and aquifer geometry on groundwater flow and aquifer behavior.
5. Apply graphical, analytical, and field-based methods to characterize groundwater flow systems and estimate hydrogeological properties.
6. Assess groundwater responses to pumping using aquifer-testing principles.
7. Evaluate vadose-zone processes and their influence on groundwater recharge, storage, and flow.
8. Apply introductory contaminant-transport concepts to evaluate the movement and attenuation of solute plumes in groundwater.
9. Develop a basic understanding of the chemical composition of groundwater and how it can be influenced by pH and redox conditions
10. Develop conceptual site models and design basic groundwater monitoring programs using geological, hydraulic, and geochemical information.

Copyright

Schedule

Timeline is subjected to change depending on course progress.

Week	Date	Theme	Lecture	Lab Assignment	Important Academic deadlines
1	09-Sep	Introduction	Introduction (includes outdoor experiential learning)	Lab 1 – Groundwater in the hydrologic cycle, Groundwater in society	**Sept. 9** Fall term begins. Full fall, early fall, and fall/winter classes begin
2	16-Sep	Aquifer Properties	Aquifer Properties 1: Porosity, hydraulic conductivity, Darcy's Law hydraulic head		**Sept. 15** Last day for registration and course changes in early-fall courses
3	23-Sep		Aquifer Properties 2: Hydraulic conductivity and heterogeneity	Lab 2 – Groundwater model, Darcy's Law, Potentiometric Mapping, Porosity	**Sept. 22** Last day for registration and course changes (including auditing) in full-fall and fall/winter courses.
4	30-Sep	Steady-state groundwater flow	Groundwater flow equations & Graphical solutions	Lab 3 – **Field lab part 1:** Campus hydrogeology, Graphical solutions	**Sept. 30** Last day to withdraw from full-fall and fall/winter courses with a full fee adjustment. **Oct. 1** Last day for academic withdrawal from early-fall courses.
5	07-Oct		**QUIZ:** on the fundamentals. Vadose zone.	Lab 4 - **Field lab part 2:** Slug tests, measuring hydraulic conductivity	**Oct. 9** December examination schedule available online.
6	14-Oct	Transient-state groundwater flow	Tessa Di'Iorio | Subsidence	Lab 4 work period	
7	21-Oct		Aquifer Testing 1: Single well tests, Theis	Vadose zone hydrogeology (buffer)	
8	28-Oct		***READING WEEK – NO CLASSES***		
9	04-Nov		Mid-term	Lab 5. Subsidence and Storage; Vadose zone.	
10	11-Nov	Groundwater contamination	Aquifer Testing 2: Beyond Theis	Lab 5 Work period	
11	18-Nov		Heather Crow | Contaminant Hydrogeology Introduction	Lab 6. Pumping tests.	***Nov 15th - Last day for academic withdrawal***
12	25-Nov		Contaminant Hydrogeology	**Guest Lecture 2: Cole Fischer, Yukon Government – Hydrogeology of the Eagle Gold Mine Disaster** **(To be Confirmed)** Lab 6 work period	Mar 25 – Last day for summative tests and examinations worth more than 15 % of the final grade in full winter term courses.

13	02-Dec	Review	Groundwater geochemistry	Lab 7. Contaminant hydrogeology and groundwater geochemistry.	April 8 – Winter term ends. Last day of classes.
14	09-Dec		Buffer / Review	Lab 7 work period	

Centre for Student Academic Support

The Centre for Student Academic Support (CSAS) designs, develops, and implements educational programs and services that are available to support all Carleton University students to have successful academic experiences. https://carleton.ca/csas/pass/pass-schedule/

Science Student Success Centre

The Science Student Success Centre helps all undergraduate students in the Faculty of Science define and achieve their academic, career, and social goals. Visit https://sssc.carleton.ca/about

Academic Integrity and Usage of Generative Artificial Intelligence (AI)

Use of Artificial Intelligence

60 % of the course grade is achieved through in-class testing during which use of AI is not permitted. These assessments are intended to evaluate your understanding of conceptual and quantitative concepts in hydrogeology that are taught during lectures and laboratories.

If you rely excessively on AI to assist in completing your lab assignments, you are at high risk of failing the course because you will not have learnt the material that will be assessed on exams. If you choose to use AI as part of your study process, I also highly recommend you be very skeptical about its answers and cross-check everything against course notes and textbooks.

Limited use of AI is permitted in the course. You may use AI to obtain feedback on your original work and revise your work based on this feedback. You are not allowed to submit AI-generated work as your own. All laboratory submissions must disclose any use of AI tools. The disclosure should identify the tool used and briefly describe how it contributed to the work. Failure to provide an AI-use declaration will result in a 50% deduction from the assignment grade.

Ensure that your use of AI abides by Carleton's policies outlined on the MacOdrum Library website.

As our understanding of the uses of GenAI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of GenAI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.

Group Work and Plagiarism

I recommend you work in groups of 2-3 together to work through assignment problems. This approach highly benefits your learning (and is funner!). It is acceptable to discuss how to solve problems, and to cross-check answers with each other, but your submitted work must be your own.

It is not acceptable to copy someone else's work and submit it as your own. It is also not acceptable to allow someone else to copy your work and submit it as theirs. Both scenarios violate Carleton's Academic Integrity Policy. This policy outlines the procedure to be followed in the event of suspected academic misconduct (e.g., plagiarism, disruption of classroom activities, improper access to confidential information). In cases where a violation of the academic policy is suspected, it is our responsibility, as instructors, to report violations to the Chair and the Associate Dean, who perform investigations and decide on outcomes.

The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This 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, material on the internet and/or conversations.

Examples of plagiarism include, but are not limited to:

- any submission prepared 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 without appropriate acknowledgement;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and
- failing to acknowledge sources through the use of proper citations when using another's work and/or failing to use quotations marks.

Plagiarism is a serious offence that cannot be resolved directly by the course's instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course or even suspension or expulsion from the University.

Academic Accommodations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the *Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances*, are outlined on the Academic Accommodations website (students.carleton.ca/course-outline).