

Faculty of Science Course Syllabus
Department of Biochemistry & Molecular Biology
BIOC 4700/5700
Proteins
Fall term, 2020

Instructor(s):

P. Liu (Coordinator) paul.liu@dal.ca

V. Ewart vewart@dal.ca

Course times:

Asynchronous: Lecture material on Brightspace, assigned videos

Synchronous (when specified): Within regular class times (Tuesdays and Thursdays, 10:05-11:25 a.m.) on specific dates. This may include class introduction, discussions, debates, presentations and other events.

Exams and assignments: Assigned and due on specific dates indicated below, but not due within class time.

Course Description

Our theme is the relationship between structure and function. The kinetic and thermodynamic determination of the protein fold is explored. Specific details of how form determines function in binding other molecules both small and large in membranes, and in energy transduction are provided. Protein evolution and turnover are examined.

Topics covered will include fundamental protein structures, protein purification and measurement, and protein-ligand interaction; protein thermodynamics and stability, states, equilibria and kinetics of protein structures, intrinsic disorder and quinary structures, replicating protein folding *in silico*, molecular simulation of slow processes, engineering structural innovation, classification and modularity in proteins, rational and directed evolution of new proteins; production and engineering of recombinant proteins through post-translational modification, directed evolution, protein splicing, and fibre formation.

Course Prerequisites

BIOC 3700 or (CHEM 3601 AND CHEM 2301 AND CHEM 2304), all with grades of B or higher or instructor's consent.

Course Objectives/Learning Outcomes

At the end of the course, students should be able to do the following:

- Describe the structures of proteins at the primary, secondary, tertiary and quaternary levels
- Summarize the life cycle of proteins and their post-translational covalent modifications
- Describe sources of proteins and expression systems to produce recombinant proteins
- Describe methods for protein measurement and purification
- Describe methodologies in the homology modelling of protein structures
- Describe the detection and measurement of protein-ligand interaction
- Apply the above knowledge to answering questions or solving problems
- Explain major types of protein splicing and their reaction mechanisms.
- Describe protein splicing methodologies for protein semi-synthesis, cyclization, segmental labeling, and site-specific chemical modification.
- Explain principle and basic design of directed evolution for improved and new protein functions.
- Describe examples of directed evolution including miniature antibody, protein aptamer, and catalytic enzymes.
- Explain structure and formation of protein fibers including spider silks as exceptionally strong biomaterial.
- Critically assess, integrate and review scientific papers on a protein-relevant topic
- Communicate the above research topic as a formal essay in the style of a scientific paper, and communicate the same as a short formal presentation (for undergraduate students) or a research seminar (for graduate students).

Course Materials

There will be no textbook. All learning materials will be provided in the course or are available at the Dalhousie library.

Course website:

Information relating to online lectures and exams, including electronic copies of lecture materials, will appear on Brightspace. The course website will be provided on the first day of classes.

Course Assessment

Undergraduates

- 3% Mini-assignment (due on September 22nd)
- 12% Protein modelling assignment (due on October 6th)
- 23% Sectional exam 1 (on Ewart's lectures only, due on October 12th)
- 10% Protein directed evolution project assignment (due on November 5th)
- 15% Essay (due date: Nov 17th)
- 10% Presentation videos (due on Nov. 24th), questions (due on Dec. 3rd) and answers from presenters (due on Dec. 8th)
- 27% Final exam (on Liu's lectures only)
(Final exam is scheduled by the Registrar during exam period)

Graduates

- 3% Mini-assignment (due on September 22nd)
- 12% Protein modelling assignment (due on October 6th)
- 20% Sectional exam 1 (on Ewart's lectures only, due on October 12th)
- 12% Protein directed evolution project assignment (due on November 5th)
- 15% Essay (due date: Nov 17th)
- 10% Presentation videos (due on Nov. 24th), questions (due on Dec. 3rd) and answers from presenters (due on Dec. 8th)
- 23% Final exam (on Liu's lectures only)
(Final exam is scheduled by the Registrar during exam period)

Other course requirements

n/a

Conversion of numerical grades to Final Letter Grades follows the [Dalhousie Common Grade Scale](#)

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

Course Policies

Policies on missed examinations, assignments, etc.— A student who misses an evaluation component of a course (midterm test, assignment, presentation, lab, etc.) due to illness should if possible notify the instructor, course coordinator, or department office either prior to, or within 48 hrs of the scheduled time or due date for that component. The student must also submit a Student Declaration of Absence Form (through the course Brightspace page or to their instructor via e-mail) 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. Absence for non-medical reasons is not ordinarily acceptable unless prearranged with the instructor. 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. Laboratory assignments must be submitted to the professor/instructor as specified in the lab manual.

Assignments Submission: All essays are to be submitted to the specific SafeAssign link on the class website by the deadline. You must always **ensure** that you are submitting the latest version of your completed work. It is the student's responsibility to keep backup copies of all submitted class work. All assignments will be considered late if submitted after the deadline, and a 10% penalty per day is levied on late assignments.

Course Content

Online lectures will be delivered asynchronously unless otherwise as specified. Lecture videos and accompanying materials will be posted to the course Brightspace page individually or in batches on a week-by-week basis.

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DATE	DAY	TOPIC (Lecture)	LECTURER
Sept. 8	T	Introduction – Microsoft Teams meeting (video 1) at 10:05 a.m. *Essay and presentation assignment given today (see videos 2-5 this week)	V. Ewart (VE)
10	Th	No class	VE
15	T	Update – Microsoft Teams meeting at 10:05 a.m. (see videos 6-9 this week) *Mini-assignment given today	VE
17	Th	No class	VE
22	T	Update – Microsoft Teams meeting at 10:05 a.m. (see videos 10-12 this week) *Mini-assignment due today (11:59 p.m.) *Protein homology modelling project given today	VE
24	Th	No class	VE
29	T	Update – Microsoft Teams meeting at 10:05 a.m. (see videos 13-15 this week)	VE
Oct. 1	Th	No class	VE
6	T	Update – Microsoft Teams meeting at 10:05 a.m. *Protein homology modelling project due today (11:59 p.m.)	VE
7	W	*Sectional exam 1 given today	VE
12	M	*Sectional exam 1 due today (11:59 p.m.) (Thanksgiving Day)	VE
13	T	Introduction of protein directed evolution	P. Liu (PL)
15	Th	Methodologies of protein directed evolution	PL
20	T	Design and strategy of protein directed evolution	PL
22	Th	Protein engineering through directed evolution	PL
27	T	Antibody engineering through directed evolution *Protein directed evolution project assignment is assigned today	PL
29	Th	Structure-function of post-translational modifications	PL
Nov. 3	T	Chemical and enzymatic methods of modifications	PL
5	Th	Introduction of protein splicing *Protein directed evolution project assignment is due today	PL
10-12		NO LECTURE (Study Break)	
17	T	Protein splicing methods for protein engineering *Completed essay is due today	PL
19	Th	Protein fiber formation in making artificial spider silks	PL
24	T	*Protein presentation videos are due today	PL and VE
Nov. 24 th to Dec. 3 rd		*Students view presentations online and ask written questions *Presenters answer at least two questions by email as per dates above	PL and VE

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Missed or Late Academic Requirements due to Student Absence

As per Senate decision instructors may not require medical notes of students who must miss an academic requirement, **including the final exam**, for courses offered during fall or winter 2020-21 (until April 30, 2021). Information on regular policy, including the use of the Student Declaration of Absence can be found here: https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html.

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. **Information:** https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>