

University of Toronto Scarborough – Department of Biological Sciences
BIOC12 – Biochemistry I: Proteins and Enzymes – Summer 2018

Course Instructor: **Dr. Jason Brown**
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Office Hours: Tuesdays 3-5pm, Wednesdays 1:30-5:30pm

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Course Description: A lecture course describing factors involved in determining protein structures and the relationship between protein structure and function. Topics include: amino acids; the primary, secondary, tertiary and quaternary structures of proteins; protein motifs and protein domains; glycoproteins; membrane proteins; classical enzyme kinetics and allosteric enzymes; mechanisms of enzyme action.

Prerequisites: [BIOB11H3 or (BIOB10Y3)] and CHMB41H3

Exclusions: CHMB62H3, BCH210H, BCH242Y, (BCH310H)

Lectures: Wednesdays 9:10-11am, SW319

****NOTE:** There will be **no lecture** on July 11th

Lecture notes will be posted (in PowerPoint format only) on Quercus ~24 hours before each lecture. NOTE: I reserve the right to make changes to the lecture notes after they are posted.

Lecture Topics:

- 1 – Amino Acids
- 2 – The Primary Structure of Proteins
- 3 – The Secondary, Tertiary, and Quaternary Structure of Proteins
- 4 – Post-Translational Modifications
- 5 – Mechanisms of Protein Evolution
- 6 – Enzymes: Classification and Catalysis
- 7 – Enzymes: Kinetics and Regulation

Textbook: There is no required textbook for this course; however, in my experience, many students enjoy having a textbook to supplement their lecture notes. If you so desire, I would recommend the following textbook:

Biochemistry: Concepts and Connections, by D. Appling et al. (2016)

➔ This textbook is available at the UTSC Bookstore

I will post suggested readings, where applicable, from this textbook; however, this textbook may discuss material not covered in lecture, and I may discuss material in class not covered by the textbook. You are only responsible for all material covered in class.

Evaluation:

Term Tests	35%	(25% best; 10% worst)
Designer Protein Project	30%	(see grade distribution below)
Final Exam	35%	

Important Notes Regarding Evaluations:

Term Tests

There are two Term Tests in this course, which are held outside of class time. The dates and times of the Term Tests will be determined by the Registrar's office during the first few weeks of the semester, and I will post this information on Quercus as soon as it is available.

Term Tests may cover any material covered in this course, but the lectures emphasized on each Term Test will be announced in class and on Quercus. Term Tests will be 2 hours and will comprise of short answer questions only. **Students will be evaluated based on the reasonableness, clarity, and conciseness of their written answers to the questions.** Students will have some choice with regards to which questions they answer (e.g., answer 1 of 2 short answer questions). **The Term Test questions will require students to think critically and creatively about the lecture content as students will be expected to explain novel observations and solve problems. This reflects my belief that undergraduate students need to develop not only their scientific knowledge but, more importantly, their competency for thinking, reasoning, and scientific inquiry.**

To help students prepare for Term Tests, optional quizzes (here optional means not worth any marks) will be posted on Quercus each week. *Students are strongly encouraged to discuss these quizzes with the course instructor when they encounter any difficulties, either by email or during office hours (preferred).*

If you know in advance that you cannot write a Term Test at the scheduled time because it conflicts with some other valid activity, please notify the course instructor as soon as possible so that arrangements can be made for you to write the Term Test at an alternative time. *Any such alternative time must be before the scheduled date of the Term Test.*

If you miss a Term Test due to medical illness, then you must submit a detailed UTSC Medical Certificate filled out by the physician who saw you on the day of the Term Test. This note must be submitted to the course instructor as soon as possible following the Term Test, whether in person or via email. Other medical notes will not be accepted, and if the UTSC Medical Certificate is not completed to the satisfaction of the course instructor, it may be refused. The UTSC Medical Certificate can be found via the following link:

http://www.utsc.utoronto.ca/~registrar/resources/pdf_general/UTSCmedicalcertificate.pdf.

If you miss a Term Test for any other valid reason, please consult with the course instructor as soon as possible. The course instructor will determine whether the reason given for a missed Term

Test is valid in accordance with university policies. Also, the course instructor may ask for any documentation required to verify the reason given.

Students who miss one Term Test for a valid reason (medical or otherwise) will not be permitted to write a make-up Term Test; rather, the weight of their Final Exam will be increased to 45%. (The weight of their remaining Term Test will be 25%).

Students who miss both Term Tests for valid reasons will not be permitted to write any make-up Term Tests; rather, the weight of their Final Exam will be increased to 65%, and they will be asked to submit an additional written assignment worth 5%, which will be due no later than the last day of classes (Tuesday, August 7th by 11:59pm).

Students who miss a Term Test for any invalid reason will receive a grade of zero for that Term Test.

Designer Protein Project

[This project has been inspired by the work of Dr. David Baker, University of Washington. You can read about his work here: <http://www.sciencemag.org/news/2016/07/protein-designer-aims-revolutionize-medicines-and-materials>]

The goal of this project is for students to design a single novel protein that can help solve one of the global issues facing the world today. *To successfully meet this objective, students are likely going to have to be creative!*

This project is organized into a series of tasks (described below) that students, working in groups, must complete in order. Students cannot seek approval for one task until the prior task has been completed and approved by either the course instructor or the TA, as applicable.

For every task completed and approved by the end of the last day of classes (Tuesday, August 7th at 11:59pm), students will receive the number of marks assigned to that task towards their final grade. If there are any tasks that have not been completed and approved by the end of the last day of classes, students will lose the marks associated with that task. *Moreover, these lost marks cannot be made up in any other way.*

The course instructor and/or TA have up to 72 hours following the submission of a task to review it and determine whether it is approved. (*Students should take note of this requirement to ensure that they leave enough time to have all their tasks approved before the deadline.*) Approval and/or denial of the task will be communicated to students via Quercus. When a submitted task is denied, feedback will be provided so that students understand how their task could be improved in order to be approved following resubmission.

Task 1:

- a) Form a group of 5-6 students.
- b) Send a group representative to the course instructor to pick a global issue at random.
- c) Send an email to the course instructor with the name of all group members and the global issue selected in part b).

- d) The course instructor will enrol the group of students on Quercus. The group's name will be the same as their global issue.
- e) Once the students are enrolled in their group, one representative from the group should go to "Assignments" and, for Task 1, they should submit the words "Ready to Go!" as their assignment submission.

CHECKPOINT – Complete part e) above (2 marks).

Task 2:

- a) Produce a 3-5-minute video that:
 - i) describes the nature of the global issue that you have selected; and
 - ii) describes how you think a single novel protein could contribute to solving this global issue.
- b) Submit the video (or a link to the video) via the Assignments tab on Quercus.

CHECKPOINT – TA indicates approval for video via comments section on Quercus (10 marks) **or** TA indicates revisions necessary via comments section on Quercus; revise and submit video.

Task 3:

For this task, you will use the Research Collaboratory for Structural Bioinformatics (RCSB) Protein Data Bank (PDB), which is available at <http://www.rcsb.org/>

- a) Choose one or more existing proteins that have structural and/or functional elements that are similar to that of your proposed novel protein.
- b) Submit a written document via the Assignments tab on Quercus that, for each protein:
 - i) shows the complete primary structure (amino acid sequence), and;
 - ii) briefly outlines the particular structural and/or functional aspects of the protein that you feel make it a good starting point for the design of your novel protein.

CHECKPOINT – TA indicates approval of written document via comments section on Quercus (5 marks) **or** TA indicates revisions necessary via comments section on Quercus; revise and resubmit written report.

Task 4:

- a) Explore the nature of the desirable structural and/or functional properties of the proteins selected in Task 3 above and use this information to create the novel protein with the characteristics described in Task 2.
 - i) There are several online tools that can help students see how particular structural and/or functional elements of their selected protein are related to the primary structure (amino acid sequence). Prosite (available at <https://prosite.expasy.org>) and SMART (available at <http://smart.embl-heidelberg.de>) can identify functional regions (and associated sequences in a protein). SWISS-MODEL (available at <https://swissmodel.expasy.org/interactive>) gives a predicted 3D model of a protein and permits users to see where each amino acid is located.

- b) Write a short report (1-2 pages) that:
- i) Gives the amino acid sequence and three-dimensional structure of your novel protein.
 - ii) Highlights the particular structural and/or functional regions of your novel protein that will allow it to contribute to the solution of your global issue; be sure to highlight, in particular, the amino acid sequence(s) that contribute to each structural and/or function element.

CHECKPOINT – TA indicates approval of written document via comments section on Quercus (13 marks) **or** TA indicates revisions necessary via comments section on Quercus; revise and resubmit written report.

Task 5:

This task is optional.

- a) Find a non-UofT-affiliated professor/researcher who:
 - i) studies the global issue that you selected in Task 1; or
 - ii) studies one of the existing proteins that you chose Task 3.
- b) Contact the researcher via email to:
 - i) explain to them the goal of this project; and
 - ii) ask them if they would be willing to watch your video (from Task 2) and/or read your written report (from Task 4) and provide some feedback.
- c) If they are willing, send them your video and/or report. Ask them if they could kindly provide feedback by a particular date (keep in mind, they are busy people who will need some time to accomplish this task, so make sure your date is reasonable.)
- d) Submit a screenshot of the email you receive from the researcher showing their name, email address, and feedback.

CHECKPOINT – TA confirms submission of email screenshot indicating name and email address of researcher, as well as their feedback (10 marks; these 10 marks will replace your worst term test.) If screenshot does not show name, email address, and feedback, students will be asked to resubmit.

Final Exam

The Final Exam will be scheduled by the Registrar's office (August 11-24) and will be worth 35% of the final grade (unless, for reasons stated above, it has a higher weight). It will be 3 hours and will cover all course material, though it will place emphasis on the material discussed since the last Term Test. It will have the same format as the Term Tests.

Accessibility Needs:

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff (located in SW302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca.

Academic Integrity:

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's *Code of Behaviour on Academic Matters* (<http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

- In papers and assignments:*
- using someone else's ideas or words without appropriate acknowledgement
 - submitting your own work in more than one course without the permission of the instructor
 - making up sources or facts
 - obtaining or providing unauthorized assistance on any assignment.
- On tests and exams:*
- using or possessing unauthorized aids;
 - looking at someone else's answers during an exam or test
 - misrepresenting your identity
- In academic work:*
- falsifying institutional documents or grades
 - falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. There are other offences covered under the Code, but these are the most common. Please respect these rules and the values that they protect.