

DEPARTMENT OF MOLECULAR AND CELLULAR BIOLOGY
UNIVERSITY OF GUELPH
BIOC*2580
INTRODUCTION TO BIOCHEMISTRY
Winter 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 1:30 PM to 2:20 PM, in WMEM 103

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 9:30 am – 11:00 am

Email: bioc2580@uoguelph.ca

Lab Coordinator

Jaspreet Kaur

Science Complex Room 3521

Office hours: Email 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% | January 23-29, 2016 | Lectures 1-6 | #1, 2, 8 |
| Online Quiz #2 | 2.5% | February 6-12, 2016 | Lectures 7-12 | #2, 3, 8 |
| Midterm | 25% | February 27, 2016 | Lectures 1-17 | #1, 2, 3, 4, 8 |
| Online Quiz #3 | 2.5% | March 10-16, 2016 | Lectures 18-23 | #5, 8 |
| Online Quiz #4 | 2.5% | March 24-30, 2016 | Lectures 24-29 | #5, 6, 8 |
| Final Exam | 40% | April 21, 2016 | Cumulative, with emphasis on lectures 18-35 | #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 23-29, Feb 6-12, March 10-16 and March 24-30

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 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, February 27 (3:00 PM to 4:15 PM), in ROZH 104

STUDENTS MUST NOTIFY THE INSTRUCTOR OF ANY ACADEMIC CONFLICTS BY Friday, January 22. 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: Thursday, April 21, 2016

This exam will **cover the entire course (lectures 1-35)**, 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 11 (see Laboratory Schedule on Courselink and 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 11th, 12th and 13th (3 days only), from 10 am - 12pm 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 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 January 11. 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, 6th ed. (2013) **OR** 5th 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

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 11th, 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 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 11 | Biological polymers; building blocks and hydrolyzable bonds. Amino acids, peptides and proteins. | 11-14; 72; 82-84 | 11-15; 76; 85-86 |
| 2 | Jan 13 | Amino acids; polarity and ionization. | 71-81 | 75-85 |
| 3 | Jan 15 | Properties of aqueous solutions; dissociation of weak electrolytes | 43-66 | 47-70 |
| 4 | Jan 18 | Analytical methods and separation by chromatography | 85-92 | 89-96 |
| 5 | Jan 20 | More analytical methods | 85-92 | 89-96 |
| 6 | Jan 22 | Polypeptides and proteins: structural hierarchy, sequence. Basis of reactivity and hydrolysis | 92-100 | 96-102 |
| | Jan 23-29 | Quiz 1 | | |
| 7 | Jan 25 | Sequence determination | 92-100 | 96-102 |
| 8 | Jan 27 | Secondary structure I: a-helix, b-sheet. | 113-123 | 115-125 |
| 9 | Jan 29 | Secondary structure II: a-helix, b-sheet. | 113-123 | 115-125 |
| 10 | Feb 1 | Principles of tertiary structure | 123-138 | 125-140 |
| 11 | Feb 3 | Binding and recognition of substrates and specificity of enzymes | 183-194 | 189-200 |
| 12 | Feb 5 | The basis of chemical and enzymatic catalysis. | 183-194 | 189-200 |
| | Feb 6-12 | Quiz 2 | | |
| 13 | Feb 8 | Mechanism of action of chymotrypsin. | 205-211 | 214-218 |
| 14 | Feb 10 | Enzyme assay and detection | 194-205 | 200-213 |
| 15 | Feb 12 | Enzyme kinetics | 194-205 | 200-213 |
| | Feb 15-19 | Winter Break - No classes | | |
| 16 | Feb 22 | Enzyme kinetics: linear plots | 194-205 | 200-213 |
| 17 | Feb 24 | Enzyme Inhibition and regulation | 194-205 | 200-213 |
| 18 | Feb 26 | Lipids: fatty acids | 343-345 | 357-360 |
| | Feb 27 | Midterm Examination 3:00- 4:15 pm in RozH 104 | | |
| 19 | Feb 29 | Lipids:TAG, Phospholipids; Analysis of lipids | 346-351; 363-365 | 360-364; 377-379 |
| 20 | March 2 | Carbohydrate chemistry: simple sugars | 235-236 | 243-244 |
| 21 | March 4 | Carbohydrate chemistry: rings; reducing sugars | 236-239; 241 | 244-248; 251 |
| 22 | March 7 | Carbohydrate chemistry: glycosides and disaccharides | 243-246 | 252-255 |
| 23 | March 9 | Chemistry of nucleic acid bases, nucleosides and polynucleotides | 271-277 | 281-287 |
| | March 10-16 | Quiz 3 | | |
| 24 | March 11 | The DNA double helix | 277-280 | 287-290 |
| 25 | March 14 | ATP as cellular energy currency | 501-509 | 517-524 |
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|----|--------------------|---|---------------------------------|---------------------------------|
| 26 | March 16 | Adenosine-containing cofactors | 516-521; 617 | 532-537; 635 |
| 27 | March 18 | Metabolic pathways | 485-488 | 501-504 |
| 28 | March 21 | Redox reactions; Catabolism of fats | 512-516; 647 | 528-538; 667 |
| 29 | March 23 | Fatty acid β -oxidation | 650-656 | 670-677 |
| | March 24-30 | Quiz 4 | | |
| 30 | March 28 | Glycolysis: anaerobic energy generation | 527-538 | 543-555 |
| | | | | |
| 31 | March 30 | Fates of pyruvate and cytosolic NADH; fermentation | 731-732; 616-620; 546-549 | 758-759; 633-638; 563-565 |
| 32 | April 1 | Acetate to CO ₂ : the citric acid cycle | 615; 620- 631 | 633; 638- 650 |
| 33 | April 4 | The electron transport chain | 707-718 | 731-743 |
| 34 | April 6 | Oxidative Phosphorylation | 718-722 | 743-747 |
| 35 | April 8 | ATP Synthase | 723-731 | 747-757 |
| | April 21 | Final Examination - 2:30 pm - 4:30 pm | | |

| LAB SCHEDULE-BIOC*2580 W'16 (subject to change) | | |
|---|--------------|-------------------------------------|
| Group A- All the odd number sections (eg: BIOC*2580*0101) | | |
| WEEK # | Dates | Activity |
| 1 | Jan 11-14 | Sign-up- First hour of the lab time |
| 2 | Jan 19-21 | Lab 1: Amino Acids, Quiz 1 |
| 3 | Jan 25-28 | No Labs |
| 4 | Feb 2-4 | Lab 2: Proteins, Quiz 2 |
| 5 | Feb 8-11 | No Labs |
| 6 | Feb 15-19 | Winter Break- No Labs |
| 7 | Feb 25-25 | Lab 3: Enzymes, Quiz 3 |
| 8 | Feb 29-Mar 3 | No Labs |
| 9 | Mar 8-10 | Lab 4: Lipids, Quiz 4 |
| 10 | Mar 14-17 | No Labs |
| 11 | Mar 22-24 | Lab 5: Carbohydrates, Quiz 5 |
| 12 | Mar 28-31 | No Labs |
| | | |
| Group B -All the even number sections (eg: BIOC*2580*0102) | | |
| WEEK # | Dates | Activity |
| 1 | Jan 11-14 | Sign-up-Second hour of the lab time |
| 2 | Jan 19-21 | No Labs |
| 3 | Jan 25-28 | Lab 1: Amino Acids, Quiz 1 |
| 4 | Feb 2-4 | No Labs |
| 5 | Feb 8-11 | Lab 2: Proteins, Quiz 2 |
| 6 | Feb 15-19 | Winter Break No Labs |
| 7 | Feb 23-25 | No Labs |
| 8 | Feb 29-Mar 3 | Lab 3: Enzymes, Quiz 3 |
| 9 | Mar 8-10 | No Labs |
| 10 | Mar 14-17 | Lab 4: Lipids, Quiz 4 |
| 11 | Mar 22-24 | No Labs |
| 12 | Mar 28-31 | Lab 5: Carbohydrates, Quiz 5 |

Introductory Week Laboratory Timings

| | 9:30-10:30 am | 10:00-11:00 am | 2:30- 3:30 pm | 3:30 - 4:30 pm |
|--------------------|--|--|---|---|
| Mon, Jan 11 | | | | SSC 3110 - Section 102 SSC 3111 - Section 104 SSC 3112 - Section 126 |
| Tue, Jan 12 | | SSC 3110 - Section 101 SSC 3111 - Section 103 | | SSC 3110 - Section 110 SSC 3111 - Section 112 SSC 3112 - Section 128 |
| Wed, Jan 13 | SSC 3110 - Section 109 SSC 3111 - Section 111 | | SSC 3110 - Section 113 SSC 3111 - Section 115 SSC 3112 - Section 121 | SSC 3110 - Section 114 SSC 3111 - Section 116 |
| Thu, Jan 14 | | SSC 3110 - Section 117 SSC 3111 - Section 119 | | SSC 3110 - Section 122 SSC 3111 - Section 124 SSC 3112 - Section 130 |