Proteins: Form and Function

Department of Biochemistry & Molecular Biology

BIOC 4700 Fall 2026

Dalhousie University operates in the unceded territories of the Mi'kmaw, Wolastoqey, and Peskotomuhkati Peoples. These sovereign nations hold inherent rights as the original peoples of these lands, and we each carry collective obligations under the Peace and Friendship Treaties. Section 35 of the Constitution Act, 1982, recognizes and affirms Aboriginal and Treaty rights in Canada.

We recognize that African Nova Scotians are a distinct people whose histories, legacies, and contributions have enriched the part of Mi'kma'ki known as Nova Scotia for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
David N. Langelaan (coordinator)	dlangela@dal.ca	Located in Tupper 8F1 Mondays 1-2 pm Wednesdays 2-3 pm
Jamie A. Davey	james.davey@dal.ca	To be announced

Course Description

This course surveys different classes of proteins with emphasis on understanding the relationship between form and function. Specific themes in this course include natural and synthetic modifications to proteins, and experimental or computer-based tools that inform upon protein structure and function.

Course Prerequisites

BIOC 3700.03 or CHEM 3601 or instructor's consent.

Course Structure

Unless otherwise noted, lectures take place in-person from ***11:35-12:55*** in ***Burbidge 310***. Course notes will be provided on Brightspace. Some lectures will be substituted with in-person workshops and journal clubs (see course schedule).

Student Resources

The best resource is your instructor and the course materials. Please review course materials and if you have any questions concerning the course content, contact the course instructor. Students may drop in for assistance during office hours or contact the course instructor to schedule an appointment.

Course Materials

Textbook: There will be no textbook. All learning materials will be provided in the course or are available at the Dalhousie library. Specific journal articles that are available at the library will also be used as source material. Some good resources also include your textbooks from BIOC 2300 and BIOC 3700 (listed below):

Biochemistry, 2nd edition, (2021) Miesfeld & McEvoy, *Norton publishing*.

Biophysical Chemistry, 2nd edition, (2025), Klostermeier & Rudolph, *CRC Press*.

Learning Objectives

1) **Describe** methods to produce, purify, and analyze proteins
2) **Demonstrate** that you can analyze data related to protein association
3) **Use** web-based tools to understand and model protein structure and function
4) **Understand** the biochemical principles of intrinsically disordered and amyloid proteins
5) **Explain** the basis and importance of protein allostery
6) **Demonstrate** an understanding of physics-based computational protein design
7) **Explain** the protein engineering workflow and devise screening and selection experiments
8) **Demonstrate** understanding of machine learning strategies for protein design
9) **Apply** machine learning tools to design protein sequences
10) **Understand** the variety and importance of natural and chemical protein post-translational modifications
11) **Explain** and differentiate mechanisms of protein splicing
12) **Apply** the above knowledge to solve protein science problems
13) **Demonstrate** critical review of scientific papers on a protein-relevant topic

Assessment

Component	Weight (% of final grade)	Date/notes:
Tests	2 × 20%	See schedule below; 80 minutes in class
Final exam	25%	Scheduled exam period
Protein binding analysis workshop	5%	Due Oct. 2nd
Protein modelling workshop	5%	Due Oct. 9th
Protein design workshop	5%	Due Dec. 4th
Journal club participation & quizzes	5 x 4%	See schedule below

Conversion of numerical grades to final letter grades follows the Dalhousie Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Content

Please note that the following schedule may be modified as required

Class	Lecture	Date	Topic	Lecturer
1	1	Sept. 9	Introduction, concept review, and web resources	**DL**
2	2	Sept. 11	Protein expression, purification, analysis	**DL**
3	3	Sept. 16	Protein interaction theory & analysis	**DL**
4	4	Sept. 18	***Workshop – analyzing protein interaction data***	**DL**
5	5	Sept. 23	Tools for protein modelling	**DL**
6	6	Sept. 25	***Workshop – protein-drug docking***	**DL**
		Sept. 30	***Truth & Reconciliation – no class***	
7	7	Oct. 2	Disordered proteins & phase separation	**DL**
8	8	Oct. 7	Amyloid proteins	**DL**
9	9	Oct. 9	***Journal club – disordered/amyloid proteins***	**DL**
10	MT1	Oct. 14	***Midterm 1 – covering lectures 1-9***	**DL**
11	10	Oct. 16	Protein allostery	**DL**
12	11	Oct. 21	***Journal club – protein allostery***	**DL**
13	11	Oct. 23	Computational protein design	**JD**
14	12	Oct. 28	***Journal club – computational protein design***	**JD**
15	13	Oct. 30	Laboratory evolution	**JD**
16	14	Nov. 4	***Journal club – laboratory evolution***	**JD**
17	15	Nov. 6	Application of machine learning for protein engineering	**JD**
			Reading week – no class	
18	16	Nov. 18	***Journal club – AI methods for engineering protein***	**JD**
19	17	Nov. 20	***Workshop – protein design using AlphaFold3***	**JD**
20	MT2	Nov. 25	***Midterm 2 – covering lectures 11-19***	**JD**
21	19	Nov. 27	Natural modifications of proteins	**JD**
22	20	Dec. 2	Chemical modifications of proteins	**JD**
23	21	Dec. 4	Protein splicing, cleavage, and degradation	**JD**
24	22	Dec. 9	BIOC 5700 presentation & review	**DL & JD**

Notes: Lecturer: **DL** – David Langelaan; **JD** – Jamie Davey; Lectures will be posted to Brightspace before class.

Course Policies on Missed or Late Academic Requirements

Policy for assignment submission

Assignments must be submitted either in class (preferably) or in person to the indicated professor no later than 5:00 pm on the designated due date. Extension of the due date may be granted upon submission of a Student Declaration of Absence Form (protocol detailed below). Extension of the due date will not normally exceed 7 calendar days. **In all other cases, a grade of zero will be received for that assignment.**

Policy on missed evaluation components

A student who misses an evaluation component of the course (midterm test, assignment, presentation, final examination) due to illness should notify the course coordinator either prior to or within 48 h of the scheduled time or due date for that component. The student must also submit a **Student Declaration of Absence Form** (through the Brightspace page) within three **(3) calendar days** following the last day of absence. Special 'make-up' tests (if offered) will normally be written within 7 calendar days after the missed test. **A missed evaluation component for which no satisfactory arrangement has been made will be given a mark of zero.** The Student Declaration of Absence form can only be submitted up to two (2) separate times per course during a term. Students who exceed this limit must inform their course instructor(s) and will be required to register with an Advisor at Student Academic Success (SAS). If students have recurring short-term absences and do not register with SAS, it is at the instructor(s)' discretion to disallow any further Student Declarations and deny alternate coursework arrangements.

Course Policies related to Academic Integrity

Course Policies on use of generative AI

Generative AI (e.g., Chat GPT) may be used to provide background information to aid with assignments or presentations. If generative AI is used, the way it was used must be clearly disclosed by the student.

Department of Biochemistry & Molecular Biology Statement on Plagiarism

What is plagiarism?

"Dalhousie University defines plagiarism as the submission or presentation of the work of another as if it were one's own[†]." The Department of Biochemistry & Molecular Biology is committed to protecting honest students against the devaluation of their work by students who resort to plagiarism.

Some examples of plagiarism include (but are not restricted to):

> Submitting as your own work any material created, in whole or in part, by someone else, including **material created in collaboration with other students**, unless specifically allowed by the class instructor and credited appropriately.

> Paraphrasing extensively or copying from sources such as the Internet, journal articles, or books (including textbooks) without crediting the original author or source.

> Using another student's laboratory data, unless specifically allowed by the lab instructor and credited appropriately.

> Submitting, in whole or in part, any work that has been submitted in another class, or re-submitting the same work in different years of the same class.

How can plagiarism be detected?

If required by the Instructor, work submitted for credit must be submitted in electronic as well as hard copy form. Submissions may be screened by one or both of the following methods:

> A pattern recognition program that compares all submissions with one another as well as submissions from previous years. Every individual has a unique pattern of writing. This program will detect submissions that are derived from a common source, even if words or phrases have been changed.

> A third-party computer-based assessment system that compares submissions against a large database including previous submissions and Internet sources.

What are the consequences of plagiarism?

"Plagiarism is considered a serious academic offence that may lead to the assignment of a failing grade, suspension or expulsion from the University. If a penalty results in a student no longer meeting the requirements of a degree that has been awarded, the University may rescind that degree.[†]" At Dalhousie University, the Department is obligated to refer any cases of suspected plagiarism to an Academic Integrity Officer, who will then conduct a hearing to evaluate the innocence or guilt of students alleged to have committed an act of plagiarism.

How can accusations of plagiarism be avoided?

You can avoid accusations of plagiarism by:

> Preparing all submissions independently and ensuring that they are expressed in your own unique writing style.

> Never sharing any written or electronic material with other students. You may not work with another student while preparing materials you are planning to hand in.

> Acknowledging any material paraphrased extensively or copied from sources such as the Internet, journal articles or textbooks.

> Guarding all your work, both drafts and final submissions, to ensure that no one else can copy it. If you provide access to your work and someone (including a student taking the same class in a future year) copies it, then you may be aiding in the commission of an academic offence. If you suspect that someone has taken any of your work, notify your class instructor immediately.

> Using only laboratory data that you actually collected in the lab. Altering laboratory data is not permitted. If your data are unusable, you must still report your own data along with any explanation as to why the data are unusable. You may then use data supplied by the lab instructor for analysis, but you must acknowledge such use.

[†] Dalhousie University Undergraduate Calendar, 2024/2025, University Regulations, Intellectual Honesty.

Syllabus Appendix

For further information regarding Dalhousie course policies, please read our syllabus appendix:

Syllabus Appendix: Student Supports & University Statements, Policies, and Guidelines