

# BIOC\*2580 - Introduction to Biochemistry

## Summer 2024 Course Outline

Section: S1

Credits: 0.50

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## Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

## 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.

**Prerequisite(s):** CHEM\*1050

**Department(s):** Department of Molecular and Cellular Biology

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## Lecture Schedule

MonWedFri 9:30am-11:20am in MACN\*105 (5/9 to 6/28)

All classes and labs will be held **in-person**. Lectures will **not** be recorded and there will not be an option to join lectures remotely.

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

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

## Instructor Information

Enoka Wijekoon, Dr.  
Instructor

Akash Jairaj  
Lab Coordinator

## 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 coordinators, Jaspreet Kaur or Akash Jairaj at [bioc2580@uoguelph.ca](mailto:bioc2580@uoguelph.ca). E-mail may not be answered outside of office hours.

## Learning Resources

### Recommended Resources

**TEXTBOOK:** Lehninger Principles of Biochemistry

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, 8th ed. (2021) **OR** 7th ed. (2017) W.H. Freeman, NY.

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

1. The loose-leaf textbook bundled with Achieve\* (Achieve 1 or 2-Term Access)
2. Achieve Online for Lehninger Principles of Biochemistry (Achieve 1 or 2-Term Access)

\*Achieve is the publisher's online platform. It gives access to all online resources associated with the textbook (ebook for online and offline reading, quizzing, videos, animations, plus additional resources by course). Use it for self study. It will NOT be used in the course to assign homework or for evaluation purposes.

To access the Achieve resources you need to register in the Achieve Course.

Achieve Course URL: <https://achieve.macmillanlearning.com/courses/s5efgh/mycourse> (<https://achieve.macmillanlearning.com/courses/s5efgh/mycourse/>)

Achieve **Course ID:** s5efgh

Ebook Access: students who purchase Achieve access (by itself or freely bundled with a physical text), will have access to the eBook after **download** for the **duration of their 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.**

Multiple copies of this textbook are on Reserve in the library. An ebook is also available to be borrowed on a single user basis.

## Campus Resources

If you are concerned about any aspect of your academic program: Make an appointment with a Program Counsellor (<https://www.uoguelph.ca/uaic/programcounsellors/>) in your degree program. If you are struggling to succeed academically: There are numerous academic resources offered by the Learning Commons (<https://www.lib.uoguelph.ca/using-library/spaces/learning-commons/>) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

## Course Learning Outcomes

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.

## Schedule of Topics and Assignments

Day:	Date:	Topic	Activities	Due:
Fri	5/10	No Class		
Mon	5/13	Biological polymers; building blocks and hydrolyzable bonds. Amino acids, peptides and proteins.  Properties of aqueous solutions; dissociation of weak electrolytes.	Lehninger (7th ed) : 12-16; 47-50; 75-76;85-86 Lehninger (8th ed): (1.2)* 10-14; (Ch 2; 2.1) 43-46; (3.1)70-71; (3.2) 80-81  Lehninger (7th ed): 58-65; 81-85 Lehninger (8th ed): (Ch 2; 2.1) 43-46; (2.2; part of 2.3) 53-61 (Ch 3;3.1) 76-80	

Wed	5/15	Analytical methods and separation by chromatography and other methods	Lehninger (7th ed): 89-96 Lehninger (8th ed): (3.3) 83-90
		Polypeptides and proteins: structural hierarchy, sequence. Basis of reactivity and hydrolysis	Lehninger (7th ed): 96-102 Lehninger (8th ed): 90-95
Fri	5/17	Sequence determination.	Lehninger (7th ed): 96-102 Lehninger (8th ed): 90-95
		Secondary structure I: $\alpha$ -helix, $\beta$ -sheet,	Lehninger (7th ed): 115-125 Lehninger (8th ed): (Ch 4; 4.1;4.2) 106-116
Mon	5/20	Holiday	
Wed	5/22	Secondary structure II: $\alpha$ -helix, $\beta$ -sheet (continued)	Lehninger (7th ed): 115-125 Lehninger (8th ed): 106-116
		Principles of tertiary structure.	Lehninger (7th ed): 125-141 Lehninger (8th ed):(4.3) 106-128
Fri	5/24	Binding and recognition of substrates and specificity of enzymes;	Lehninger (7th ed): 187-198 Lehninger (8th ed): (Ch 6; 6.1; 6.2) 177-188
		The basis of chemical and enzymatic catalysis.	Lehninger (7th ed):187-198 Lehninger (8th ed): 177-188
Mon	5/27	Enzyme assay and detection	Lehninger (7th ed): 95-96; 203 Lehninger (8th ed): (3.3) 89-90; (6.3) 192-193
		Enzyme kinetics	Lehninger (7th ed): 198-213 Lehninger (8th ed): (6.3; 6.4) 188-203
Wed	5/29	Mechanism of action of chymotrypsin	Lehninger (7th ed): 213-217 Lehninger (8th ed): (6.4) 203-208
		Experimental enzyme kinetics: linear plots; Enzyme inhibition and regulation.	Lehninger (7th ed): 198-213 Lehninger (8th ed): (6.3; 6.4) 188-203
Fri	5/31	Experimental enzyme kinetics: linear plots; Enzyme inhibition and regulation.	Lehninger (8th ed): (6.3; 6.4) 188-203 Lehninger (7th ed): 198-213
Mon	6/3	Lipids: fatty acids; TAG	Lehninger (7th ed): 361-366 Lehninger (8th ed): (Ch 10; 10.1) 341- 344
		Lipids: Phospholipids; Analysis of lipids	Lehninger (7th ed): 366-369; 381-383 Lehninger (8th ed): (Ch 10.1; 10.2) 344- 348; (10.4) 361-362
Wed	6/5	Carbohydrate chemistry: simple sugars	Lehninger (7th ed): 241-243 Lehninger (8th ed): (Ch 7; 7.1) 229- 233
		Carbohydrate chemistry: rings; Reducing sugars	Lehninger (7th ed): 243-247; 249 Lehninger (8th ed): (Ch 7.1) 233-235; 237

Fri	6/7	Carbohydrate chemistry: glycosides and disaccharides	Lehninger (7th ed): 250-252 Lehninger (8th ed): (Ch7.1) 237- 241	
		Chemistry of nucleic acid bases, nucleosides and polynucleotides	Lehninger (7th ed): 279-285 Lehninger (8th ed): (Ch 8; 8.1) 263-269	
Mon	6/10	The DNA double helix	Lehninger (7th ed): 285-287 Lehninger (8th ed): (8.2) 269-272	
		ATP as cellular energy currency	Lehninger (7th ed): 507-514 Lehninger (8th ed): (13.3) 479-485	
Wed	6/12	Introduction to Metabolism; Redox reactions	Lehninger (7th ed): 491-494; 517-522 Lehninger (8th ed): (Part II) 461-464; (13.4) 488-492	
		Adenosine containing cofactors; Catabolism of fats	Lehninger (7th ed): 649-650;621 Lehninger (8th ed): 576; (13.4) 492-496; (8.10) 294-295	
Fri	6/14	Fatty acid $\beta$ -oxidation	Lehninger (7th ed): 652-659; 522-526 Lehninger (8th ed): (Ch 17) 601; (17.1) 603-611	
		Glycolysis: anaerobic energy generation	Lehninger (7th ed): 533-545 Lehninger (8th ed): (Ch 14) 510-521	
Mon	6/17	Fates of pyruvate and cytosolic NADH; fermentation	Lehninger (7th ed): 619-624; 739-740; 553-558 Lehninger (8th ed): (14.3) 525-526; 530-533; (Ch 16) 574-578; (Ch 19) 683-686	
		Acetate to CO <sub>2</sub> : the citric acid cycle	Lehninger (7th ed): 619; 624-636 Lehninger (8th ed): (Ch 16) 574-575; (16.2) 578-589	
Wed	6/19	The electron transport chain	Lehninger (7th ed): 711-724 Lehninger (8th ed): (Ch 19) 659-672	
		Chemiosmotic energy transduction	Lehninger (7th ed): 724-728 Lehninger (8th ed): 672-674	
Fri	6/21	***LECTURE THURSDAY JUNE 20** Rescheduled from May 20th ATP Synthase	***LECTURE THURSDAY JUNE 20** Lehninger (7th ed) 728-739 Lehninger (8th ed): 674-683	***LECTURE THURSDAY JUNE 20**
		Efficiency of oxidative phosphorylation	Lehninger (7th ed):657-659 Lehninger (8th ed): 609-611	

## Teaching and Learning Activities

### Lab Topics

LAB SCHEDULE-BIOC\*2580 S'2024

All Labs will be in-person.

Week#	Activity
1	Watch Safety, and Micropipetting Videos, take the two quizzes on Couselink
2	Lab 1: Amino Acids
3	Lab 2- Proteins
4	Lab 3: Enzyme Reaction Kinetics
5	Lab 4- Lipids
6	Lab 5- Carbohydrates

## Assessment Breakdown

Description	Weighting (%)	Due Date
Online Quiz #1	2.5%	May 18-21
Online Quiz #2	2.5%	May 25-28
Midterm	25%	Monday, June 3 (2:30-4:00 PM)
Online Quiz #3	2.5%	June 8-11
Online Quiz #4	2.5%	June 15-18
Final Exam	40%	See Final Exam Section Below
Laboratories	25%	

## Assessment Details

### Last Day to Drop Course

The final day to drop Summer 2024 courses without academic penalty is the last day of classes: June 20

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

## Course Standard Statements

### Themes

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

### 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

## Department of Molecular and Cellular Biology Statements

### Academic Advisors

If you are concerned about any aspect of your academic program. Please make an appointment with a program counsellor in your degree program. B.Sc. Academic Advising (<https://bsc.uoguelph.ca/>) or Program Counsellor (<https://www.uoguelph.ca/uaic/programcounsellors/>)

### Academic Support

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: Chemistry / Physics Help (<http://www.lib.uoguelph.ca/getassistance/studying/chemistry-physics-help/>) and Math / Statistics Help (<http://www.lib.uoguelph.ca/getassistance/studying/math-stats-help/>)

## 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 (<https://www.uoguelph.ca/webadvisor/>) as they become available.

## Online Behaviour

Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student
- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors and/or TAs
- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your username and password
- Recording lectures without the permission of the instructor

## 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 (<http://www.e-laws.gov.on.ca/index.html.html>) (FIPPA). 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 (<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml/>) please see the Undergraduate Calendar.

## Wellness

If you are struggling with personal or health issues:

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

## Standard Statements for Undergraduate Courses

### 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 discourages misconduct. 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.

The Academic Misconduct Policy (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/>) is outlined in the Undergraduate Calendar.

## 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 10 days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (<https://www.uoguelph.ca/sas/>)

## Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodations of Religious Obligations (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-accommodation-religious-obligations/>).

## 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.

## 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 undergraduate students 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 the Undergraduate Calendar - Dropping Courses (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/dropping-courses/>).

## Email 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.

## Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (<https://wellness.uoguelph.ca/>). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (<https://wellness.uoguelph.ca/navigators/>) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources (<https://wellness.uoguelph.ca/shine-this-year/>). The Student Wellness team are here to help and welcome the opportunity to connect with you.

## 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).

## 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.

## Resources

The Academic Calendars (<http://www.uoguelph.ca/registrar/calendars/?index>) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

## 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. See the Undergraduate Calendar for information

on regulations and procedures for Academic Consideration. (<https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/>)