

Mechanisms of Signal Transduction

Syllabus

Department of Biochemistry & Molecular Biology

BIOC 4305/5305 Winter 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
Kirill Rosen (KR)	kirill.rosen@dal.ca	Monday-Friday, 9am-5pm
Thomas Pulinkunnil (TP)	tpulinil@Dal.Ca	Monday-Friday, 9am-5pm
Petra Kienesberger (PK)	pkienesb@Dal.Ca	Monday-Friday, 9am-5pm

Course Description

The goal of this course is to introduce the key concepts of signal transduction. Topics include regulation of cell signalling by receptors and protein kinases, lipids in signalling, nutrient signalling and signalling pathways in energy metabolism, apoptosis, autophagy, cell cycle and disease.

Course Prerequisites

BIOC 3700, 3300.03, 3400.03

Student Resources

Will be provided during lectures

Course Structure

Lectures: 8:35-9:55 am Monday and Wednesday.

Essay: Students will be expected to write a two-page essay (single-spaced, 12pt font, 1-inch margins) plus one page for figures, charts and tables, summarizing the current state of knowledge on one of the topics of the course selected by course instructors. Students will be evaluated based on: clarity (10%), adherence to the scientific review style and grammar (20%), accuracy of capturing the state of the field (60%), and figure design and use (10%).

Seminar (specific to BIOC 5305): The student will present a manuscript on one of the topics of the field. Manuscripts will be selected by course instructors. The presentation will take 20 minutes plus 5 minutes for questions. Students are expected to interpret all experimental data, understand the contribution of the work to the field and identify shortcomings of the study. Students will be evaluated based on comprehension of the presented material, responses to questions as well as their presentation style (audiovisual, voice, mannerisms).

Essay (specific to BIOC 5305): Students will be expected to write a two-page essay (single-spaced, 12pt font, 1-inch margins) explaining the principles of the key techniques used in the paper presented by them during the seminar and how these techniques contributed to the study. Students will be evaluated based on: clarity (10%), adherence to the scientific review style and grammar (20%), and accuracy of describing the principles of the methods and their contribution to the study (70%).

Course Delivery

Synchronous online, via Microsoft Teams.

Students connecting to online resources from outside Canada are responsible for ensuring awareness and compliance with any applicable laws in the country from which they are connecting.

Course Materials

Exams will be given via Brightspace.

Assessment

Course Assessment - BIOC 4305

Component	Weight (% of final grade)	Date
Quiz	4%	January 26
Online exam on TP's material	26%	February 2
Online exam on PK's material	30%	March 9
Online exam on KR's material	30%	TBA (during the final exams period)
Written essay on selected subjects in the field of Cell Signalling	10%	Submission deadline: March 1

Note: BIOC 4305 students are expected to attend the critical seminar given by the graduate students (please see below). Some of the exam questions will be on the material presented during the seminar.

Course Assessment - BIOC 5305

Quiz	4%	January 26
Online exam on TP's material	21%	February 2
Online exam on PK's material	25%	March 9
Online exam on KR's material	25%	TBA (during the final exam period)
Written essay on selected subjects		
in the field of Cell Signalling	8%	Submission deadline: March 1
Critical seminar	10%	April 6
Written essay on experimental methods used in the field of		
Cell Signalling	7%	Submission deadline: March 20

Assignments (please see essay description above)

No other requirements

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 Policies on Missed or Late Academic Requirements

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.

Course Policies related to Academic Integrity

The use of AI-generated text for written assignments is prohibited. The use of AI in such cases will be treated as academic integrity violation. Please see the University policy on Academic integrity below.

Learning Objectives

1. Understand the concept of signal transduction
2. Understand the role of signalling networks in key aspects of cell biology
3. Understand the roles of various aspects of metabolism and metabolite signalling in cellular homeostasis
4. Identify key types of regulators of signal transduction
5. Understand the fundamental concepts of cell signalling and metabolism involved in the pathology of diabetes
6. Understand the key physiological roles of cell death and autophagy
7. Understand the roles of oncogenes and tumour suppressor genes in the control of the key aspects of cancer cell biology
8. Learn to write reviews on specific subjects in the field of Cell Signalling

Objectives/Learning Outcomes specific to BIOC 5305

9. Learn to critically examine, present and discuss published studies in the field of Cell Signalling
10. Understand the basis of key experimental methods used in the field of Cell Signalling

Course Content

Jan 7	Introduction to cell signalling (TP)
Jan 12	Signalling pathways in glucose metabolism and growth (TP)
Jan 14	Amino acid sensing, and mTOR signalling (TP)
Jan 19	Randle Cycle and ketone body signalling (TP)

Jan 21	Mitochondrial DNA and mutations (TP)
Jan 26	TCA cycle signaling (TP) (Online quiz during class hours)
Jan 28	Signalling pathways in lipid metabolism (PK)
Feb 2	Online exam on TP's and PK's material during class hours
Feb 4	Receptor tyrosine kinase signalling, part 1 (PK)
Feb 9	Cell cycle signaling in health and disease (TP)
Feb 11	Receptor tyrosine kinase signalling, part 2 (PK)
Feb 23	Signalling pathways in insulin resistance (PK)
Feb 25	Adipokine signalling (PK)
March 2	Myokine and cardiotkine signalling (PK)
March 4	Lysophospholipid & GPCR signalling (PK)
March 9	Online exam on PK's and TP's material during class hours
March 11	Mitochondria-mediated signalling mechanisms of apoptotic cell death (KR)
March 16	Death receptor-mediated signalling mechanisms of apoptotic cell death (KR)
March 18	Signalling mechanisms of non-apoptotic cell death (KR)
March 23	Autophagy-dependent signalling mechanisms of cell survival (KR)
March 25	Signals generated by cell-extracellular matrix adhesion as regulators of cell survival (KR)
March 30	Signalling mechanisms of cancer progression (KR)
April 1	Signalling mechanisms of tumor angiogenesis (KR)
April 6	Seminar: graduate students' presentations (KR)

University Policies and Statements

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 at 1321 Edward St or elders@dal.ca. Additional information regarding Mi'kmaq and Indigenous Relations (including the Elders in Residence program, Land Acknowledgements, Understanding Our Roots, and much more) can be found at: <https://www.dal.ca/about/mission-vision-values/mikmaq-indigenous-relations.html>

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about/mission-vision-values/global-relations.html>

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all 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. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/campus_life/ssc.html).

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

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 (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <https://www.dal.ca/about/mission-vision-values/equity-diversity-inclusion-and-accessibility/about-office-equity-inclusion.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. The full Code of Student Conduct can be found at:

<https://www.dal.ca/content/dam/www/about/leadership-and-governance/governing-bodies/code-student-conduct.pdf>

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: <https://www.dal.ca/content/dam/www/about/leadership-and-governance/university-policies/fair-dealing-policy.pdf>

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.