BIOC*2580 Introduction to Biochemistry

Summer 2021
Section(s): C01

Department of Molecular and Cellular Biology
Credit Weight: 0.50
Version 1.00 - April 28, 2021

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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 to be offered in an alternate format online

Classes will be held through a mixture of synchronous lectures via Zoom and pre-recorded lectures. Any lecture/lab session held synchronously will also be recorded and made available for later viewing for those who are unable to attend synchronously.

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

1.4 Final Exam

Monday, June 28 9:30 AM - 11:30 AM (Online through Courselink Quizzes)

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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
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Lab Co-ordinator:	Jaspreet Kaur
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Office:	SC1 3521

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3 Learning Resources

3.1 Recommended Resources

Lehninger Principles of Biochemistry (Textbook)

The following text is **recommended.** It is also used in the second biochemistry course, BIOC*3560 and several other senior biochemistry courses. It is however, not required for you to have the textbook. It will mainly be used as an additional reference.

Lehninger Principles of Biochemistry; D.L. Nelson and M.M. Cox, 7th ed. (2017) **OR** 6th ed. (2013) W.H. Freeman, NY.

Multiple copies of this text book are on Reserve in the library.

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

1. The hardcover textbook bundled with Sapling Plus* (2-semester Access)
2. The loose-leaf textbook bundled with Sapling Plus (2-semester access)
3. Sapling Plus (2-semester Access) with **24 months access** to the ebook
4. Sapling Plus (1-semester Access) with **24 months access** to the ebook

*Sapling Plus comes bundled with the textbook. It will **NOT** be used in the course for evaluation but could be used as an additional study resource and for self evaluation.

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. Only use your @uoguelph account when sending messages. Enquiries regarding the laboratory should be sent to the lab coordinator at 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 (6th ed)	Lehninger (7th ed)
1	May 14	Biological polymers; building blocks and hydrolyzable bonds. Amino acids, peptides and proteins.	11-15; 76; 85-86	12-16;75-76;85-86
		Amino acids; polarity and ionization.	75-85	75-85
2	May 17	Properties of aqueous solutions; dissociation of weak electrolytes.	47-50; 58-65	47-50; 58-65
		Analytical methods and separation by chromatography.	89-96	89-96
3	May 19	More analytical methods.	89-96	89-96
		Polypeptides and proteins: structural hierarchy, sequence. Basis of reactivity and hydrolysis.	96-102	96-102
	May 20-23	**Quiz 1 (Lectures 1-3)**		
4	May 21	Sequence determination.	96-102	96-102
		Secondary structure I: α-helix, β-sheet.	115-125	115-125
5	May 26	Secondary structure II: α-helix, β-sheet.	115-125	115-125
		Principles of tertiary structure.	125-140	125-141

6	May 28	Binding and recognition of substrates and specificity of enzymes.	189-200	187-198
		The basis of chemical and enzymatic catalysis.	189-200	187-198
	May 29-June 1	**Quiz 2 (lectures 4-6)**		
7	May 31	Enzyme kinetics.	200-213	198-213
		Experimental enzyme kinetics: linear plots.	200-213	198-213
8	June 2	Enzyme inhibition and regulation.	200-213	198-213
		Mechanism of action of chymotrypsin.	214-218	213-217
9	June 4	Enzyme assay and detection.	95-96; 204-205	95-96;203
		REVIEW		
10	June 7	Lipids: fatty acids; TAG	357-362	361-366
		Phospholipids; Analysis of lipids	362-364; 377-379	366-369; 381-383
		Midterm Examination (online; 9:30 AM - 11:00 AM)		
11	June 9	Carbohydrate chemistry: simple sugars	243-245	241-243
		Carbohydrate chemistry: rings; Reducing sugars	245-248; 251	243-247; 249

12	June 11	Carbohydrate chemistry: glycosides and disaccharides	252-254	250-252
		Chemistry of nucleic acid bases, nucleosides and polynucleotides	281-287	279-285
	June 12-15	**Quiz 3 (Lectures 10-12)**		
13	June 14	The DNA double helix	287-290	285-287
		ATP as cellular energy currency	517-524	507-514
14	June 16	Introduction to Metabolism; Redox reactions	501-504; 528-532	491-494; 517-522
		Catabolism of fats	501-504; 528-532	649-650;621
15	June 18	Fatty acid β-oxidation	667-677; 532-537	652-659; 522-526
		Glycolysis: anaerobic energy generation	543-555	533-545
	June 19-22	**Quiz 4 (Lectures 13-15)**		
16	June 21	Fates of pyruvate and cytosolic NADH; fermentation	758-759; 633-638; 563-565	619-624; 739-740; 553-558
		Acetate to CO_2: the citric acid cycle	633; 638-650	619; 624-636
17	June 23	The electron transport chain	731-743	711-724

		Chemiosmotic energy transduction	743-747	724-728
18	June 24	ATP synthase	747-757	728-739
		Efficiency of oxidative phosphorylation	675-676	657-659
	June 28	Final examination (online; 9:30 AM- 11:30 AM)		

5.2 Lab Schedule - BIOC*2580 S'20

WEEK #	Dates	Activity
1	**May 13-14**	**Lab Intro and Lab Safety**
2	**May 18-20**	**Lab 1: Amino Acids**
3	**May 25-27**	**Lab 2: Proteins**
4	**June 1-3**	**Lab 3: Enzyme Kinetics**
5	**June 8-10**	**Lab 4: Lipids**
6	**June 15-17**	**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 20 - Sun, May 23, Online
Learning Outcome: 1, 2, 8
Lectures 1-3

Online Quiz #2 (2.5%)
Due: Sat, May 29 - Tue, Jun 1, Online
Learning Outcome: 2, 3, 8
Lectures 4-6

Midterm (25%)
Date: Mon, Jun 7, 9:30 AM - 11:00 AM, ONLINE
Learning Outcome: 1, 2, 3, 4, 8
Lectures 1-9.

Online Quiz #3 (2.5%)
Due: Sat, Jun 12 - Tue, Jun 15, Online
Learning Outcome: 5, 8
Lectures 10-12

Online Quiz #4 (2.5%)
Due: Sat, Jun 19 - Tue, Jun 22, Online
Learning Outcome: 5, 6, 8
Lectures 13-15

Final Exam (40%)
Date: Mon, Jun 28, 9:30 AM - 11:30 AM, Online
Learning Outcome: 1, 2, 3, 4, 5, 6, 8

Cumulative, with emphasis on lectures 10-18

Laboratories (25%)
Date: Weekly
Learning Outcome: 7, 8
Laboratories will be offered online with associated quizzes + other assignments

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:

May 20-23, May 29-June 1, June 12-15 and June 19-22

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 recommended time limit for each attempt is 1 hr. However, everyone will be given 120 min (2hrs) to complete each attempt (ie. Everyone is given Double Time to complete the quiz; no further adjustments will be made for student that are granted extra time for exams). Since the questions are randomly selected, **each attempt will have different questions** but on the same theme.

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. As per university policy, verification of illness will not be required for the S21 semester. 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 7 (9:30 AM to 11:00 AM) ONLINE VIA COURSELINK QUIZZES (VIRTUAL INVIGILATION VIA RESPONDUS LOCKDOWN BROWSER + MONITOR)

YOU WOULD REQUIRE ACCESS TO A COMPUTER WITH A WEBCAM (BUILT-IN OR EXTERNAL) TO COMPLETE THIS EXAM.

STUDENTS MUST NOTIFY THE INSTRUCTOR OF ANY ACADEMIC CONFLICTS BY Friday, May 21. Academic conflicts are courses or labs that are scheduled at the exact same time.

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

ONLINE VIA COURSELINK QUIZZES **(VIRTUAL INVIGILATION VIA RESPONDUS LOCKDOWN BROWSER + MONITOR)**

YOU WOULD REQUIRE ACCESS TO A COMPUTER WITH A WEBCAM (BUILT-IN OR EXTERNAL) TO COMPLETE THIS EXAM.

This exam will **cover the entire course (lectures 1-18),** with strong emphasis on the material covered after the midterm examination. 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 are designed to relate to the lecture content and to introduce students to proper scientific recording of data and analysis of results. Due to the alternate format used in the course offering this semester, labs will be conducted through videos posted on Courselink under the LABS folder under Contents.

You are required to complete all lab quizzes and write-ups.

Laboratories will begin on May 13

Location: online

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.**

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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)

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 book their exams at least 7 days in advance and not later than the 40th Class Day.

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 and academic schedules. Any such changes will be announced via CourseLink and/or class email. 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

The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.