BIOC*3560 Structure and Function in Biochemistry

Winter 2018
Sections(s): C01

College of Biological Science
Credit Weight: 0.50
Version 1.00 - January 02, 2018

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1 Course Details

1.1 Calendar Description

This course develops the understanding of biochemical processes by examining the molecular mechanisms underlying the regulation of specific cellular and physiological systems. Examples may include: oxygen binding and transport; regulation of enzyme function; carbohydrate and lipid metabolic pathways and metabolic integration; structure of membranes and membrane proteins; and membrane transport and signaling.

Pre-Requisite(s): BIOC*2580

1.2 Course Description

This course develops the understanding of biochemical processes by examining the molecular mechanisms underlying the regulation of specific cellular and physiological systems. Examples may include: oxygen binding and transport; regulation of enzyme function; carbohydrate and lipid metabolic pathways and metabolic integration; structure of membranes and membrane proteins; and membrane transport and signalling.

1.3 Timetable

Monday/Wednesday/Friday, 9:30 – 10:20 am, WMEM 103

1.4 Final Exam

Friday, April 13, 2:30 – 4:30 pm (location **TBA**). The final exam is cumulative. Students who score a significantly higher grade on the Final Exam, compared with the midterm, may receive a higher weighting of the final exam (midterm: 25%, final: 75%), at the instructor's discretion. A significantly higher grade is one that is 25 percentage points or higher.

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2 Instructional Support

2.1 Instructor(s)

Matthew Kimber

Email:	mkimber@uoguelph.ca
Telephone:	+1-519-824-4120 x52568
Office:	SCI 2254
Office Hours:	From Jan 8th until Feb 16th: Tuesdays, 10:30 am – noon Fridays, 1:30 – 3:00 pm Additional office hours will be offered before the final exam. Other times can be arranged by appointment upon request.

Dr. Kimber will be teaching until the mid semester break, and will cover topics A-C.

Manfred Brauer	
Email:	mbrauer@uoguelph.ca
Telephone:	+1-519-824-4120 x53795
Office:	SC1 3520
Office Hours:	MWF 10:30 - 11:30 a.m.

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3 Learning Resources

3.1 Required Resources(s)

Courselink (Website)
There is a Courselink site for this course. Course-related information will be posted there.

3.2 Recommended Resources(s)

Textbook (Textbook)
Lehninger Principles of Biochemistry By Nelson and Cox

7th or 6th Edition; Freeman Publishers

Available at the Bookstore

Several copies of the 6th and 7th Editions are on reserve (2 hour loan) at the Library Reserve Desk.

Problem Sets (Other)
Periodically throughout the semester, problem sets will be posted. These exercises are for review/practice purposes; answers will be posted, no marks will be assigned.

3.3 Assigned Reading

Chapter and page numbers below are from Lehninger Principles of Biochemistry 7th and 6th Editions. We will be using figures mainly from the 6th Ed.; however, the material covered by the course is similar in both, and purchase of a hardcopy version 6th or 7th Ed. is not required. Note that an electronic version is included with the purchase of Sapling Learning.

Part A - Regulation of Protein Function (Chapters 5, 6 and 12)

The Oxygen-binding Proteins	6th Ed.	7th Ed.
Protein-ligand Interactions I	157-158	158-159
Myoglobin Structure/Function	158-159	158-159
Protein-ligand Interactions II	159-163	159-163
Hemoglobin	163-167	163-167
Cooperative Ligand Binding, Hill Equation	167-169	167-169
Hemoglobin and $O_2/H^+/CO_2$ Transport	169-172+	169-172+
	Box 5-1	Box 5-1
Regulatory Enzymes		
Review Enzyme Function	189-203	187-201
Regulatory Enzymes	226-228	225-228
Enzyme Regulation by Reversible Covalent Modification	228-229	228-229
Phosphorylation		
Glycogen phosphorylase, glycogen synthase:	229-231	229-230
Modulation by Proteolytic Cleavage:	231-232	230-232
Chymotrypsin	214-218	213-215
Caspases	492-494	485-487
Complex Regulation of Enzyme Activity	235-236	235-236
Cyclin-dependent kinases	484-488	476-481

Research article: Stieglitz et al. Structure of the E. coli Aspartate Transcarbamoylase Trapped in the Middle of the Catalytic Cycle (2005) *Journal of Molecular Biology* 352, 478-486.

Part B - Regulation and Integration of Carbohydrate Metabolism (Chapters 14, 15)

Carbohydrate Metabolism	6th Ed.	7th Ed.
Regulation of Metabolic Pathways	501-504	491-494
Review of Glycolysis	543-555	533-545
Gluconeogenesis	568-575	558-565
Pentose Phosphate Pathway	575-580	565-570

Reciprocal Regulation of Glycolysis and Gluconeogenesis	601-608	589-596
Glycogen Metabolism	612-620	601-608
Coordinated Regulation of Glycogen Synthesis and Breakdown	620-627	608-614

Part C - Regulation and Integration of Lipid Metabolism (Chapters 17, 21, 23)

Lipid Metabolism	**6th Ed.**	**7th Ed.**
Fatty Acid Catabolism	667-672	649-654
Mobilization and Oxidation of Fatty Acids	672-679	654-664
Ketone Bodies	686-688	668-670
Fatty Acid Biosynthesis	833-848	811-826
Triacylglycerol Metabolism	848-850	826-829
Integration of Metabolism		
Tissue-specific Metabolism	939-951	918-930
Hormonal Regulation of Fuel Metabolism	623-627, 951-959	609-614, 930-938
Diabetes	959-960	938-939

Part D – Membranes, Transport and Biosignalling (Chapters 10-12)

Membranes and Transport	**6th Ed.**	**7th Ed.**
Review of Lipids	357-362	361-366
Membrane Lipids	362-370	366-374
Membrane Structure and Function	385-389	387-391
Membrane Proteins	389-395	391-397

Membrane Dynamics and Fusion	395-402	397-405
Transport Across Membranes; ATPase Ion Pumps	402-420	405-425
Ion Selectivity	420-427	425-429
<u>Biochemical Signaling</u>		
Introduction to Biosignaling	433-437	437-440
Gated Ion Channels; Synaptic Transmission	464-470	471-473
Receptor Enzymes	453-459	461-465
G Protein-coupled Receptors and 2nd Messengers	437-447	440-451
Steroid Hormone Receptors	471-472, 1182-1184	473-474, 1155- 1157

3.3 Campus Resources

If you are concerned about any aspect of your academic program: Make an appointment with a Program Counsellor in your degree program.

If you are struggling to succeed academically: 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.

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.

If you have a documented disability or think you may have a disability: Student Accessibility Services (SAS) formerly Centre for Students with Disabilities can provide services

and support for students with a documented learning or physical disability. They can also provide information about how to be tested for a learning disability.

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4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Describe structure/function relationships of proteins at the amino acid level, and how this contributes to ligand-binding and enzyme activity.
2. Describe the regulation of proteins by post-translational modifications and allosteric affectors.
3. Explain how regulatory enzymes are controlled in the regulation of pathways of carbohydrate and fatty acid metabolism in mammals. Explain the biochemical mechanisms that mediate signaling of these pathways at the tissue, organ and organism level.
4. Describe how proteins and lipids define the structure and function of biological membranes. Explain the ways in which substances can be transported across membrances and the energy requirements for such transport.
5. Describe the biochemical mechanisms by which signals are propagated across the membrane and within a cell.

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5 Teaching and Learning Activities

5.1 Lecture

Topic(s): Lectures

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6 Assessments

Online Quizes:

The online quizzes are administered through “Sapling Plus” associated with Lehninger Principles of Biochemistry 7th edition. They 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 each question and each quiz will be kept open for a period of one week. You can start the quiz any time during this 1-week period. However, once you start an attempt you will have 2 hours to complete it. Students registered with the SAS need to confirm their accommodation with the professor.

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 the end date.

6.1 Marking Schemes & Distributions

Scheme A - Students who opt-in into Sapling Learning

Scheme B- Students who opt-out of Sapling Learning

Name	Scheme A (%)	Scheme B (%)
Online Quiz #1	2.50	0.00
Online Quiz #2	2.50	0.00
Midterm Examination	35.00	40.00
Online Quiz #3	2.50	0.00
Online Quiz #4	2.50	0.00
Final Examination	55.00	60.00
Total	100.00	100.00

6.2 Assessment Details

Quiz 1 (2.50%)
Date: Sun, Jan 21 - Sat, Jan 27

Quiz 2 (0.00%)
Date: Sun, Feb 4 - Sat, Feb 10

Midterm (0.00%)
Date: TBA
Midterm Examination: TBA. Students with a potential **academic** conflict should contact the instructor by Jan. 22.

Re-grading: Midterm papers may be returned to us for correction of grading errors, only within one week of the return of the paper to the student. We may refuse to re-grade a paper at our discretion.

Quiz 3 (0.00%)
Date: TBA

Quiz 4 (0.00%)
Date: TBA

Final Exam (0.00%)
Date: Fri, Apr 13, TBA
Final Examination: Friday, April 13, 2:30 – 4:30 pm (location **TBA**). The final exam is cumulative. Students who score a significantly higher grade on the Final Exam, compared with the midterm, may receive a higher weighting of the final exam (midterm: 25%, final: 75%), at the instructor's discretion. A significantly higher grade is one that is 25 percentage points or higher.

6.3 All assessments are required.

If the midterm or an online assignment is not written due to an illness, the student is required to provide appropriate documentation. In this case, the final will be re-weighted approppriately.

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7 Course Statements

7.1 Quizzes

The online quizzes are administered through “Sapling Plus” associated with Lehninger Principles of Biochemistry 7th edition. They 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 each question and each quiz will be kept open for a period of one week. You can start the quiz any time during this 1-week period. However, once you start an attempt you will have 2 hours to complete it. Students registered with the SAS need to confirm their accommodation with the professor.

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 the end date.

7.2 Re-Grading

Midterm papers may be returned to us for correction of grading errors, only within one week of the return of the paper to the student. We may refuse to re-grade a paper at our discretion.

7.3 Exam Aids

No materials may be brought to the exam except for pencils, pens and an eraser. No calculators, electronic devices (including cell phones), pencil cases, purses, bags, tissue boxes or other containers may be present. All materials are subject to inspection.

7.4 Drop and Add

Notification is **not** needed for dropping the course before the **DROP DEADLINE.** Program approval is only needed for drops and adds if your category is "Special" or "Provisional".

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8 College of Biological Science 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.

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