



UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF BIOLOGICAL SCIENCES
COURSE OUTLINE

1. **Course:** BCEM 393, Introduction to Biochemistry -- Spring 2018

Instructor Name	Email	Phone	Office	Hours
<i>L01:</i> (MWF 09:00 - 10:50 in ST 147)				
Georgia Balsevich	georgia.balsevich@ucalgary.ca	403-220-7055	TBA	TBA
Robert Edwards	redwards@ucalgary.ca	403-220-5350	BI443	Put "BCEM393" in the subject line of all e-mails.

Course Site:

D2L: BCEM 393 L01-(Spring 2018)-Introduction to Biochemistry

Department of Biological Sciences:

Office: BIO 186
Phone: 403 220-3140
Email: biosci@ucalgary.ca

Note:

Students must use their U of C account for all course correspondence.

2. **Requisites:**

See section [3.5.C](#) in the Faculty of Science section of the online Calendar.

Prerequisite(s): Chemistry 351; and Biology 311 or admission to the BHSc Honours program and Medical Sciences 341.

Antirequisite(s): Credit for Biochemistry 393 and 341 will not be allowed.

Notes: Prior or concurrent completion of Biology 331 is strongly recommended. Biochemistry 393 and 443 are the recommended courses for students wishing to take only two biochemistry courses.

3. **Grading:**

The University policy on grading and related matters is described in [F.1](#) and [F.2](#) of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Component(s)	Weighting %
Quizzes (6 quizzes x 0.5% each)	3
Labs (6 labs x 3% each)	18
Midterm Exam	34
Final Exam	45

Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student's grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

The conversion between a percentage grade and letter grade is as follows.

	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
Minimum % Required	92.0 %	86.0 %	82.0 %	78.0%	74.0%	70.0 %	66.0 %	62.0%	58.0%	54.0 %	50.0 %

In order to pass the course, students will be required to **pass** the **laboratory component** of the course by achieving 50% or more on the laboratory component. If a student's final exam percentage is at least 5 % greater than the student's midterm percentage, then the final exam weight will be increased from 45% to 50% of the final grade and the midterm weight will be decreased from 34% to 29%.

This course has a registrar scheduled final exam.

4. Missed Components of Term Work:

The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in [Section 3.6](#). It is the student's responsibility to familiarize himself/herself/themself with these regulations. See also [Section E.3](#) of the University Calendar.

If a student misses an exam or quiz, then they must a valid signed Physician/Counselor Statement, to receive either an excused absence or deferred work (at the discretion of the instructor). There are six laboratory sessions in this course and attendance is required. If you do not attend a laboratory session, then you will receive a zero for that lab and are not permitted to submit a report for that experiment(s); unless, you provide the course coordinator with valid documentation (e.g. Physician/Counselor Statement Form) of a valid excuse for your absence. You must complete at least 5 of the labs. If you miss more than one laboratory session with valid excuses, then you will be required to do a make-up lab session(s).

5. Scheduled out-of-class activities:

There are no scheduled out of class activities for this course.

6. Course Materials:

Required Textbook(s):

John L. Tymoczko, Jeremy M. Berg, & Lubert Stryer, *Biochemistry: A Short Course* : W.H. Freeman, 3rd Edition .

The 3rd edition of *Biochemistry: A Short Course* is recommended; however the 2nd edition will be adequate. This textbook is required for your learning and both new copies and a few used copies are available from the bookstore. You can choose to purchase either a hardcover, a binder-ready, or an electronic version of the textbook.

Laboratory manual and reports:

The laboratory manual will be available from the D2L course site for download. The laboratory manual describes the reports you are expected to submit for each laboratory. These reports will be submitted to the box designated for submission 120 hours after the beginning of your laboratory session in which you did the experiment.

Online course components:

Quizzes will be done on-line using the D2L site. There will be 6 on-line quizzes. They will be open for 5 days each. The quiz will open at 3 p.m. on the days indicated on the schedule below and close 120 hours later. You can try each quiz twice. The higher of the two marks will be averaged into your mark. These are low stakes quizzes - the are each worth only 0.5% of your final composite grade. Use them as a learning tool. You are encouraged to study your notes and the textbook before trying a quiz and then to try the first of these two attempts closed book (without using your textbook or notes). From that first attempt note what areas require further study, study them, and then attempt the quiz a second time with your textbook and notes open. The starting date for each of the quizzes in given in the tentative schedule below.

7. Examination Policy:

Non-programmable calculators are allowed on tests or examinations. The midterm and final exams will consist of multiple choice and written questions. The midterm exam will examine material uncovered from the beginning of the course until 1 June. Although the final exam will be cumulative, there will be greater emphasis placed on material uncovered after 1 June.

Students should also read the Calendar, [Section G](#), on Examinations.

8. Approved Mandatory and Optional Course Supplemental Fees:

There are no mandatory or optional course supplemental fees for this course.

9. Writing across the Curriculum Statement:

For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also Section [E.2](#) of the University Calendar.

10. Human & living organism studies statements:

Students will not participate as subjects or researchers in human studies.

See also [Section E.5](#) of the University Calendar.

STUDIES IN THE BIOLOGICAL SCIENCES INVOLVE THE USE OF LIVING AND DEAD ORGANISMS. Students taking laboratory- and field-based courses in these disciplines can expect involvement with and experimentation on such materials. Students perform dissections on dead or preserved organisms in some courses. In particular courses, students experiment on living organisms, their tissues, cells, or molecules. Sometimes field work requires students to collect a variety of living materials by many methods, including humane trapping.

All work on humans and other animals conforms to the Helsinki Declaration and to the regulations of the Canadian Council on Animal Care. The Department strives for the highest ethical standards consistent with stewardship of the environment for organisms whose use is not governed by statutory authority. Individuals contemplating taking courses or majoring in one of the fields of study offered by the Department of Biological Sciences should ensure that they have fully considered these issues before enrolling. Students are advised to discuss any concern they might have with the Undergraduate Program Director of the Department.

Students are expected to be familiar with [Section SC.4.1](#) of the University Calendar.

11. Reappraisal of Grades:

A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See [Section I.3](#) of the University Calendar.

1. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **15 days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall immediately submit the Reappraisal of Graded Term work form to the department in which the course is offered. The department will arrange for a re-assessment of the work if, and only if, the student has sufficient academic grounds. See sections [I.1](#) and [I.2](#) of the University Calendar
2. **Final Exam:** The student shall submit the request to Enrolment Services. See [Section I.3](#) of the University Calendar.

12. OTHER IMPORTANT INFORMATION FOR STUDENTS:

- a. **Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, [Mental Health Services Website](#)) and the Campus Mental Health Strategy website ([Mental Health](#)).
- b. **Misconduct:** Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under [Section K](#). Student Misconduct to inform yourself of definitions, processes and penalties. Examples of academic misconduct may include: submitting or presenting work as if it were the student's own work when it is not; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; collaborating in whole or in part without prior agreement of the instructor; borrowing experimental values from others without the instructor's approval; falsification/fabrication of experimental values in a report. **These are only examples.**
- c. **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on [assembly points](#).
- d. **Academic Accommodation Policy:** Students needing an accommodation because of a disability or medical

condition should contact Student Accessibility Services in accordance with the procedure for accommodations for students with disabilities available at [procedure-for-accommodations-for-students-with-disabilities.pdf](#).

Students needing an accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Associate Head, Undergraduate of the Department of Biological Sciences, Heather Addy by email addy@ucalgary.ca or phone 403 220-6979. Religious accommodation requests relating to class, test or exam scheduling or absences must be submitted no later than **14 days** prior to the date in question. See [Section E.4](#) of the University Calendar.

- e. **Safewalk:** Campus Security will escort individuals day or night (See the [Campus Safewalk](#) website). Call [403-220-5333](tel:403-220-5333) for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- f. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see [Legal Services](#) website.
- g. **Student Union Information:** [VP Academic](#), Phone: [403-220-3911](tel:403-220-3911) Email: suvpaca@ucalgary.ca. SU Faculty Rep., Phone: [403-220-3913](tel:403-220-3913) Email: sciencerep@su.ucalgary.ca. Student Ombudsman, Email: suvpaca@ucalgary.ca.
- h. **Internet and Electronic Device Information:** Unless instructed otherwise, cell phones should be turned off during class. All communication with other individuals via laptop, tablet, smart phone or other device is prohibited during class unless specifically permitted by the instructor. Students that violate this policy may be asked to leave the classroom. Repeated violations may result in a charge of misconduct.
- i. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction ([USRI](#)) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.
- j. **SU Wellness Center:** The Students Union Wellness Centre provides health and wellness support for students including information and counselling on physical health, mental health and nutrition. For more information, see www.ucalgary.ca/wellnesscentre or call [403-210-9355](tel:403-210-9355).

LABORATORY INFORMATION

Schedule

Section No.	Day	Time	Room
01	W	12:00 noon	BI 136
02 & 03	R	12:00, 16 :00	BI 136
04	F	12:00 noon	BI 136

The experiments you will be doing in the laboratory will make use of techniques commonly used in clinical and research laboratories to study biological molecules and metabolic pathways. For example you will measure the concentrations of biomolecules, determine what molecules can cross a lipid bilayer, measure enzyme activities, and separate proteins in solution, use electrophoresis to monitor the purity of a protein, and cleave nucleic acids. You will have the opportunity to develop technical skills, as well as increase your understanding of the principles of the methodology used. In several of the experiments you will ask and answer real scientific questions. You will become more proficient at carefully and consistently recording observations (especially of numerical data) and also gain significant experience analyzing and interpreting data. In addition your written technical communication skills will be improved.

Your experience in the laboratory will help to consolidate many of the concepts taught in lecture. Before most of the laboratory sessions there will be a "Lab Lecture" to introduce and reinforce the relevant concepts for that lab. Your knowledge of the content of the lab lectures as well as the principles and techniques used in labs themselves will be examined along with the lecture and textbook topics in both the midterm and the final exams.

The up-dated course outcomes for this course for Spring 2018 are as follows:

By the end of this course you will be able to:

- compare and contrast the roles of van der Waals forces, charge-charge interactions, hydrogen bonds, and hydrophobic interactions in protein and macromolecular structure and indicate how the roles of these forces differ from those of covalent bonds;
- describe the role and preparation of buffers in biological systems;
- describe the structures and the physicochemical properties of amino acids, carbohydrates (monosaccharides, disaccharides and polysaccharides), lipids (fatty acids, triglycerides, glycerophospholipids, and sphingolipids) and

- nucleic acids (DNA and RNA);
- o distinguish the four levels of protein structure and describe the folding and forces leading to these structures;
- o contrast the function of myoglobin and hemoglobin using differences in protein structure;
- o list, discuss and evaluate the major techniques used in separating proteins, including ammonium sulfate precipitation, column chromatography, and SDS-PAGE;
- o describe and experimentally examine how enzymes catalyze reactions, and how inhibitors can affect their function using the principles of protein structure and enzyme kinetic analysis;
- o distinguish between aerobic and anaerobic carbohydrate metabolism, and describe the reactants and products, the reaction purpose(s), the conditions under which they occur, and their regulatory mechanisms;
- o describe how the processes of replication, repair, transcription, and translation lead to high fidelity synthesis of nucleic acids and proteins;
- o and, work effectively in diverse teams and provide constructive peer feedback to teammates.

Dates	Lectures and Labs	Topic	Chapter	
M 14/5	Introduction & Water	Intro	1	RAE
	Acid/Bases/Buffers	Water	2	RAE
W 16/5	Amino acids & Oligopeptides	Prot 1	3	RAE
W,R,F	1st LAB lecture - Lab #1 (DNA in Milk) *Quiz*			RAE
F 18/5	Secondary Structure	Prot 2	4	RAE
	Protein purification	Prot 3	5	RAE
M 21/5	*** Victoria Day - No Lectures***			
	*** Victoria Day - No Lectures***			
W 23/5	Lipids - classification, properties and structures	Lipid-1	11	GB
W,R,F	2nd LAB Lecture - Lab #@ (Protein Purification 1 & MLVs) *Quiz*			RAE
F 25/5	Lipids - Micelles & Bilayers	Lipid-2	11	GB
	Monosaccharides & Oligosaccharides	Carb-1	10	GB
M 28/5	Derivatives & Polysaccharides	Carb-2	10	GB
	Tertiary and Quaternary Structure	Prot 4	4	RAE
W 30/5	Protein Stability & Folding	Prot 5	4	RAE
W,R,F	3rd LAB Lecture - Lab #3 (Protein Purification2 & Carbs) *Quiz*			RAE
F 1/6	Enzymes - General Concepts	Enz-1	6	GB
	Enzymes - Kinetics	Enz-2	7	RAE
M 4/6	***2 Hour Midterm Exam ***			
	***2 Hour Midterm Exam ***			
W 6/6	Enzymes - Mechanisms and Inhibitors	Enz-3	8	RAE
W,R,F	4th LAB Lecture - Enz-Kinetics & Lab#4 (LDH Kinetics) *Quiz*			RAE
F 8/6	Allosteric Proteins and Enzymes	Enz-4	9	RAE
	Overview of Metabolism	Mtb-1	15	GB
M 11/6	Glycolysis & Fermentation	Mtb-2	16	GB
	Gluconeogenesis	Mtb-3	17	GB
W 13/6	Bridge Reaction	Mtb-4	18	GB
	Krebs Cycle W,R,F Lab #5 (Metabolism) *Quiz*	Mtb-5	19	GB
F 15/6	Oxidation	Mtb-6	20	GB
	Phosphorylation	Mtb-7	21	GB
M 18/6	Structure of Nucleic Acids \$ DNA Replication	Nuc-1	33 & 34	GB
	DNA Repair	Nuc-2	35	GB
W 20/6	Prokaryotic Transcription	Nuc-3	36	RAE
W,R,F	6th LAB Lecture Lab #6 (DNA - techniques) *Quiz*		41	RAE
F 22/6	Eukaryotic Transcription	Nuc-4	36	RAE
	RNA Processing	Nuc-5	38	GB
M 25/6	Genetic Code & Translation	Nuc-6	39 & 40	GB
	Overflow and Review	Nuc-7		GB
28-30/6	FINAL EXAM (3 hours & comprehensive) Scheduled by Registrar			

Course Outcomes

- Compare and contrast the roles of van der Waals forces, charge-charge interactions, hydrogen bonds, and hydrophobic interactions in protein and macromolecular structure and indicate how the roles of these forces differ from those of covalent bonds
- Describe the role of buffers in biological systems, and select and prepare the best buffer when given specific conditions
- Describe the structures and the physicochemical properties of the 20 amino acids, carbohydrates (monosaccharides, disaccharides and polysaccharides), lipids (fatty acids, triglycerides and glycerophospholipids) and nucleic acids (DNA and RNA)
- Distinguish between the four levels of protein structure and identify the highest level of structure for a given protein
- Contrast the function of myoglobin and hemoglobin using differences in protein structure
- List, discuss, use and evaluate the major techniques used in separating proteins, including ammonium sulphate precipitation, column chromatography, and SDS-PAGE
- Describe and experimentally examine how enzymes catalyze reactions, and how inhibitors and allosteric regulators can affect their function using the principles of protein structure and Michaelis-Menten kinetics
- Formulate a hypothesis and generate a written research proposal to investigate the effects of mutations on protein structure and function
- Distinguish between aerobic and anaerobic carbohydrate metabolism, and describe the reactants and products, the reaction purpose(s), the conditions under which they occur, and their regulatory mechanisms
- Work effectively in diverse teams and provide constructive peer feedback to teammates