

**DEPARTMENT OF MOLECULAR AND CELLULAR BIOLOGY  
UNIVERSITY OF GUELPH  
BIOC\*2580  
INTRODUCTION TO BIOCHEMISTRY  
Winter 2017, 0.5 credits**

**Course Information**

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.

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.

**LECTURES**

Monday, Wednesday & Friday 1:30 PM to 2:20 PM, in ROZH 104

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

**Instructor**

Dr. Enoka Wijekoon

Science Complex Room 3517

Office hours: Tues 2:00-3:30 pm and Wed 3:00 pm – 4:30 pm

Email: [bioc2580@uoguelph.ca](mailto:bioc2580@uoguelph.ca)

**Lab Coordinator**

Jaspreet Kaur

Science Complex Room 3521

Office hours: Email [jkaur@uoguelph.ca](mailto:jkaur@uoguelph.ca) to book an appointment**GRADE ASSESSMENT**

<b>Form of Assessment</b>	<b>Weight of Assessment (% of final)</b>	<b>Due Date of Assessment</b>	<b>Course Content /Activity</b>	<b>Learning Outcome Addressed</b>
Online Quiz #1	2.5%	January 21-27, 2017	Lectures 1-6	#1, 2, 8
Online Quiz #2	2.5%	February 4-10, 2017	Lectures 7-12	#2, 3, 8
Midterm	25%	<b>March 4, 2017</b>	Lectures 1-18	#1, 2, 3, 4, 8
Online Quiz #3	2.5%	March 11-17, 2017	Lectures 19-24	#5, 8
Online Quiz #4	2.5%	March 25-31, 2017	Lectures 25-30	#5, 6, 8
Final Exam	40%	April 10, 2017	Cumulative, with emphasis on lectures 19-36	#1-6, 8
Laboratories	25%	Bi-Weekly	Laboratory experiments and write-up	#7, 8

**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*.

## I. LECTURE COMPONENT

### ONLINE QUIZZES:

**Jan 21-27, Feb 4-10, March 11-17 and March 25-31**

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, the mark you got for each question (from which you can determine which questions you answered correctly and which you answered incorrectly) and any feedback if available 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 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, March 4 (5:30 PM to 7:00 PM), in ROZH 104**

**STUDENTS MUST NOTIFY THE INSTRUCTOR OF ANY ACADEMIC CONFLICTS BY Friday, January 20.** 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, April 10, 2017

This exam will **cover the entire course (lectures 1-36)**, 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.

## II. 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 January 9 (see Laboratory Schedule at the end of this document)**

### Location:

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

- (i) Purchase a current laboratory manual; lab manuals will be sold in the Science Complex (room 2302) on January 9<sup>th</sup>, 10<sup>th</sup> and 11<sup>th</sup> (3 days only), from 9:30 am - 12pm and from 1 pm – 3:30 pm. The lab manual cost is \$10, cash only; please bring exact change.
- (ii) Have a lab coat and approved safety goggles; these are required in all biochemistry laboratories.

### 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](mailto: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 January 9. 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.

### 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, 6<sup>th</sup> ed. (2013) **OR** 5<sup>th</sup> ed. (2008) W.H. Freeman, NY.

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

There are three purchase options to choose from:

- 1) The hardcover textbook + Launchpad<sup>‡</sup> + study guide
- 2) The loose leaf textbook + Launchpad + study guide or
- 3) Launchpad only.

<sup>‡</sup> Launchpad is the publisher's online/digital system which includes 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.**

### **GETTING HELP IN BIOC\*2580**

Course Email: [bioc2580@uoguelph.ca](mailto:bioc2580@uoguelph.ca)

**You can make use of the course e-mail address to ask questions. Only use your @mail.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.

### **Learning Outcomes for the course**

By the end of this course successful students will 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.

## **Standard University Course Policies**

### **E-mail Communication:**

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

### **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 the lab demonstrator if it concerns the labs) in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

[Undergraduate Calendar - Academic Consideration](#)

### **Drop Date:**

The last date to drop winter semester courses, without academic penalty, is **March 10th, 2017**. See the schedule of dates in the Undergraduate Calendar. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar: [Undergraduate Calendar - Dropping Courses](#)

### **Accessibility:**

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact Student Accessibility Services (SAS) as soon as possible. For more information, contact SAS at 519-824-4120 ext. 56208 or email [csd@uoguelph.ca](mailto:csd@uoguelph.ca) or see the website: [Student Accessibility Services \(SAS\)](#)

### **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: [Undergraduate Calendar - Academic Misconduct](#)

### **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.

### **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: [Academic Calendars](#)

### **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.

## LECTURE SCHEDULE

Class	Date	Topic	Lehninger (5th ed)	Lehninger (6th ed)
1	Jan 9	Biological polymers; building blocks and hydrolyzable bonds. Amino acids, peptides and proteins.	11-14; 72; 82-84	11-15; 76; 85-86
2	Jan 11	Amino acids; polarity and ionization.	71-81	75-85
3	Jan 13	Properties of aqueous solutions; dissociation of weak electrolytes	43-66	47-70
4	Jan 16	Analytical methods and separation by chromatography	85-92	89-96
5	Jan 18	More analytical methods	85-92	89-96
6	Jan 20	Polypeptides and proteins: structural hierarchy, sequence. Basis of reactivity and hydrolysis	92-100	96-102
	<b>Jan 21-27</b>	<b>Quiz 1 (Lectures 1-6)</b>		
7	Jan 23	Sequence determination	92-100	96-102
8	Jan 25	Secondary structure I: $\alpha$ -helix, $\beta$ -sheet.	113-123	115-125
9	Jan 27	Secondary structure II: $\alpha$ -helix, $\beta$ -sheet.	113-123	115-125
10	Jan 30	Principles of tertiary structure	123-138	125-140
11	Feb 1	Binding and recognition of substrates and specificity of enzymes	183-194	189-200
12	Feb 3	The basis of chemical and enzymatic catalysis.	183-194	189-200
	<b>Feb 4-10</b>	<b>Quiz 2 (lectures 7-12)</b>		
13	Feb 6	Mechanism of action of chymotrypsin.	205-211	214-218
14	Feb 8	Enzyme assay and detection	194-205	200-213
15	Feb 10	Enzyme kinetics	194-205	200-213
16	Feb 13	Enzyme kinetics: linear plots	194-205	200-213
17	Feb 15	Enzyme Inhibition and regulation	194-205	200-213
18	Feb 17	Enzyme Inhibition and regulation(continued); Review	194-205	200-213
	<b>Feb 20-24</b>	<b>Winter Break - No classes</b>		
19	Feb 27	Lipids: fatty acids; TAG	343-349	357-362
20	March 1	Lipids: Phospholipids; Analysis of lipids	349-350; 363-365	362-364; 377-379
21	March 3	Carbohydrate chemistry: simple sugars	235-236	243-245
	<b>March 4</b>	<b>Midterm Examination 5:30- 7:00 pm in RozH 104</b>		
22	March 6	Carbohydrate chemistry: rings; reducing sugars	238-239; 241	245-248; 251
23	March 8	Carbohydrate chemistry: glycosides and disaccharides	241-245	252-254
24	March 10	Chemistry of nucleic acid bases, nucleosides and polynucleotides	271-277	281-287
	<b>March 11-17</b>	<b>Quiz 3 (Lectures 19-24)</b>		



25	March 13	The DNA double helix	277-280	287-290
26	March 15	ATP as cellular energy currency	501-509	517-524
27	March 17	Introduction to Metabolism: Redox reactions	485-488; 512-516	501-504; 528-538
28	March 20	Catabolism of fats	617;647	665;667
29	March 22	Fatty acid $\beta$ -oxidation	647-656; 516-521	667-677; 532-537
30	March 24	Glycolysis: anaerobic energy generation	527-538	543-555
	<b>March 25-31</b>	<b>Quiz 4 (Lectures 25-30)</b>		
31	March 27	Fates of pyruvate and cytosolic NADH; fermentation	731-732; 616-620; 546-549	758-759; 633-638; 563-565
32	March 29	Acetate to CO <sub>2</sub> : the citric acid cycle	615; 620- 631	633; 638- 650
33	March 31	The electron transport chain	707-718	731-743
34	April 3	Chemiosmotic energy transduction	718-722	743-747
35	April 5	ATP Synthase	723-731	747-757
36	April 7	Efficiency of Oxidative Phosphorylation	656	675-676
	<b>April 10</b>	<b>Final Examination - 2:30 pm - 4:30 pm</b>		

<b>LAB SCHEDULE-BIOC*2580 W'17 (subject to change)</b>		
<b>Group A- All the odd number sections (eg: BIOC*2580*0101)</b>		
WEEK #	Dates	Activity
1	Jan 9-13	Sign-up- First hour of the lab time
2	Jan 16-20	Lab 1: Amino Acids, Quiz 1
3	Jan 23-27	No Labs
4	Jan 30-Feb 3	Lab 2: Proteins, Quiz 2
5	Feb 6-10	No Labs
6	Feb 13-17	Lab 3: Enzymes, Quiz 3
7	Feb 20-24	Winter Break- No Labs
8	Feb 27-Mar 3	No Labs
9	Mar 6-10	Lab 4: Lipids, Quiz 4
10	Mar 13-17	No Labs
11	Mar 20-24	Lab 5: Carbohydrates, Quiz 5
12	Mar 27-31	No Labs
<b>Group B -All the even number sections (eg: BIOC*2580*0102)</b>		
WEEK #	Dates	Activity
1	Jan 9-13	Sign-up-Second hour of the lab time
2	Jan 16-20	No Labs
3	Jan 23-27	Lab 1: Amino Acids, Quiz 1
4	Jan 30-Feb 3	No Labs
5	Feb 6-10	Lab 2: Proteins, Quiz 2
6	Feb 13-17	No Labs
7	Feb 20-24	Winter Break No Labs
8	Feb 27-Mar 3	Lab 3: Enzymes, Quiz 3
9	Mar 6-10	No Labs
10	Mar 13-17	Lab 4: Lipids, Quiz 4
11	Mar 20-24	No Labs
12	Mar 27-31	Lab 5: Carbohydrates, Quiz 5