

**UNIVERSITY of TORONTO SCARBOROUGH**  
**December 2021**  
*Department of Physical & Environmental Sciences*

***Environmental Science EESC18***

**The Great Lakes: An Introduction to Limnology**

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.

Instructors: Maria Dittrich (MD) [m.dittrich@utoronto.ca](mailto:m.dittrich@utoronto.ca)

Office: ESCB452 (Maria Dittrich)

The course consists of a 2-hour lecture each week; and designated readings.

Each lecture will be accompanied by either a PPT file of the lectures, it will be posted on the web usually the day before the lectures

Teaching assistant: Nigarsan Kokilathanan [nigarsan.kokilathanan@mail.utoronto.ca](mailto:nigarsan.kokilathanan@mail.utoronto.ca)

**Lectures: Thursdays 2 pm – 4 pm**

**Tutorials: Tuesdays 5 pm – 6 pm**

**Office hours: Tuesdays 2 pm – 3 pm please contact me per email for an appointment.**

## Assignments and Evaluation

<b>Course Grade:</b>	<b>4 Assignment</b>	<b>40 %</b>
	<b>5 Quizzes</b>	<b>30 %</b>
	<b>Students video-presentations</b>	<b>25%</b>
	<b>Participation in the discussion of the presentations</b>	<b>5%</b>

Assignment	Details: Topic of the assignment	Due date, 12pm, over Quercus	Weight
Assignment 1	Thermal stratification	February 3rd, 2022	10%
Assignment 2	Nutrient Dynamics and Lake Ecology	February 17th, 2022	10%
Assignment 3	The Nitrogen Cycle, Food-Webs and Planktonic Communities	March 10th, 2022	10%
Assignment 4	Iron and Sulfur Cycles and Eutrophication	March 24th, 2022	10%

## COURSE OUTLINE

Date	Week	Lecture Topic	Lecturer	Tutorial/ TA
Jan-13	1	<ul style="list-style-type: none"> <li>Introduction: Structure of Aquatic Ecosystems</li> </ul>	MD	No tutorial
Jan-20	2	<ul style="list-style-type: none"> <li>Thermal Structure of the Great Lakes</li> <li><b>Assignment 1 due Week 4</b></li> <li><b>Quiz 1</b></li> </ul>	MD	Jan-18
Jan-27	3	<ul style="list-style-type: none"> <li>Productivity of Aquatic Ecosystems</li> <li>Carbon and Nitrogen cycles</li> </ul>	MD	Jan-26
Feb-3	4	<ul style="list-style-type: none"> <li>Phosphorus Cycle</li> <li><b>Assignment 2 due on Week 6</b></li> <li><b>Quiz 2</b></li> </ul>	MD	Feb-2
Feb-10	5	<ul style="list-style-type: none"> <li>Case studies</li> <li><b>Discussion of the students presentations</b></li> </ul>	MD	Feb-9
Feb-17	6	<ul style="list-style-type: none"> <li>Food Web / Planktonic Communities/Case studies</li> <li><b>Assignment 3 due on Week 8</b></li> <li><b>Quiz 3</b></li> </ul>	MD	Feb-16
Feb-24		<ul style="list-style-type: none"> <li>Reading week</li> </ul>		
March-3	7	<ul style="list-style-type: none"> <li>Cycling of micronutrients: Iron, Sulfur and Silica</li> </ul>	MD	March-1
March-10	8	<ul style="list-style-type: none"> <li>Eutrophication in Great Lakes</li> <li><b>Assignment 4 due on Week 10</b></li> <li><b>Quiz 4</b></li> </ul>	MD	March-8
March-17	9	<ul style="list-style-type: none"> <li>Water-Land-Interfaces</li> </ul>	MD	March-15
March-24	10	<ul style="list-style-type: none"> <li>Invasive species</li> <li><b>Quiz 5</b></li> </ul>	MD	March-22
March-31	11	<ul style="list-style-type: none"> <li>Pollutants in Great Lakes</li> </ul>	MD	March-29
Apr-7	12	<ul style="list-style-type: none"> <li><b>Examples of the students presentations</b></li> </ul>	MD	Apr-5

**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 Case studies**

**Week 6 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 7 MIDTERM**

**Week 8 CYCLING OF MICRONUTRIENTS: IRON, SULFUR AND SILICA**

**Week 9 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 10 WATER-LAND-INTERFACES/ REPORTS DEADLINE**

*The littoral zone: aquatic macrophytes, their metabolism and primary production  
Productivity of littoral algae Periphyton, littoral zooplankton communities  
Importance of wetlands and estuaries*

**Week 11 INVASIVE SPECIES**

*Stressors and Induced Ecological Changes  
Invasive exotic Species: Definition and Mechanisms of Introduction*

**Week 12 POLLUTANTS IN THE GREAT LAKES /Course Overview**

*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*

***N.B.*** 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.

## 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.

**HANDING IN ASSIGNMENT:** You are responsible for making sure that your TA 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. Excuses are not accepted in the case of lost or misplaced work.

### **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**

If recording:

**OPTION 1: 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.

**OPTION 2: Notice of video recording and sharing (download permissible; re-use prohibited)**

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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>).

### ***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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