

**DEPARTMENT OF MOLECULAR AND CELLULAR BIOLOGY  
UNIVERSITY OF GUELPH  
BIOC\*2580  
INTRODUCTION TO BIOCHEMISTRY  
Summer 2016, 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 9:30 AM to 11:20 AM, in RICH 2529

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: Mon 2:00-3:30 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

Form of Assessment	Weight of Assessment (% of final)	Due Date of Assessment	Course Content /Activity	Learning Outcome Addressed
Online Quiz #1	2.5%	May 19-22, 2016	Lectures 1-3	#1, 2, 8
Online Quiz #2	2.5%	May 28-31, 2016	Lectures 4-6	#2, 3, 8
Midterm	25%	<b>June 6, 2016</b>	Lectures 1-9	#1, 2, 3, 4, 8
Online Quiz #3	2.5%	June 11-14, 2016	Lectures 10-12	#5, 8
Online Quiz #4	2.5%	June 18-21, 2016	Lectures 13-15	#5, 6, 8
Final Exam	40%	June 29, 2016	Cumulative, with emphasis on lectures 10-18	#1-6, 8
Laboratories	25%	Weekly	Laboratory experiments, lab quizzes 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:

**May 19-22, May 28-31, June 11-14 and June 18-21**

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:** 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.**

#### MIDTERM EXAM:

**Monday, June 6 (5:30 PM to 6:45 PM), in RICH 2520**

**STUDENTS MUST NOTIFY THE INSTRUCTOR OF ANY ACADEMIC CONFLICTS BY Friday, May 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: Wednesday, June 29, 2016 (9:30 -11:30 AM)

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.

## 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 May 16 (see Laboratory Schedule on Courselink and at the end of this document)**

### Location:

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

- (i) Purchase a current laboratory manual; lab manuals will be sold in the MCB Admin Offices, SSC 4479 on May 11, 12, 16, 17 & 18<sup>th</sup> (5 days only), from 9 am – 11am and from 1 pm – 3 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 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 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 [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 May 16. The last 3 digits on your class schedule are your section number; e.g. for BIOC\*2580\*0101, the section number is 101.

## 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 options, each containing the same information, but in slightly different formats:

- 1) The hardcover textbook bundled with an eBook;
- 2) The loose leaf textbook with an eBook, or
- 3) The eBook only.

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 summer session courses, without academic penalty, is **June 9th, 2016**. 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 (5 <sup>th</sup> ed)	Lehninger (6 <sup>th</sup> ed)
1	May 13	Biological polymers; building blocks and hydrolyzable bonds. Amino acids, peptides and proteins.	11-14; 72; 82-84	11-15; 76; 85-86
		Amino acids; polarity and ionization.	71-81	75-85
2	May 16	Properties of aqueous solutions; dissociation of weak electrolytes.	43-66	47-70
		Analytical methods and separation by chromatography.	85-92	89-96
3	May 18	More analytical methods.	85-92	89-96
		Polypeptides and proteins: structural hierarchy, sequence. Basis of reactivity and hydrolysis.	92-100	96-102
	<b>May 19-22</b>	<b>Quiz 1 (Lectures 1-3)</b>		
4	May 20	Sequence determination.	92-100	96-102
		Secondary structure I: $\alpha$ -helix, $\beta$ -sheet.	113-123	115-125
5	May 25	Secondary structure II: $\alpha$ -helix, $\beta$ -sheet.	113-123	115-125
		Principles of tertiary structure.	123-138	125-140
6	May 27	Binding and recognition of substrates and specificity of enzymes.	183-194	189-200
		The basis of chemical and enzymatic catalysis.	183-194	189-200
	<b>May 28-31</b>	<b>Quiz 2 (lectures 4-6)</b>		
7	May 30	Enzyme kinetics.	194-205	200-213
		Experimental enzyme kinetics: linear plots.	194-205	200-213
8	June 1	Enzyme inhibition and regulation.	194-205	200-213
		Mechanism of action of chymotrypsin.	205-211	214-218
9	June 3	Enzyme assay and detection.	194-205	200-213
		REVIEW		
10	June 6	Lipids: fatty acids; TAG	343-349	357-362
		Phospholipids; Analysis of lipids	349-350; 363-365	362-364; 377-379
		<b>Midterm Examination 5:30 pm - 6:45 pm</b>		
11	June 8	Carbohydrate chemistry: simple sugars	235-238	243-245
		Carbohydrate chemistry: rings; Reducing sugars	238-239; 241	245-248; 251
12	June 10	Carbohydrate chemistry: glycosides and disaccharides	241-245	252-254
		Chemistry of nucleic acid bases, nucleosides and polynucleotides	271-277	281-287
	<b>June 11-14</b>	<b>Quiz 3 (Lectures 10-12)</b>		
13	June 13	The DNA double helix	277-280	287-290
		ATP as cellular energy currency	501-509	517-524
14	June 15	Adenosine-containing cofactors	516-521; 617	532-537; 635
		Metabolic pathways	485-488	501-504



15	June 17	Redox reactions; Catabolism of fats	512-516; 647	528-538; 667
		Fatty acid $\beta$ -oxidation	650-656	670-677
	<b>June 18-21</b>	<b>Quiz 4 (Lectures 13-15)</b>		
16	June 20	Glycolysis: anaerobic energy generation	527-538	543-555
		Fates of pyruvate and cytosolic NADH; fermentation	731-732; 616-620; 546- 549	758-759; 633-638; 563-565
17	June 22	Acetate to CO <sub>2</sub> : the citric acid cycle	615; 620- 631	633; 638- 650
		The electron transport chain	707-718	731-743
18	June 23	Chemiosmotic energy transduction	718-722	743-747
		ATP Synthase	723-731	747-757
	<b>June 29</b>	<b>Final examination 9:30 AM – 11:30 AM</b>		

**LAB SCHEDULE** (Subject to change)

<b>WEEK #</b>	<b>Dates</b>	<b>Activity</b>
<b>1</b>	<b>May 17-19</b>	<b>Lab 1: Amino Acids, Quiz 1</b>
<b>2</b>	<b>May 24-26</b>	<b>Lab 2: Proteins, Quiz 2</b>
<b>3</b>	<b>May 31- June 2</b>	<b>Lab 3: Enzymes, Quiz 3</b>
	<b>Mon, Jun-06</b>	<b>Midterm Exam 5:30 – 6:45 PM</b>
<b>4</b>	<b>June 7-9</b>	<b>Lab 4: Lipids, Quiz 4</b>
<b>5</b>	<b>June 14-16</b>	<b>Lab 5: Carbohydrates, Quiz 5</b>
	<b>Wed, Jun-29</b>	<b>Final Exam 9:30- 11:30 AM</b>