



# BIOC\*2580 Introduction to Biochemistry

01

Summer 2022

Section(s): 01

Department of Molecular and Cellular Biology

Credit Weight: 0.50

Version 2.00 - May 31, 2022

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## 1 Course Details

### 1.1 Calendar Description

This course introduces students to the evolution, chemical structure, and biological roles of the major molecular components of the cell: including proteins, nucleic acids, lipids, and carbohydrates. Topics and processes integrated through understanding biological macromolecules include enzymology and intermediary metabolism, with emphasis on catabolic processes. Students will gain basic investigative skills through hands-on experiences in a laboratory setting.

**Pre-Requisites:** CHEM\*1050

### 1.2 Course Description

There are three main themes that run throughout this foundational course in biochemistry:

1. The principles of Physics and Chemistry can explain Biology.
2. The Structure and Function of biological molecules are inextricably connected.
3. Biochemistry is the link between biological Metabolism and its underlying Chemistry.

### 1.3 Timetable

Monday, Wednesday, & Friday 9:30 AM to 11:20 AM in MACN 113

All classes and labs will be held **in-person** unless otherwise directed by public health and university guidelines. In-person lectures are **NOT** planned to be recorded for later viewing or to be simulcasted for joining in remotely.

All material covered in lectures is the responsibility of the student, including announcements regarding midterms, labs, and exams.

For Labs, see the Lab Schedule posted under Activities. Labs will be held in-person in Lab Rooms SSC 3110 and SSC 3111.

## 1.4 Final Exam

Monday, June 27 9:30 AM - 11:30 AM (in-person; MACN 113)

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## 2 Instructional Support

### 2.1 Instructional Support Team

**Instructor:** Dr. Enoka Wijekoon  
**Email:** ewijekoo@uoguelph.ca  
**Telephone:** +1-519-824-4120 x56095  
**Office:** SC1 3517

**Lab Co-ordinator:** Jaspreet Kaur  
**Email:** jkaur@uoguelph.ca  
**Telephone:** +1-519-824-4120 x58220  
**Office:** SC1 3521

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## 3 Learning Resources

### 3.1 Recommended Resources

#### Lehninger Principles of Biochemistry (Textbook)

The following text is **recommended**, especially if you also intend to take the second biochemistry course, BIOC\*3560 Structure and Function in Biochemistry. It is also used in several other senior biochemistry courses.

Lehninger Principles of Biochemistry; D.L. Nelson and M.M. Cox, 8<sup>th</sup> ed. (2021) **OR** 7<sup>th</sup> ed. (2017) W.H. Freeman, NY.

Multiple copies of this text book are on Reserve in the library. An e-book is also available to be borrowed on a single user basis.

There are multiple options, each containing the same information, but in different formats:

1. The loose-leaf textbook bundled with Achieve\*
2. Achieve for Lehninger principles of Biochemistry (Gives access to e-book)

\*Achieve gives access to all online resources associated with the text book and the e-book. Use it for self study. It will NOT be used in the course to assign homework or for evaluation purposes. With Achieve access (by itself or freely bundled with a physical text), you will have access to the eBook for the duration of your education or 4-years.

Loose leaf versions cannot be resold as a used textbook at the Bookstore. **BE AWARE: With the eBook, you are purchasing access to the electronic version for a specific period of time; once this is over, you will not be able to access the eBook.**

## 3.2 Getting Help in BIOC\*2580

You are welcome to email your questions to Dr. Wijekoon at [ewijekoo@uoguelph.ca](mailto:ewijekoo@uoguelph.ca). Only use your @uoguelph account when sending messages. Enquiries regarding the laboratory should be sent to the lab coordinator, Jaspreet Kaur, at [jkaur@uoguelph.ca](mailto:jkaur@uoguelph.ca). E-mail may not be answered outside of office hours.

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# 4 Learning Outcomes

## 4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Describe the structures and the chemical properties of the 20 amino acids.
2. Describe the methods used in the separation of amino acids and proteins based on their chemical properties.
3. Describe the first three levels of protein structure and explain how protein structure is influenced by the amino acid sequence.
4. Explain how enzymes catalyze reactions and how enzyme activity is affected by inactivators and inhibitors.
5. Describe the structure and the chemical properties of carbohydrates (monosaccharides and disaccharides), lipids (fatty acids, triglycerides and glycerophospholipids) and nucleic acids (RNA and DNA).
6. Describe the chemical reactions involved in the generation of ATP through the oxidation of glucose and fatty acids.
7. Apply several of the knowledge outcomes in 1-6 by effectively working with a partner to carry out laboratory procedures to collect, properly record and analyse experimental data.

8. Manage time effectively and follow instructions to meet deadlines for course requirements.

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## 5 Teaching and Learning Activities

### 5.1 Lecture Schedule

Class	Date	Topic	Lehninger (7 <sup>th</sup> ed)	Lehninger (8 <sup>th</sup> ed)
1	May 13	Biological polymers; building blocks and hydrolyzable bonds. Amino acids, peptides and proteins.	12-16;75-76;85-86	(1.2)* 10-14; (3.1)70-71; (3.2) 80-81
		Amino acids; polarity and ionization.	75-85	(Ch 3;3.1) 70-80
2	May 16	Properties of aqueous solutions; dissociation of weak electrolytes.	47-50; 58-65	(Ch 2; 2.1) 43-46; (2.2; part of 2.3) 53-61
		Analytical methods and separation by chromatography.	89-96	(3.3) 83-90
3	May 18	More analytical methods.	89-96	(3.3) 83-90
		Polypeptides and proteins: structural hierarchy, sequence. Basis of reactivity and hydrolysis.	96-102	90-95
<b>May Quiz 1 (Lectures 1-3)</b>				
<b>19-22</b>				
4	May 20	Sequence determination.	96-102	90-95

		Secondary structure I: $\alpha$ -helix, $\beta$ -sheet.	115-125	(Ch 4; 4.1;4.2)
				106-116
5	May 25	Secondary structure II: $\alpha$ -helix, $\beta$ -sheet.	115-125	106-116
		Principles of tertiary structure.	125-141	(4.3) 106-128
6	May 27	Binding and recognition of substrates and specificity of enzymes.	187-198	(Ch 6; 6.1; 6.2)
		The basis of chemical and enzymatic catalysis.	187-198	177-288 177-188
	<b>May 28-31</b>	<b>Quiz 2 (lectures 4-6)</b>		
7	May 30	Enzyme assay and detection	95-96; 203	(3.3) 89-90; (6.3)
		Enzyme kinetics.	198-213	192-193 (6.3; 6.4) 188-203
8	June 1	Mechanism of action of chymotrypsin.	213-217	(6.4) 203-208
		Experimental enzyme kinetics: linear plots; Enzyme inhibition and regulation.	198-213	(6.3; 6.4) 188-203
9	June 3	Lipids: fatty acids; TAG	361-366	(Ch 10; 10.1) 341-344
		Lipids: Phospholipids; Analysis of lipids	366-369;	(10.1; 10.2) 344-
			381-383	348; (10.4) 361-
				362
10	June 6	Carbohydrate chemistry: simple sugars	241-243	(Ch 7; 7.1) 229-

				233
		Carbohydrate chemistry: rings; Reducing sugars	243-247;	(7.1) 233-235; 237
			249	
<b>Midterm Examination (2:30 PM - 4:00 PM in MACN 113)</b>				
11	June 8	Carbohydrate chemistry: glycosides and disaccharides	250-252	(7.1) 237-241
		Chemistry of nucleic acid bases, nucleosides and polynucleotides	279-285	(Ch 8; 8.1) 263-
				269
12	June 10	The DNA double helix	285-287	(8.2) 269-272
		ATP as cellular energy currency	507-514	(13.3) 479-485
<b>June Quiz 3 (Lectures 9-11) 11-14</b>				
13	June 13	Introduction to Metabolism; Redox reactions	491-494; 517-522	(Part II) 461-464; (13.4) 488-492
		Adenosine containing cofactors; Catabolism of fats	649-650;621	576; (13.4) 492-496; (8.10) 294-295
14	June 15	Fatty acid $\beta$ -oxidation	652-659;	(Ch 17) 601; (17.1)
			522-526	603-611
		Glycolysis: anaerobic energy generation	533-545	(Ch 14) 510-521
15	June 17	Fates of pyruvate and cytosolic NADH; fermentation	619-624;	(14.3) 525-526; 530-533;
			739-740;	(Ch 16) 574-578; (Ch 19) 683-686
			553-558	
		Acetate to CO <sub>2</sub> : the citric acid cycle	619;	(Ch 16) 574-575; (16.2) 578-589

624-636

**June Quiz 4 (Lectures 12-14)  
18-21**

16	June 20	The electron transport chain	711-724	(Ch 19) 659-672
		Chemiosmotic energy transduction	724-728	672-674
17	June 22	ATP synthase	728-739	674-683
		ATP synthase; Efficiency of oxidative phosphorylation	657-659	609-611
18	June 23	Efficiency of oxidative phosphorylation contd.,	657-659	609-611
	<b>June 27</b>	<b>Final examination (9:30 AM- 11:30 AM)</b>		

**5.2 Lab Schedule - BIOC\*2580 S'22**

<b>WEEK #</b>	<b>Dates</b>	<b>Activity</b>
<b>1</b>	<b>May 12-16</b>	<b>Lab Intro and Lab Safety</b>
<b>2</b>	<b>May 17-19</b>	<b>Lab 1: Amino Acids</b>
<b>3</b>	<b>May 24-26</b>	<b>Lab 2: Proteins</b>

**4**                      **May 31-June 2**                      **Lab 3: Enzyme Kinetics**

**5**                      **June 7-9**                      **Lab 4: Lipids**

**6**                      **June 14-16**                      **Lab 5: Carbohydrates**

## 6 Assessments

### 6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Online Quiz #1	2.5
Online Quiz #2	2.5
Midterm	25
Online Quiz #3	2.5
Online Quiz #4	2.5
Final Exam	40
Laboratories	25
Total	100

### 6.2 Assessment Details

#### Online Quiz #1 (2.5%)

**Due:** Thu, May 19 - Sun, May 22, Online

**Learning Outcome:** 1, 2, 8

Lectures 1-3

#### Online Quiz #2 (2.5%)

**Due:** Sat, May 28 - Tue, May 31, Online

**Learning Outcome:** 2, 3, 8

Lectures 4-6

#### Midterm (25%)

**Date:** Mon, Jun 6, 2:30 PM - 4:00 PM, In-person, MACN 113



**Learning Outcome:** 1, 2, 3, 4, 8  
First-Half Lecture sets I, II & III

**Online Quiz #3 (2.5%)**

**Due:** Sat, Jun 11 - Tue, Jun 14, Online

**Learning Outcome:** 5, 8

Lectures 9-11

**Online Quiz #4 (2.5%)**

**Due:** Sat, Jun 18 - Tue, Jun 21, Online

**Learning Outcome:** 5, 6, 8

Lectures 12-14

**Final Exam (40%)**

**Date:** Mon, Jun 27, 9:30 AM - 11:30 AM, In-person; MACN 113

**Learning Outcome:** 1, 2, 3, 4, 5, 6, 8

**Cumulative**, with emphasis on lectures 9-18 (Second Half Lectures Sets I, II & III)

**Laboratories (25%)**

**Date:** Weekly, SSC 3110 and SSC 3111

**Learning Outcome:** 7, 8

Laboratories will be offered in-person. Each Lab is worth 5% (Lab write-up- 3% and Lab quiz- 2%).

## 6.3 Note

- Lecture Component: 75%
- Laboratory Component: 25%
- Total: 100%

**Students must pass the Lecture component on its own AND the Laboratory component on its own to pass the course as a whole (i.e. students need to achieve an overall grade of at least 37.5/75 for the 4 quizzes and the 2 exams and a minimum of 12.5/25 for the laboratory).** This means that a high laboratory mark cannot be used to secure a pass if the lecture component is failed or *vice versa*. In cases where this standard is not achieved, the final grades assigned will either be the calculated grade *or* 47%, whichever is *less*.

## 6.4 Online Quizzes

### ONLINE QUIZZES:

The online quizzes are meant to ensure that students keep up with and have a chance to assess their understanding of the lecture material. Although these assignments are online, **STUDENTS ARE EXPECTED TO ANSWER THE QUESTIONS BY THEMSELVES.** The goal of the quizzes is to have students review and reflect on the material, and facilitate studying for the midterm and final exam in a lower-stakes format. As such, students will be given **three**

**attempts** at the quiz over a period of 4 days. For each attempt, you will see your overall grade and the mark you received for each question (from which you can determine which questions you answered correctly and which you answered incorrectly) immediately after submitting the quiz. The highest attempt out of the 3 will be used in the overall grade calculation. The allocated time limit for each attempt is 1 hr\*. Since the questions are randomly selected, **each attempt will have different questions** but on the same theme.

\*The time limit of 1 hr is given due to the formative nature of these quizzes. It does not reflect the amount of time that would be required to complete the ~15 questions that each quiz contains. Midterm and final exams will consist of a larger number of questions with a much shorter time limit.

**Access to grades, answers and feedback:** Students will be granted access to answers the day after the closing of the quiz. Questions about grades must be made to the instructor within a period of one-week following that. **Please note that feedback, explanations or answers to quiz questions cannot be provided while the quiz is open. These will only be answered once the quiz has closed. Please review the marking scheme once it has been released before emailing your questions.**

**Deferrals policy:** **The quiz cannot be extended beyond the 4-day period it is open as answers are set to be released immediately following the closure of each quiz.** Students with medical or compassionate issues that **cover the entire 4-day period the quiz is open** will be granted a changed mark weighting. The value of quizzes missed will be added to the value of the final exam. Please inform the instructor within **one week** of the end of the assignment deadline. Be sure you have access to a working computer with a stable Internet connection. **Technical problems are not grounds for a deferral.**

## 6.5 Midterm Exam

**Monday, June 6 (In-person; Time: 2:30-4:00 PM ; Place: MACN 113)**

**STUDENTS MUST NOTIFY THE INSTRUCTOR OF ANY ACADEMIC CONFLICTS BY Friday, May 20.** Academic conflicts are courses or labs that are scheduled at the exact same time. Please note that work commitments are NOT grounds for a deferral.

**Access to grades, answers and feedback:** Students will be granted access to their grades and answers to the midterm once the exams have been graded. Questions about grades must be made to the instructor within one week of the midterm being available for return.

**Deferrals policy:** Only medical or compassionate accommodations will be granted a missed midterm. Please inform the instructor within **one-week** of the exam date. If a missed midterm is granted, the weight will be moved to the final exam which will be reweighted to 65%. THERE WILL BE NO ALTERNATE EXAM DATES.

## 6.6 Final Exam

**Monday, June 27, 9:30-11:30 AM (MACN 113)**

This exam will **cover the entire course (lectures 1-18)**, with strong emphasis on the material that was covered in Second half lecture sets I, II & III. A **metabolic chart** will be posted on Courselink and provided at the final examination. The chart shows chemical structures organized into metabolic pathways, but it does not show compound or enzyme names, reaction stoichiometries and mechanisms, etc. Students are expected to be familiar with these, as outlined in the Learning Outcomes for the course.

**Technology in all exams:** Students may use a numerical calculator with ln and log functions for exams. Advanced calculators or smart phones may **not** be used.

## 6.7 Laboratory Component

**Laboratory sessions will begin on May 17 and the last Lab will be on June 16th (See Lab Schedule for specific dates). All Labs will be offered in-person (unless otherwise directed by Public Health and University guidelines). When the Labs are being offered in-person, there will be no option of doing the labs online.**

**Location:** SSC 3110 and SSC 3111.

Laboratory sessions are designed to relate to the lecture content and to introduce students to proper scientific recording of data and analysis of results.

The labs will be conducted in person. Lab write-ups and the Lab quizzes will be done on paper during the Lab time in the Lab room. Please read the Lab Manual posted on the Courselink in the LABS folder before coming to the lab and come prepared for the lab and the quiz. If possible, bring a print-out of the Lab manual with you to the lab.

**You are required to attend all labs.** If for some reason you are unable to attend your own lab section for any lab, please email Jaspreet Kaur (jkaur@uoguelph.ca) and arrange to attend an alternate lab section.

### **Lab exemptions:**

If you have earned a passing lab grade in a previous attempt at BIOC\*2580 within the last 12 months, you may apply for a lab exemption. Send your request to jkaur@uoguelph.ca (put *Lab exemption* on the Subject line). **You do not have a valid lab exemption unless you have received confirmation that it has been granted.**

## 7 Course Statements

### 7.1 E-mail Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

### 7.2 Statement on the Use of Animals

No animals are used directly in the laboratory exercises for BIOC\*2580. However it is in the nature of biochemistry that some enzymes or biochemical substances may be derived from animal sources. Efforts have been made to reduce the use of animal related products by using equivalent enzymes or substances derived from microbial or plant sources, but in some cases it may be necessary to use these products.

## 8 Department of Molecular and Cellular Biology Statements

### 8.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

### 8.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. <http://www.learningcommons.uoguelph.ca/>
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

### 8.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance. <https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations. <http://www.selfregulationskills.ca/>

## 8.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) <http://www.e-laws.gov.on.ca/index.html>. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar. (<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml>)

## 8.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

# 9 University Statements

## 9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

## 9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

### 9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

### 9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

### 9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website  
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website  
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

## 9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

## 9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars  
<https://www.uoguelph.ca/academics/calendars>

## 9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

## 9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

## 9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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