

## ERTH 3205 Physical Hydrogeology Course Outline | Winter 2024

### Overview:

Groundwater is the largest reservoir of liquid freshwater on Earth, accounting for 97 % of usable freshwater. It serves as an essential source of potable water for half of the global population, sustains critical biological habitats in freshwater systems, and transports contaminants, hydrocarbons, and essential metals underground.

ERTH 3205 introduces this underappreciated resource with an emphasis on understanding how groundwater flows through Earth materials. Students will gain insight into groundwater's role in the hydrological cycle, and will apply graphical and analytical methods to quantify groundwater flow and important aquifer properties. Laboratory exercises involve working through problem sets that provide students with practical skills and reinforces concepts governing fluid flow through porous media.



Photo E. Skierszkan

### Instructor

Elliott Skierszkan, PhD  
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### Teaching Assistant

Colleen Harper, MSc, PhD Candidate  
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### Class Schedule

In-person lectures and laboratories:

Lectures	Fridays 9:35 AM – 11:25 AM HP 3120
Labs	Fridays 2:35 PM – 5:25 PM HP 2130

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.

Assignments will involve solving practical problems pertaining to groundwater flow and groundwater-resource evaluation and will require spreadsheet-based calculations.

### Office Hours

To be determined on first lecture

## Grading Schema

Lab assignments	45%
Mid-term exam	20%
Final exam	30 %
Classroom attendance and participation	5%

## Late Policy

Grace Period: all students are allowed 3 days of grace period for submitting late assignments penalty-free over the course of the term. 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.

## 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

The course draws heavily on material from the book *Groundwater* by Allan R. Freeze and John G. Cherry. This book is always found on a consultant and researcher's bookshelf, so I highly recommend acquiring a copy. There are affordable second-hand versions at online bookstores, and the entire textbook has also been graciously been made freely available by the authors via The Groundwater Project: [gw-project.org/books/groundwater/](http://gw-project.org/books/groundwater/).

## Pre-Requisites

1.0 credit from EARTH 1001, EARTH 1006, EARTH 1007 or equivalent

## 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:

- Explain the role of groundwater within the hydrological cycle.
- Explain groundwater behavior: origins, flow, storage, extraction, and discharge
- Relate subsurface geological material properties to groundwater movement
- Apply graphical and analytical methods to quantify groundwater flow
- Apply analytical methods to determine aquifer properties using well-pumping tests
- Apply analytical methods to calculate travel times for nonreactive and reactive contaminants in a groundwater system
- Differentiate between mechanisms of groundwater and contaminant transport in the subsurface (advection, hydrodynamic dispersion, diffusion)

## Copyright

Lectures and course materials are protected by copyright and owned by the instructor. You may take notes and make copies of course materials for your own educational use. You may not

allow others to reproduce or distribute lecture notes and course materials publicly for commercial purposes without the instructor's express written consent.

## Schedule

*Timeline is subjected to change depending on course progress. The instructor is looking to schedule guest lectures with precise dates yet to be determined.*

Week	Date	Theme	Lecture	Lab Assignment
1	12-Jan	Introduction	Groundwater in the hydrological cycle; Groundwater and society	Lab 1. Carleton campus hydrogeology; Groundwater in the hydrological cycle (due Jan 22 <sup>nd</sup> )
2	19-Jan	Aquifer Properties	Porosity, hydraulic conductivity, Darcy's Law 1.	Lab 2. Aquifer properties (due Feb 2 <sup>nd</sup> )
3	26-Jan		Porosity, hydraulic conductivity, Darcy's Law 2.	Lab 2 work period
4	2-Feb	Steady-state groundwater flow	Graphical and analytical solutions; regional flow systems	Lab 3. Steady-state groundwater flow (due Feb 16 <sup>th</sup> )
5	9-Feb		Unsaturated-zone hydrogeology	Lab 3 work period
6	16-Feb	Transient-state groundwater flow	Storage, subsidence	No lab. Mid-term review session (tentative)
7	23-Feb		Reading Week	
8	1-Mar		Mid-term exam. Guest lecture (to be confirmed)	No lab.
9	8-Mar		Aquifer testing	Pumping tests (due Mar 15 <sup>th</sup> )
10	15-Mar	Groundwater contamination	Groundwater transport: advection, dispersion, diffusion	Lab 4. work period
11	22-Mar		Groundwater geochemistry	Lab 5. Contaminant transport and geochemistry (due Mar 28 <sup>th</sup> )
12	29-Mar		No lecture/lab - Good Friday	
13	5-Apr	Review	Review	Review

## 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

Carleton University's [Academic Integrity Policy](https://carleton.ca/registrar/academic-integrity/) 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): <https://carleton.ca/registrar/academic-integrity/>. All submitted work must be your own. The instructor is required to report all suspected incidents to the Dean.

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 University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University.

You may need special arrangements to meet your academic obligations during the term. There are specific processes to follow for academic accommodations for pregnancy obligations, religious obligations, students with disabilities, survivors of sexual violence, student activities (e.g., varsity sports), short-term incapacitation, and scheduling and examination support.

Full procedures and details can be found here: <https://students.carleton.ca/course-outline/>. You may also contact the departmental administrator.

If you require special arrangements to meet your academic obligations during the term, please begin the process as soon as possible such that your instructor can adapt the course to accommodate your needs.