



BIOC*2580 Introduction to Biochemistry

Fall 2018

Section(s): C01,C02

Department of Molecular and Cellular Biology

Credit Weight: 0.50

Version 2.00 - September 06, 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 Timetable

Lectures

Section I: Tuesdays and Thursdays 8:30 AM to 9:50 AM, in ROZH 104

Section II: Tuesdays and Thursdays 11:30 AM to 12:50 PM, in ROZH 104

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

1.3 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: bioc2580@uoguelph.ca
Telephone: +1-519-824-4120 x56095
Office: SC1 3517
Office Hours: Tuesday 2:00-3:30 pm

2.2 Instructional Support Team

Lab Co-ordinator:	Jaspreet Kaur
Email:	bioc2580@uoguelph.ca
Telephone:	+1-519-824-4120 x58220
Office:	SC1 3521
Office Hours:	Email to book an appointment

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 multiple 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
5. Ebook only (no Sapling) (Could be purchased from Macmillan Learning student store.
The ebook option is not available through the bookstore)

***We will not be using Sapling Plus in the course.** It comes bundled with the textbook at no added cost. You can use the resources found there for your studies 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

Course Email: bioc2580@uoguelph.ca

You can make use of the course e-mail address to ask questions. Only use your @uoguelph account when sending messages to this address. Enquiries regarding the laboratory should have the word LAB in the subject line. E-mail may not be answered outside of office hours.

Supported Learning Group (SLG)

SLGs are free study sessions led by students. These trained SLG Leaders sit in on lectures and run sessions that are informal, flexible, and fun. Students who make regular use of the SLG have a higher average grade on this course than those who do not. SLG information and schedules are available in CourseLink.

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.

5 Teaching and Learning Activities

5.1 Lecture Schedule

Class	Date	Topic	Lehninger (6th ed)	Lehninger (7th ed)
1	Sept 6	Biological polymers; building blocks and hydrolyzable bonds. Amino acids, peptides and proteins.	11-15;76; 85-86	12-16;75-76;85-86
2	Sept 11	Amino acids, peptides and proteins (continued), Polarity and ionization of amino acids	75-85; 47-50;58-65	75-85; 47-50;58-65
3	Sept 13	Separation of amino acids and proteins by chromatography	89-96	47-50; 58-65
4	Sept 18	More analytical methods; Polypeptides and proteins: structural hierarchy, sequence. Basis of reactivity and hydrolysis	89-96; 96-102	89-96; 96-102
	Sep 19-25	Quiz 1		
5	Sept 20	Sequence determination, Secondary structure : α -helix, β -sheet,	96-102; 115-125	96-102; 115-125
6	Sept 25	Secondary structure : α -helix, β -sheet (continued)	115-125	115-125
7	Sept 27	Principles of tertiary structure. Protein stability and function	125-140; 189-200	125-141; 187-198
8	Oct 2	Binding and recognition of substrates and specificity of enzymes; The basis of chemical and enzymatic catalysis.	189-200	187-198
	Oct 3-10	Quiz 2		
9	Oct 4	Mechanism of action of chymotrypsin, Enzyme assay and detection	214-208; 95-96; 204-205	213-217; 95-96; 203
10	Oct 11	Enzyme assay and detection (continued), Enzyme kinetics	200-213	198-213

Class	Date	Topic	Lehninger (6th ed)	Lehninger (7th ed)
11	Oct 16	Experimental enzyme kinetics: linear plots, Enzyme inhibition and regulation.	200-213	198-213
12	Oct 18	Enzyme inhibition and regulation (continued), REVIEW SESSION	200-213	198-213
	Oct 20	Midterm Examination 1:00 - 2:30 pm		
13	Oct 23	Lipids: fatty acids	357-360	361-364
14	Oct 25	Lipids: triacylglycerols, phospholipids; Analysis of lipids; Carbohydrate chemistry: simple sugars	360-364; 377-379; 243-245	364-369; 381-383; 241-243
15	Oct 30	Carbohydrate Chemistry: linear and ring structures, Reducing sugars	245-248; 251	243-247; 249
16	Nov 01	Carbohydrate chemistry: glycosides, di and polysaccharides, Nucleic acid chemistry (RNA & DNA): nucleotides and polynucleotides	252-254; 281-287	250-252; 279-285
	Nov 2-8	Quiz 3		
17	Nov 06	The DNA double helix, ATP as cellular energy currency	287-290; 517-524	285-287; 507-514
18	Nov 08	ATP as cellular energy currency (continued), Introduction to metabolism; Redox reactions	517-524; 501-504; 528-538	507-514; 491-494; 517-522
19	Nov 13	Adenosine containing cofactors: Catabolism of Fats- fatty acid beta oxidation	635; 532-537; 667-675;	621; 522-526;

Class	Date	Topic	Lehninger (6th ed)	Lehninger (7th ed)
				649-650; 652-659
20	Nov 15	Fatty acid beta oxidation contd.; Glycolysis: anaerobic energy generation	667-677; 543-555;	652-659; 533-545
	Nov 16-22	Quiz 4		
21	Nov 20	Fates of pyruvate; Shuttle systems conveying cytosolic NADH to mitochondria, Pyruvate dehydrogenase complex, The Citric Acid Cycle	563-565 758-759; 633-635; 633; 638-650	619-624; 739-740; 553-558; 619; 624-636
22	Nov 22	Citric acid cycle cont.; The electron transport chain	638-647; 731-743	624-636; 7711-724
23	Nov 27	Chemiosmotic energy transduction; ATP synthase	743-747; 747-757	724-728; 728-739
24	Nov 29	ATP Synthase; Efficiency of oxidative phosphorylation	747-757; 675-676	728-739; 657-659
	Dec 3	Final Examination (8:30-10:30 am)		

5.2 Lab Schedule (Subject to Change)

LAB SCHEDULE-BIOC*2580 F'18 (subject to change)**Group A- All the odd number sections (eg: BIOC*2580*0101)**

WEEK #	Dates	Activity
1	Sept 10-14	Sign-up-Second hour of the lab time
2	Sept 17-21	Lab 1: Amino Acids, Quiz 1
3	Sept 24-28	No Labs
4	Oct 1-5	Lab 2: Proteins,Quiz 2
5	Oct 8-12	No Labs
6	Oct 15-19	No Labs
7	Oct 22-26	Lab 3: Enzymes,Quiz 3
8	Oct 29- Nov 2	No Labs
9	Nov 5-9	Lab 4: Lipids,Quiz 4
10	Nov 12-16	No Labs
11	Nov 19-23	Lab 5: Carbohydrates,Quiz 5
12	Nov 26-30	No Labs

Group B -All the even number sections (eg: BIOC*2580*0102)

WEEK #	Dates	Activity
1	Sept 10-14	Sign-up-First hour of the lab time
2	Sept 17-21	No Labs
3	Sept 24-28	Lab 1: Amino Acids, Quiz 1
4	Oct 1-5	No Labs
5	Oct 8-12	No Labs

LAB SCHEDULE-BIOC*2580 F'18 (subject to change)		
6	Oct 15-19	Lab 2: Proteins, Quiz 2
7	Oct 22-26	No Labs
8	Oct 29- Nov 2	Lab 3: Enzymes, Quiz 3
9	Nov 5-9	No Labs
10	Nov 12-16	Lab 4: Lipids, Quiz 4
11	Nov 19-23	No Labs
12	Nov 26-30	Lab 5: Carbohydrates, Quiz 5

6 Assessments

6.1 Grade Assessments

Form of Assessment	Weight of Assessment (% of final)	Due Date of Assessment	Course Content /Activity	Learning Outcome Addressed
Online Quiz #1	2.5%	September 19 - 25, 2018	Lectures 1-4	#1, 2, 8
Online Quiz #2	2.5%	October 3 - 10, 2018	Lectures 5-8	#2, 3, 8
Midterm	25%	October 20, 2018	Lectures 1-12	#1, 2, 3, 4, 8
Online Quiz #3	2.5%	November 2 - 8, 2018	Lectures 13-16	#5, 8
Online Quiz #4	2.5%	November 16 - 22, 2018	Lectures 17-20	#5, 6, 8

Form of Assessment	Weight of Assessment (%) (% of final)	Due Date of Assessment	Course Content /Activity	Learning Outcome Addressed
Final Exam	40%	December 3, 2018	Cumulative, with emphasis on lectures 13-24	#1-6, 8
Laboratories	25%	Bi-Weekly	Laboratory experiments and write-up	#7, 8

Lecture Component: 75%

Laboratory Component: 25%

Total: 100%

6.2 Note

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.

6.3 Lecture Component

LECTURE COMPONENT

ONLINE QUIZZES:

Sep 19-25, Oct 3-10, Nov 2-8 and Nov 16-22

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 one week. 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 grades, answers and feedback: Students will be granted access to the feedback and 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: The quiz cannot be extended beyond the one week 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 one-week 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.**

MIDTERM EXAM:

Saturday, October 20, 1:00 - 2:30 pm in ROZH 101,103 and 104

STUDENTS MUST NOTIFY THE INSTRUCTOR OF ANY ACADEMIC CONFLICTS BY Friday, September 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 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%.

FINAL EXAM:

Monday, December 3, 8:30-10:30 am

This exam will **cover the entire course (lectures 1-24)**, 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.

6.4 Laboratory Component

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 September 10 (see Laboratory Schedule on Courselink and at the end of this document)

Location:

Science Complex 3110, 3111 and 3112. Each student must, in advance:

- Purchase a current laboratory manual; The dates, times and location for the lab manual sale will be notified via email. 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 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 bioc2580@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 September 10. The last 3 digits on your class schedule are your section number; e.g. for BIOC*2580*0110, the section number is 110. Please follow the Lab Schedule given on the last page of this document.

7 Course Statements

7.1 Themes

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

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

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.
- 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](#) and [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.
 - [Student Health Services](#) 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 and one-on-one sessions related to [stress management and high performance situations](#).
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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.
