

# **BIOL 335**

## **Limnology and Aquatic Ecology**

Fall Term (2022)

### **CALENDAR DESCRIPTION**

**Physics, chemistry and biology of freshwater lakes. Emphasis on: morphometry; light and temperature; water chemistry in relation to nutrients; physiological requirements; composition and interaction of algal and invertebrate populations; eutrophication; pollution; environmental change.**

NOTE Field trip: estimate cost \$45. RECOMMENDATION BIOL 201/3.0 and BIOL 202/3.0 are highly recommended. PREREQUISITE CHEM 112/6.0

Limnology is a diverse subject that covers geological, physical, and chemical aspects of inland waters (lakes, rivers, streams, wetlands, etc.) and their associated ecosystems. In a 3-unit course we cannot attempt to examine all facets of the integrative and transdisciplinary subject of limnology. Although inland waters represent only a small fraction of the water on Earth, they play a pivotal and essential role in our lives. The objectives of this course are to provide you with a basic understanding of the physics, chemistry, and biology of inland waters, with an emphasis on lakes. As humans continue to impact freshwater environments, understanding how aquatic ecosystems are structured and function is important, so that threats to biodiversity can be assessed and important ecosystem services maintained. In this course, another goal is to provide you with knowledge necessary to assess how humans have impacted inland waters, and the expertise to assess and reverse detrimental impacts to aquatic environments.

<b>Instructor</b>	Brian Cumming, PhD., Professor and Head (Biology)
<b>Instructor Contact</b>	<a href="mailto:cummingb@queensu.ca">cummingb@queensu.ca</a> Phone: 613-533-6153
<b>Office Hours</b>	Friday, 9 to 10 am (Rm. 3102 Biosciences Complex)
<b>Teaching Assistants (TAs):</b>	TBA; See OnQ page
<b>TA Contact Information</b>	TBA; See OnQ page

#### **Instructor Information:**

BIOL335, Limnology and Aquatic Ecology, is a course that I am passionate about. My training (BSc., PhD in Biology, Queen's University), a visiting scientist in Norway, and an NSERC Post-doctoral Fellow at the Limnological Research Center at the University of Minnesota have all focused on understanding anthropogenic and natural changes to aquatic ecosystems. I have undertaken research on lakes and rivers on three continents, that focus on understanding natural (e.g., fire, climate) and anthropogenic disturbances on lakes (acidic deposition, agriculture, climate, dams, forest harvesting, mining, and urbanization), and the development and application of techniques to study and isolate the impact of multiple stressors in lakes and rivers. I received the 'Frank Rigler' Award in 2020 for "...established aquatic scientists with a proven record of contribution to the field of aquatic sciences, whose work is widely recognized for its influence and importance.". At Queen's I served as the Director of the School of Environmental Studies (2006 – 2015), the Head of the Department of Biology (2016 – present) and a Co-director of the Paleocological Environmental Assessment and Research Laboratory, a world-class facility, with my colleague John Smol.

In this course, you can expect me to be engaged, passionate and organized, and ready to help you succeed. I appreciate both the theoretical, applied nature, and interdisciplinarity of limnology and aquatic ecology. If

you have any questions or concerns about any aspect of this course, please feel free to contact me. I'm always available before or following the lecture time. I also have office hours for this course (Rm. 3102, Biosciences complex) on Friday from 9 to 10 am, and my e-mail is cummingb@queensu.ca

This course also will involve interactions with the Teaching Assistants (TAs) and your fellow students in the labs and on our full-day excursion to our biology station. To facilitate your learning, please be prepared for your classes, labs and field trip and ask questions. Also, please see the netiquette and discussion guidelines below.

### **Course Schedule:**

**Lectures:** Monday, 12:30-13:30; Wednesday, 11:30-12:30; Thursday, 13:30-14:30. (Nicol Hall, rm. 321)

**Labs:** Total of 4 labs + a one-day compulsory fieldtrip. Please show up to your scheduled lab section in the second week of class – your demonstrators will go over important organizational and safety information. Always come prepared for the labs (i.e., read and understand the PDF that has been posted for the lab). Attendance at the labs is compulsory. The lab sections have for this course are at the following times: Monday, 14:30-17:30; Tuesday, 8:30-11:30; Wednesday, 14:30-17:30. All labs are held in Rm. 3320 of the Biosciences Complex.

**Fieldtrip:** In this course we have a compulsory one-day fieldtrip to the Queen's University Biology Station (QUBS) (Saturday, October 1, or Sunday, October 2). The bus will arrive on Barrie St. at the north end of the Biosciences Complex by 7:20 am. We will leave at 7:30 sharp and will return by approximately 6 pm the same day. The cost of the fieldtrip will be \$45. This cost will cover the cost of transportation to and from the Biology Field Station, user fees, and lunch.

### **Important Dates:**

The fall term starts on Tuesday, September 6<sup>th</sup>, so our first class will be on Wednesday, September 7<sup>th</sup> @ 11:30 in Nicol Hall Rm. 321 (60 Union Street), a 4-minute walk from the Biosciences Complex.

In the second week of class (September 12<sup>th</sup> to 16<sup>th</sup>), please show up to your regularly lab slot (on Monday, Tuesday, or Wednesday) for an introduction to the labs. All labs will be held in room 3320 in the BioSciences Complex. During this lab, you will be divided up into two sections. In your first lab, you will be asked to select a preference for the day trip to the Queen's University Biology Station (QUBS). We will also be collecting a \$45 fee for the bus, lunch, and QUBS user fees, or giving you instructions on how to pay. Please contact me if there is an issue with the cost of the trip. The fieldtrip will occur rain or shine, so if you don't have a raincoat or boots, please feel free to contact the Queen's Outdoor Field Experience Initiative run by biology graduate students (qofei.com).

The add/drop date for fall courses is September 19<sup>th</sup>.

We have planned a day trip to the Queen's University Field Station (QUBS) on lake Opinicon on Oct. 1st or Oct. 2<sup>nd</sup>. During this field day, you will participate in four hands-on modules, that alternate between on lake, and off lake activities. I will post the field manual on the BIOL335 OnQ website as you will need to read this manual prior to coming on the field trip.

The midterm for this course is scheduled for Thursday, October 6.

The lab exam is scheduled for Monday, November 28<sup>th</sup>, in your lab slot (if you are scheduled for a Monday lab), or during the scheduled lecture time. This exam will assess your knowledge of the material covered in the labs and on the field trip and will occur in the limnology lab (rm. 3320 Biosciences).

The final exam will be scheduled by the exams office following the fall-term pre-examination study period (December 6-7).

For other important university dates during the fall term, please visit the Faculty of Arts and Sciences webpage (<https://www.queensu.ca/academic-calendar/arts-science/academic-calendar/>).

**Equity, Diversity, and Inclusion Statement:**

I am committed and continue to promote and develop an inclusive climate that recognizes and respects equal dignity and worth of all persons. This climate is created and maintained by a university-wide commitment to and understanding of educational equity, supported by policies, programs, curricula, practices that promote safe and full participation of all members. Our department has embraced these initiatives and continue to develop and integrate principles of EDII and ways of knowing throughout our department. I am happy to discuss our ongoing initiatives and I welcome constructive feedback.

As many of you are aware, our Chancellor at Queen's is the Honourable Murray Sinclair, an Anishinaabe and member of the Peguis First Nation, a legal scholar, judge, a Commissioner of the Truth and Reconciliation Commission (TRC), a former Senator, and the General Counsel of an Indigenous law firm. At a recent convocation, he spoke elegantly about the TRC, and the steps to promote reconciliation between Canada and the Indigenous peoples. One of the 94 recommendations of the TRC was the importance of land acknowledgements. As part of this syllabus, I am happy to provide a land acknowledgement as part of this syllabus: *Queen's University is situated on the traditional Anishinaabe and Haudenosaunee territory. I am grateful to be able to live, learn, teach, and play on these lands, forming respectful relationships with ancestors of the original occupants of these lands.*

**Course Learning Outcomes:**

Limnology, the study of inland waters, is an inherently interdisciplinary subject. The overall goal of this course is to provide you with a basic understanding of the physical, chemical, and biological processes in lakes, as well as an appreciation of the impact of human activities on these waterbodies, and solutions to pressing problems in aquatic ecology.

More specifically the Learning Outcomes of this course include being able to:

- a) Explain and effectively communicate how basic principles and concepts associated with the physical, chemical, and biological aspects of limnology can be applied to understand lake ecosystems.
- b) Understand, recognize and describe contributions from the disciplines of physics, chemistry, biology, geography, environmental studies and engineering to the understanding of limnological systems;
- c) Use limnological techniques to collect, analyse and interpret chemical and biological data;
- d) Conduct, analyse and interpret the laboratory exercises to gain understanding of limnological concepts, and gain experience in the writing of clear, concise and integrated reports;
- e) Apply limnological concepts and critical thinking to demonstrate an integrated understanding of the roles of physical, chemical, and biological characteristics in the structure and function of aquatic communities (at all trophic levels from microbes to fish), in lakes and ponds from the Arctic to the tropics; and
- f) Describe, understand, logically predict, and clearly communicate the impact of a variety of human activities (e.g., watershed disturbances, mining, industrial activities) on aquatic ecosystems and environmental health, and formulate appropriate remediation techniques.

**Course Materials (Textbooks/Readings):**

There are two textbooks that are appropriate for this course (Option A or B below). It is not necessary to have both. I will post relevant chapters to read from both books along with the associated pages that should be used to supplement the lectures. Online versions are available for < \$70.

Option A: Wetzel, R.G. 2001. *Limnology: Lake and River Ecosystems* (3<sup>rd</sup> edition), Academic Press. This has been the historic text used in this course. It is a comprehensive account of limnology, and a great reference, but written in a traditional format. The summaries at the end of each chapter are excellent.

Option B: Kalff, J. 2022. *Limnology: Inland Water Ecosystems*, Prentice Hall. This is a well written book, in a more causal style in comparison to Wetzel, and is written from an ecosystem perspective.

Several scientific journal articles relevant to the material presented in the course will be linked to the library via the BIOL335 OnQ website.

**Course Approach and Timeline:**

Course material will be presented using three approaches: formal lectures, laboratories, and a compulsory field trip to the Queen's University Biology Station on Lake Opinicon (one day; either Saturday, Oct. 1 or Sunday, Oct. 2). Although there is some overlap in the material that will be presented using these approaches, they and the associated reports and exams serve to reinforce the important concepts related to the learning outcomes of this course.

There is a strong practical component to this course beginning with the field trip where you will receive a crash course in limnological surveys. You will also receive an introduction to physical, chemical, and biological sampling techniques, and activities involving the identification of living plankton and invertebrates. Preserved specimens will be collected for use in our labs, but experience of sampling and identifying live organisms cannot be recreated in the lab, so attending the one-day fieldtrip is important. The material covered on the fieldtrip will also form part of the Lab Exam.

In teaching this course, I adapt the approach used in most standard texts, starting with the importance of physical characteristics of lakes and their interaction with light, heat, and geographic location, followed by the importance of chemistry and limiting nutrients. This simplification allows insights into the complexities of the physics and chemistry that are fundamentally linked to biology and biological change over time. In the final part of the course, I will use several integrative examples to show how lakes are impacted by both natural and anthropogenic activities, and why an understanding of environmental and ecological change is important to manage the biodiversity and ecosystem services that are provided by inland waters. Lecture topics that will be included in this course are listed below.

**Lecture Topics:**

Introduction to Limnology and Aquatic Ecology

Physical Limnology (~5 lectures: Lake morphometry; Light in lakes; Heat in lakes; Origin of lakes; Water movements)

Chemical Limnology (~7 lectures: Oxygen; Salinity; Carbon; Nitrogen; Phosphorus; Sulfur and Silica; Case studies)

Biological Limnology (~5 lectures: Phytoplankton and primary production; Zooplankton; Fish and trophic

interactions)

Integrative Limnology and Applications (~10+ lectures: Paleolimnology; Acidification; Lake remediation; Contaminants; Invasive species; Arctic and Antarctic lakes; Tropical lakes; Climate change; Multiples Stressors....)

**Approximate Learning Hours:**

<i>Teaching method</i>		<i>Average hours per week</i>	<i>Number of weeks</i>	<i>Total hours</i>
In-class hours	Lecture/in class	~3	12	36
	Seminar			
	Laboratory	3	4 labs (see OnQ page) and lab exam	~13 + field trip (below)
	Tutorial			
	Practicum			
	Group learning			
	Individual instruction			
Other	Online activity			
	Off-campus activity	Day trip to Queen's University Biology Station)	Oct. 1 or 2	Leave 7:30 am, return by 6 pm.
	Private study			~60
Total hours on task				~120

**Course Assessment:**

<b>Component</b>	<b>Weight (%)</b>
Assignment 1 (Lab 1): Lake Models and thermal stratification; your assignment is due 10 days following your lab.	10%
Midterm exam (covers lecture material up to the end of the physical and chemical limnology sections of this course)	20%
Assignment 2 (Lab 3): Assessment of long-term change in aquatic systems; your assignment is due 10 days following your lab.	15%
Lab Exam (covers material covered in lab and fieldtrip)	15%
Final Exam	40%

One of the skills you are expected to master during your university education is to communicate clearly and logically the knowledge that you have gained. Two written assignments are part of this course (Lab 1 and Lab 3). As 25% of your final mark will be dependent on them, you should spend considerable time in preparing concise, clear, and correct reports. These reports should be written as papers. The format of the papers will be detailed in your lab. You reports will be due 10 days following your lab. Each assignment will have an automatic three-day grace period. As such, short-term academic consideration are built into the assignments. Submission of assignments after the grace period will be reduced by 10%/day.

### **Grading Method:**

All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen's Official Grade Conversion Scale:

*Queen's Official Grade Conversion Scale*

<b>Grade</b>	<b>Numerical Course Average (Range)</b>
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69
C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

### **Questions About the Course and Contacting the Teaching Team:**

Questions about your labs (and the associated assignments) should be directed to your Teaching Assistant. Normally, your TA will be available in your regularly scheduled lab slot. Any reoccurring questions or concerns that we learn of will be addressed on the OnQ page for this course, either as a course announcement, or in the discussion form.

For any questions on the lecture components of this course, please feel free to contact me before/after lecture, or during the regularly scheduled office hours on Friday. If this is not possible, please e-mail me and we can setup a time to discuss your questions.

### **Academic Integrity:**

Queen's students, faculty, administrators and staff therefore all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility (see <http://www.academicintegrity.org>) and by the quality of courage. These values and qualities are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University.

Students are responsible for familiarizing themselves with and adhering to the regulations concerning academic integrity. General information on academic integrity is available at [Academic Integrity @ Queen's](#)

University, along with Faculty or School specific information. Departures from academic integrity include, but are not limited to, plagiarism, use of unauthorized materials, facilitation, forgery, and falsification. Actions which contravene the regulation on academic integrity carry sanctions that can range from a warning, to loss of grades on an assignment, to failure of a course, to requirement to withdraw from the university.

### **About Turnitin at Queen's:**

This course makes use of Turnitin, a third-party application that helps maintain standards of excellence in academic integrity. Normally, students will be required to submit their course assignments to through onQ to Turnitin. In doing so, students' work will be included as source documents in the Turnitin reference database, where they will be used solely for the purpose of detecting plagiarism. Turnitin is a suite of tools that provide instructors with information about the authenticity of submitted work and facilitates the process of grading. Turnitin compares submitted files against its extensive database of content, and produces a similarity report and a similarity score for each assignment. A similarity score is the percentage of a document that is like content held within the database. Turnitin does not determine if an instance of plagiarism has occurred. Instead, it gives instructors the information they need to determine the authenticity of work as a part of a larger process.

Please read Turnitin's Privacy Pledge, Privacy Policy, and Terms of Service, which governs users' relationship with Turnitin. Also, please note that Turnitin uses cookies and other tracking technologies; however, in its service contract with Queen's Turnitin has agreed that neither Turnitin nor its third-party partners will use data collected through cookies or other tracking technologies for marketing or advertising purposes. For further information about how you can exercise control over cookies, see Turnitin's Privacy Policy.

Turnitin may provide other services that are not connected to the purpose for which Queen's University has engaged Turnitin. Your independent use of Turnitin's other services is subject solely to Turnitin's Terms of Service and Privacy Policy, and Queen's University has no liability for any independent interaction you choose to have with Turnitin.

### **Accommodation for Disabilities:**

Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact the **Queen's Student Accessibility Services (QSAS)** and register as early as possible. For more information, including important deadlines, please visit the QSAS website at: <http://www.queensu.ca/studentwellness/accessibility-services/> Typical accommodations may include extra time on assessments and/or special room requirements.

**Academic Consideration** is mitigation for a short-term issue related to an extenuating circumstance. All academic considerations must go through the student portal available on the Faculty of Arts and Science website (<https://www.queensu.ca/artsci/accommodations>). Following your request, I will be notified.

There are 2 types of academic considerations. The first is called a 'brief absence' (up to 48hrs) and is essentially a self-declaration of an extenuating circumstance. The second is a short-term extenuating circumstance that can be from 2 days-3 months. The later requires documentation.

The aim of centralizing academic considerations is to log extenuating circumstances to provide better support for students who need it, and to watch for patterns where students are abusing the system.

**Copyright:**

Course materials created by the course instructor, including all slides, presentations, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's ***express consent***. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights.