

UNIVERSITY of TORONTO SCARBOROUGH  
January 2023  
*Department of Physical & Environmental Sciences*

***Environmental Science EESC18***  
**The Great Lakes: An Introduction to Limnology**

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**Lectures:** Thursdays 2 pm – 4 pm  
**Tutorials:** Tuesdays 5 pm – 6 pm  
**In person office hours:** Tuesdays 2-4pm  
Wednesdays 2-4pm

**Office hours can also be made by appointment or can be changed by referendum during the course depending on students' schedules.**

***A Brief Introduction***

Welcome to Limnology or EESC18, if you have any questions about the course start by checking the course syllabus and Quercus discussion boards. If you still do not see an answer to your question please feel free to email me at anytime. You are encouraged to use the discussion boards to ask questions and they will also be used in evaluating your participation in the course. I will make my best effort to reply to emails and discussion boards within 24 hours, however if you do not see a response by then please send me a gentle reminder.

***Course Format and Delivery***

The course consists of a 2-hour lecture each week; designated readings, coupled with a tutorial to help you navigate completion of assignments and understanding the designated readings. Each lecture will be accompanied by a PPT file of the lectures, it will be posted on the web usually the day before the lectures. The online discussion board will be maintained and I will post topics of interest, as well as demonstrations and articles to supplement lecture materials and also assist with understanding of designated readings.

## *Course Themes and Objectives*

North America is endowed with eight of the twelve largest fresh-water lakes in the world. The origin and geological history, cycles of carbon, nitrogen and phosphorus, and structures of ecosystems of the North American Great Lakes will be used as examples of *large* lacustrine systems.

Fundamental concepts in limnology will be related to features found in the Great Lakes. Topics include: lake origins, lake classification, lake temperature structure and heat budgets, seasonal water circulations, productivity, plankton ecology, food-web dynamics, exotic species invasions, eutrophication-related phenomena and water quality/fisheries management. Specific anthropogenic influences will be illustrated using case studies from the local environment, and students will be allowed to pursue their own interests through a series of short seminars. Through this course students will be able to critically apply their understanding to current and emerging issues facing the great lakes today.

## *Assignments and Evaluation*

<b>Course Grade:</b>	<b>4 Assignments</b>	<b>20 %</b>
	<b>Term Test</b>	<b>25 %</b>
	<b>Participation in the course</b>	<b>5 %</b>
	<b>Group Presentation/Individual Report</b>	<b>20 %</b>
	<b>Final Exam</b>	<b>30 %</b>

### **Assignments: 20% of Final Grade**

4 assignments weighted at 5% each with the topics described below in the table. Assignments can be submitted in person or online.

<b>Assignment</b>	<b>Details: Topic of the assignment</b>	<b>Due date, 12pm</b>	<b>Weight</b>
Assignment 1	Physical structure of lakes	Feb. 3rd, 2022	5%
Assignment 2	Nutrient Dynamics and Lake Ecology	Feb. 17th, 2022	5%
Assignment 3	The Nitrogen Cycle, Food-Webs and Planktonic Communities	March 10th, 2022	5%
Assignment 4	Iron and Sulfur Cycles and Eutrophication	March 24th, 2022	5%

**HANDING IN ASSIGNMENTS: You are responsible for making sure that your TA/Instructor receives your work.**

**LOST OR MISPLACED ASSIGNMENT: It is your responsibility to keep a photocopy of your work, and to make more than one copy of your work. I understand online submissions can run into technical issues. Please keep all receipts of online submitted work. Lost or misplaced assignments (on your part) will be subject to late policies.**

### **Term Test: 25% of Final Grade**

There will be one term test covering all content from the course up until the test date. The term test will consist of multiple choice, short answer, essay and calculations. The exact breakdown of each

component as well as test details will be announced closer to the date. Currently it is planned as an in-class test to take place on February 16<sup>th</sup>.

### **Participation: 5% of Final Grade**

Participation in the course will be evaluated through use of discussion boards and engagement in the course. Students will be expected to contribute a minimum of **10 times** to the discussion board throughout the course with a **maximum of 2 posts per week/topic** contributing to the participation grade. Contributions to the discussion include posting and answering questions or commenting on topics demonstrating knowledge gained from the course. Students are also encouraged to attend the last lectures and tutorials to provide feedback on student presentations. **Feedback for group presentations can be used as an equivalent to 50% of the participation grade.**

### **Group Presentation or Individual Report: 20% of Final Grade**

Students have the option of creating a group presentation or submitting a short report on a topic of their choice. A list of possible topics will be made available the first week of lectures and groups or students must provide me their topic at the latest the week of February 7<sup>th</sup>. Groups can have a maximum of 4 students and presentations can be done in person or submitted in a video file and they will be evaluated during the last lecture and tutorial sessions. Individual reports can be submitted in person or online. Presentation and report details such as length and suggested structure will be given during the lecture and tutorials the week of February 7<sup>th</sup>.

### **Final Exam: 30% of Final Grade**

There will be an **in-person** final exam. The final exam is **cumulative** and will consist of multiple choice, short answer, essay and calculations. The exact breakdown of each component as well as test details will be announced closer to the date.

## COURSE OUTLINE

Date	Week	Lecture Topic	Lecturer	Tutorial/ TA
Jan-12	1	• Introduction: Structure of Aquatic Ecosystems	MD	No tutorial
Jan-19	2	• Thermal Structure of the Great Lakes <b>Assignment 1 due Week 4</b>	MD	Jan-17
Jan-26	3	• Productivity of Aquatic Ecosystems • Carbon and Nitrogen cycles	MD	Jan-24
Feb-2	4	• Phosphorus Cycle • <b>Assignment 2 due on Week 6</b>	MD	Jan-31
Feb-9	5	• Food Web / Planktonic Communities/Case studies) • <b>Discussion of the students presentations</b>	MD	Feb-7
Feb-16	6	• <b>Assignment 3 due on Week 8</b> • In-class Term Test	MD	Feb-14
Feb-23		• Reading week		
March-2	7	• Cycling of micronutrients: Iron, Sulfur and Silica	MD	Feb-28
March-9	8	• Eutrophication in Great Lakes • <b>Assignment 4 due on Week 10</b>	MD	March-7
March-16	9	• Water-Land-Interfaces	MD	March-14
March-23	10	• Invasive species	MD	March-21
March-30	11	• Pollutants in Great Lakes	MD	March-28
Apr-6	12	• <b>Students presentations</b>	MD	Apr-4

### **Week 1 ORIENTATION/GREAT LAKES IN A GLOBAL CONTEXT/ STRUCTURE OF GREAT LAKES**

*Course Outline; Lecture Schedule Thermal Layering & Lake Overturning Thermal Classification of Lakes; Vertical Stability. Examples from the North American Great Lakes, Dynamic Forcing of the Lakes, Coastal upwelling; Thermal bar revisited, Great Lakes Circulation, Thermocline Development  
Lake Ecological Concept Ecosystem Interrelationships*

### **Week 2 THERMAL STRUCTURE OF THE GREAT LAKES**

*Understanding the thermal structure of the Great Lakes. Conceptual understanding of mictic classification. Understand formation of the thermocline. Measures of vertical stability*

### **Week 3 PRODUCTIVITY OF GREAT LAKES CARBON AND NITROGEN CYCLES**

*Algal Productivity. The occurrence of inorganic carbon in freshwater systems, utilization of carbon by algae. Sources and transformation of nitrogen in water, nitrogen loading*

**Week 4 PHOSPHORUS CYCLE**

*Phosphorus in freshwater systems, Phosphorus diagenesis, internal loading, sediment*

**Week 5 FOOD WEB, PLANKTONIC COMMUNITIES**

*Composition of the Algae of Phytoplankton, Importance of size*

*Phytoplanktonic Communities, Growth Characteristics and Mortality of Phytoplankton*

*Heterotrophy of organic carbon by algae and cyanobacteria*

*Seasonal succession of Phytoplankton*

**Week 6 – In class Term Test**

**Week 7 CYCLING OF MICRONUTRIENTS: IRON, SULFUR AND SILICA**

**Week 8 EUTROPHICATION PROBLEMS IN THE GREAT LAKES**

*Basic Concepts of Eutrophication Natural and Cultural Processes of Eutrophication*

*Relationships among Nutrients, Water Clarity, and Phytoplankton*

*Eutrophication Problems in: (i) Lake Erie; (ii) Lake Superior; (iii) Lake Michigan, (iv) Lake Huron; (v) Lake Ontario.*

**Week 9 WATER-LAND-INTERFACES**

*The littoral zone: aquatic macrophytes, their metabolism and primary production*

*Productivity of littoral algae Periphyton, littoral zooplankton communities Importance of wetlands and estuaries.*

**Week 10 INVASIVE SPECIES**

*Stressors and Induced Ecological Changes*

**Week 11 POLLUTANTS IN THE GREAT LAKES**

*Toxic Substances, Sources of Contaminants, The Fate of Contaminants, The Sediment Record*

*Physical and Chemical Characteristics of Contaminants and Their Distribution in Nature,*

*Toxicity and Its Prediction, Bioaccumulation and Biomagnification, Mercury and the Mercury Cycle, Toxic Chemicals, Environmental Health*

**Week 12 STUDENTS PRESENTATIONS**

**READINGS**

There is **no required text** for this course, since there is no book that covers all the course material, while several books cover much more material than is required. Thus, specific readings will be given out during each lecture and/or practical sessions; however, a number of texts cover the course material in part and there is one journal devoted specifically to research on large lakes of the world, but with a dominance of papers on North American Great Lakes research:

**Journal of Great Lakes Research**, International Association for Great Lakes Research.

<http://www.iaglr.org/jglr/journal.php>

This journal and the reference sources below will be used for course readings and as starting points for student seminars.

**Books:**

**Kalff, J.**, 2002. *Limnology*, Prentice-Hall, NJ, 592 pp.

**Wetzel, R.G.**, 2001. *Limnology: Lake and River Ecosystems*. Third Edition, Academic Press, NY.

**Lampert, W., Sommer, U.**, 2007, *Limnology*, Oxford ; New York : Oxford University Press Inc., 2007. 2nd ed.

***Late Penalties***

The late policies: 5% penalty per day, and an assignment will not be accepted more than 1 week after due date.

Extensions without penalty will be granted for reasons of accommodation, illness or emergencies when appropriate documentation is submitted to the instructor. Reweighting of assignments/grades is not permitted.

***Recording/electronics usage***

Some lectures may be recorded. If recording:

**Notice of video recording and sharing (download and re-use prohibited)**

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.

For questions about the recording and use of videos in which you appear, please contact your instructor.

***Academic Integrity***

All suspected cases of academic dishonesty will be investigated following procedures outlined in the *Code of Behaviour on Academic Matters*. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to me. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources (for example, the [University of Toronto website on Academic Integrity](#)).

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The [University of Toronto's Code of Behaviour on Academic Matters](#) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

### In papers and assignments:

- Using someone else's ideas or words without appropriate acknowledgement.
- Submitting your own work in more than one course without the permission of the instructor in all relevant courses
- Making up sources or facts
- Obtaining or providing unauthorized assistance on any assignment

### On tests and exams:

- Using or possessing unauthorized aids
- Looking at someone else's answers during an exam or test
- Misrepresenting your identity

### In academic work:

- Falsifying institutional documents or grades
- Falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes

## **Plagiarism**

Students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (<https://uoft.me/pdt-faq>).

## ***Accommodations and Accessibility***

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. The UTSC AccessAbility Services staff (located in S302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or [ability@utsc.utoronto.ca](mailto:ability@utsc.utoronto.ca). The sooner you let us know your needs the quicker we can assist you in achieving your learning goals in this course.

## ***Religious Observances***

Students at UTSC hold a wide range of religious beliefs. In accordance with the University [Policy on Scheduling of Classes and Examinations and Other Accommodations for Religious Observances](#) (June 2005) reasonable accommodation must be arranged for students who observe religious holy days other than those already accommodated by ordinary scheduling and statutory holidays.

Accommodations for term work in a course are the responsibility of the instructor. If the date of a final examination falls on a holy day observed by a student, the student should submit, through [eService](#), a request for accommodation no later than two full weeks before the commencement of examinations. This will normally be granted with an explanation.

A ready reference on issues related to this topic can be found on the [Accommodations for Religious Observances website](#).

### *Services, such as the writing centre*

Please use the support of the writing centre at the UTSC.

### *Mental Health Statement*

#### ***Supporting Mental Health in the U of T Community***

As a student at U of T, you may experience circumstances and challenges that can affect your academic performance and/or reduce your ability to participate fully in daily activities. An important part of the University experience is learning how and when to ask for help. There is no wrong time to reach out, which is why there are resources available for every situation and every level of stress.

Please take the time to inform yourself of available resources, including:

- [Your College Registrar](#)
- [Student Life Safety & Support](#)
- [Student Life Health & Wellness](#)
- [Mental Health Resources](#)
- [Emergency support if you're feeling distressed](#)

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