



BIOC*2580 Introduction to Biochemistry

Summer 2018

Section(s): C01

Department of Molecular and Cellular Biology

Credit Weight: 0.50

Version 1.00 - May 01, 2018

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-Requisite(s): 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 RICH 2520

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

1.4 Final Exam

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

2 Instructional Support

2.1 Instructor(s)

Dr. Enoka Wijekoon

Email: ewijekoo@uoguelph.ca
Telephone: +1-519-824-4120 x56095
Office: SC1 3517
Office Hours: Office hours: Mon 1:00-2:30 pm (If this time slot doesn't work, please email to set up another time)

2.2 Instructional Support Team

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

3 Learning Resources

3.1 Recommended Resource(s)

Lehninger Principles of Biochemistry (Textbook)

The following text is highly **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, 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

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.

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 (6 th ed)	Lehninger (7 th ed)
1	May 11	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 14	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 16	More analytical methods.	89-96	89-96

		Polypeptides and proteins: structural hierarchy, sequence. Basis of reactivity and hydrolysis.	96-102	96-102
	May 17-20	Quiz 1 (Lectures 1-3)		
4	May 18	Sequence determination.	96-102	96-102
		Secondary structure I: α -helix, β -sheet.	115-125	115-125
5	May 23	Secondary structure II: α -helix, β -sheet.	115-125	115-125
		Principles of tertiary structure.	125-140	125-141
6	May 25	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 26-29	Quiz 2 (lectures 4-6)		
7	May 28	Enzyme kinetics.	200-213	198-213
		Experimental enzyme kinetics: linear plots.	200-213	198-213
8	May 30	Enzyme inhibition and regulation.	200-213	198-213
		Mechanism of action of chymotrypsin.	214-218	213-217
9	June 1	Enzyme assay and detection.	95-96; 204-205	95-96;203
		REVIEW		
10	June 4	Lipids: fatty acids; TAG	357-362	361-366
		Phospholipids; Analysis of lipids	362-364; 377-379	366-369; 381-383
		Midterm Examination 5:30 pm - 7:00 pm		
11	June 6	Carbohydrate chemistry: simple sugars	243-245	241-243

		Carbohydrate chemistry: rings; Reducing sugars	245-248; 251	243-247; 249
12	June 8	Carbohydrate chemistry: glycosides and disaccharides	252-254	250-252
		Chemistry of nucleic acid bases, nucleosides and polynucleotides	281-287	279-285
	June 9-12	Quiz 3 (Lectures 10-12)		
13	June 11	The DNA double helix	287-290	285-287
		ATP as cellular energy currency	517-524	507-514
14	June 13	Introduction to Metabolism; Redox reactions	501-504; 528-532	491-494; 517-522
		Catabolism of fats	667; 635	649-650; 621
15	June 15	Fatty acid β -oxidation	667-677; 532-537	652-659; 522-526
		Glycolysis: anaerobic energy generation	543-555	533-545
	June 16-19	Quiz 4 (Lectures 13-15)		
16	June 18	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 20	The electron transport chain	731-743	711-724

		Chemiosmotic energy transduction	743-747	724-728
18	June 21	ATP Synthase	747-757	728-739
		Efficiency of oxidative phosphorylation	675-676	657-659
	June 27	Final examination 9:30 AM – 11:30 AM		

5.2 Lab Schedule - BIOC*2580 W18 (subject to change)

LAB SCHEDULE (Subject to change)

WEEK #	Dates	Activity
1	May 15-17	Lab 1: Amino Acids, Quiz 1
2	May 22-24	Lab 2: Proteins, Quiz 2
3	May 29- 31	Lab 3: Enzymes, Quiz 3
	Mon, Jun-04	Midterm Exam 5:30 – 7:00 PM
4	June 5-7	Lab 4: Lipids, Quiz 4
5	June 12-14	Lab 5: Carbohydrates, Quiz 5
	Wed, Jun-27	Final Exam 9:30- 11:30 AM

6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Online Quiz #1	2.50
Online Quiz #2	2.50
Midterm	25.00
Online Quiz #3	2.50
Online Quiz #4	2.50
Final Exam	40.00
Laboratories	25.00
Total	100.00

6.2 Assessment Details

Online Quiz #1 (2.50%)

Due: Thu, May 17 - Sun, May 20
Lectures 1-3

Online Quiz #2 (2.50%)

Due: Sat, May 26 - Tue, May 29
Lectures 4-6

Midterm (25.00%)

Date: Mon, Jun 4, 5:30 PM - 7:00 PM, RICH 2520
Lectures 1-9

Online Quiz #3 (2.50%)

Due: Sat, Jun 9 - Tue, Jun 12
Lectures 10-12

Online Quiz #4 (2.50%)

Due: Sat, Jun 16 - Tue, Jun 19
Lectures 13-15

Final Exam (40.00%)

Date: Wed, Jun 27, 9:30 AM - 11:30 AM
Cumulative, with emphasis on lectures 10-18

Laboratories (25.00%)

Date: Bi-Weekly
Laboratory experiments and write-up

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 17-20, May 26-29, June 9-12 and June 16-19

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 got for each question (from which you can determine which questions you answered correctly and which you answered incorrectly) immediately after submitting the quiz. The time limit per attempt will be one hour. Since the questions are randomly selected, **each attempt will have different questions** but on the same theme.

Access to answers: Students will be granted access to answers to the quiz questions on the day following the closing of the quiz. Questions about the grades must be made to the instructor within a period of one-week following that.

Deferrals policy: 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. Accommodation forms from Program Counselors and documentation are **required** 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 4 (5:30 PM to 7:00 PM), in RICH 2520

STUDENTS MUST NOTIFY THE INSTRUCTOR OF ANY ACADEMIC CONFLICTS BY Friday, May 18. 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 before the drop date. Questions about the 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. Accommodation forms from Program Counselors and documentation are **required** within one week after the midterm. If a missed midterm is granted the final exam will be

reweighted to 65%.

6.6 Final 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, computers, tablets 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. Students are expected to be punctual, obey all safety instructions, cooperate with your lab partner and the lab demonstrator, follow good work habits in the lab, work efficiently and independently from your lab partner (where applicable), and wear proper apparel (lab coat, goggles, appropriate footwear).

Attendance:

Attendance at all laboratory periods is *mandatory*. Students missing **more than one lab without documentation** will not earn credit for the lab component of the course. Students missing **more than 2 laboratories, even with valid documentation (medical or compassionate), cannot pass the course**, and will earn a grade of 47% for the entire course. Please see your lab manual (page Intro-2) for details of these policies.

Laboratory sessions begin the week of May 14 (see Laboratory Schedule on Courselink and at the end of this document)

Location:

Science Complex 3110 and 3111. Each student must, in advance:

- Purchase a current laboratory manual; lab manuals will be sold in the MCB Admin Offices, SSC: 4481 during the first week of classes. Exact dates and times will be notified later. The lab manual cost is \$10, cash only; please bring exact change.
- Have a lab coat and approved safety goggles; these are required in all biochemistry labs.

Lab Quizzes and Write-up:

There will be a 10 min. quiz (2% each) at the start of each lab, in which you will be tested on the theory behind the day's experiment. Once the experiments are done, you will complete the Lab write-up (3% each) for that experiment in the lab itself and hand it in before you leave.

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.**

Lab times:

Attend the section assigned to you by the registrar. If you are unassigned for a lab or have a conflict, WebAdvisor now handles all lab section assignments. You must be assigned in time for your first laboratory in the week of May 14. The last 3 digits on your class schedule are your section number; e.g. for BIOC*2580*0101, the section number is 101.

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.uoguelph.ca/~ksomers/>

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 regulations and procedures for [Academic Consideration](#) are detailed in the Undergraduate Calendar.

9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for [Dropping Courses](#) are available in the Undergraduate Calendar.

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.

More information: www.uoguelph.ca/sas

9.6 Academic Misconduct

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](#) is detailed in the Undergraduate Calendar.

9.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate 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 which apply to undergraduate, graduate and diploma programs.

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