

Advanced Cardiovascular Biochemistry Syllabus

Department of Biochemistry and Molecular Biology
BIOC 5309 Fall 2024

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
Dr. Thomas Pulinilkunnil	tpulinil@dal.ca	contact by email, Mon-Fri 9 AM to 5 PM Dal Med NB Room 136
Dr. Petra Kienesberger	pkienesb@dal.ca	contact by email, Mon-Fri 9 AM to 5 PM Dal Med NB Room 138

Course Description

Advanced Cardiovascular Biochemistry is a specialized area for students pursuing graduate and postgraduate programs in cardiovascular sciences. The course material for BIOC 5309 is presented in two 90-min sessions per week and is a 3-credit course. There will be 25 sessions.

Course Prerequisites

The students must have gained fundamental knowledge of biochemistry, cell biology, and molecular biology in the prerequisite classes. A basic knowledge of mammalian physiology is desirable.

Course Exclusions

N/A

Student Resources

N/A

Course Structure

Course Delivery & Lectures

In-person - (Teams link: [Join the meeting now](#)); lectures will not be recorded.

Wednesdays 1:00 - 2:25 – G36 Halifax and DMNB St. John Room 221

Thursdays 11:35 – 12:55 – C223 Halifax and DMNB St. John Room 221

Laboratories

N/A

Tutorials

N/A

Course Materials

Those with limited knowledge of cellular biochemistry are urged to review appropriate sections of an introductory biochemistry textbook such as Harper, 31st Edition Biochemistry (9th Edition) or Principles of Biochemistry by Lehninger (8th Edition). This course will be beyond the scope of these texts and will involve material from original manuscripts and review articles.

Textbooks recommended for this course are:

- Molecular Mechanisms of Cardiac Hypertrophy and Failure- Edited by Richard Walsh
- Cardiac Energy Metabolism in Health and Disease- Edited by Lopaschuk & Dhalla; 2014
- Heart Physiology and Pathology by Eugene Braunwald; 18th Edition
- Heart Failure-Bench to Bedside Jose Marin Garcia
- Biochemistry of Cardiovascular Dysfunction in Obesity- by Tappia, Bhullar & Dhalla; 2020

Assessment:

Assessment	% Weightage (final grade)	Date
Mini Review	25	November 1, 2024
Grant Proposal –Write Up	25	November 27, 2024
Grant Proposal –Presentation	20	Nov 28 & Dec 04, 2024
Literature discussion	30	September 12 & 26 October 16 & 31 November 27

Assignments/Tests/quizzes

Literature discussion and participation (30%):

Students will work together to discuss research papers related to prior lecture topics. There will be five such sessions. Papers will be assigned by the course coordinator and sent to the class at least two weeks before the discussion. Students will present the manuscript as a PowerPoint presentation for 15 minutes, followed by 5 minutes of Q&A. Each student is expected to present a maximum of 10-12 slides with an in-depth focus on the question, methodology, strengths and weaknesses, advancement to the field, and possible implications for their respective graduate program research. Examples of what the presentation entails are:

- a) Summarize the background information, rationale, current knowledge, and knowledge gaps.
- b) State the goals and hypotheses of the study.
- c) Describe the methodological approaches and experimental design to address the goals and hypotheses.
- d) Describe figures within the results section with details on readouts, graph/plot details, and statistical analyses.
- e) Highlight the contribution of this study, knowledge advancement, and its impact on the field.
- f) Highlight the strengths and weaknesses of the study, the appropriateness of the methodology, and the study design, and provide feedback on how the study could have been improved.

It is expected that all students will have read the assigned research papers before the presentation. The grade is based on attendance, presentation, and participation at the literature discussion. If a student is unable to attend, they must inform the course coordinator beforehand to avoid being penalized. The grade will be determined at the end of the semester based on the course coordinator's assessment of the above criteria.

Mini Review (25%) and Grant Presentation and Write up (45%):

Review article writing and developing a grant proposal directly test the ability of the student to apply the knowledge gained from cardiovascular biochemistry to the field. After discussing with each student, course coordinators will finalize the topics for review and grant by the second week of September.

Students will be expected to write 1 mini review (2 pages, Font 12, double spaced, one separate page of figures/tables allowed). Page limit does not include references. Review article submission is due on November 15, 2024. The grant proposal topic is based on the topic of the mini review (essentially, the mini review will form the introduction to the grant proposal).

Students will be expected to write a three-year grant (3 pages, Font 12, double spaced, one separate page of figures/tables allowed) on a research area that is at arm's length from the

student's graduate thesis work. Page limit does not include references. The grant must include a brief background of the problem, hypothesis, aims/goals, methodology for each aim, contingency plans, anticipated data, timeline, sex and gender considerations, future direction, impact, and knowledge translation. Grant submission is due on November 30, 2024. Students will need to make a 20 min presentation (not more than 10 slides) on their proposed grant and defend the proposal similar to that expected of a qualifying exam. Grant presentations will be held on December 01 and 06, 2024.

It is expected that students complete these assignments in a timely manner. For any non-communicated deferral, 10% marks will be for every week after the deadline. University regulations on plagiarism will be strictly adhered to in this course. Details on guidelines and policies around plagiarism are available on the following URL: (<http://www.registrar.dal.ca/calendar/ug/UREG.htm#12>).

The use of AI tools for mini-review and grant writing is not permitted.

Other course requirements

N/A

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 fails to appear in class or misses due dates on assignments due to exceptional circumstances must notify the course coordinator or department office within 48 h. Absence for non-medical reasons is not ordinarily acceptable unless prearranged with the professor. A missed assignment for which no satisfactory arrangement has been made will be given a mark of zero.

Students are expected to use the Student Declaration of Absence form for late or missed requirements during the term once during this course.

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

Course Policies related to Academic Integrity

N/A

Learning Objectives

1. Understand cardiac anatomy and myocyte structure, and describe the biochemical basis of myocyte action potential, calcium handling, contractility and vasoactive signaling.
2. Illustrate biochemistry of substrate utilization and nutrient signaling in the heart. Understand the established principles of glucose, fatty acid and amino acid metabolism. Decipher the molecular underpinnings of mitochondrial metabolism, TCA cycle signaling and mitochondrial function.
3. Apply the knowledge of cardiac metabolism and signaling to understand the biochemistry of metabolic disorders in obesity, diabetes, coronary artery disease, hypertrophy, ischemia reperfusion injury and heart failure.
4. Describe the molecular basis for emerging heart failure drugs.
5. Organize an effective literature search and apply it to formulate a mini review and conceive an idea for a potential grant application.

Course Content

Week	Date	Lesson Topic(s)	Reading/Assessment
1	Sep 04, 2024	Cardiac anatomy, action potential, and myocyte structure & cytoskeletal architecture	Lecture-TP
1	Sep 05, 2024	Cardiomyocyte contraction and calcium handling	Lecture-PK
2	Sep 11, 2024	Vasoactive signaling in the heart	Lecture-PK
2	Sep 12, 2024	Literature discussion (relating to week 1 & 2 lectures)	Literature Discussion/Presentation
3	Sep 18, 2024	Cardiac energy metabolism-carbohydrate utilization and insulin signaling	Lecture-TP
3	Sep 19, 2024	Cardiac lipid metabolism	Lecture-PK
4	Sep 25, 2024	Lipoprotein metabolism and bioactive lipid signal transduction	Lecture-PK
4	Sep 26, 2024	Literature discussion (relating to week 3 & 4 lectures)	Literature Discussion/Presentation

Week	Date	Lesson Topic(s)	Reading/Assessment
5	Oct 02, 2024	Amino acid signaling and metabolism in the heart	Lecture-TP
5	Oct 03, 2024	Mitochondrial metabolism of substrates: Randle's Hypothesis	Lecture-TP
6	Oct 09, 2024	TCA Cycle signaling	Lecture-TP
6	Oct 10, 2024	Mitochondrial quality control in the cardiomyocyte	Lecture-PK
7	Oct 16, 2024	Literature discussion (relating to week 5 & 6 lectures)	Literature Discussion/Presentation
7	Oct 17, 2024	Signal transduction of physiological and pathological hypertrophy	Lecture-PK*
8	Oct 23, 2024	Pathways and players of protein synthesis and degradation within the heart	Lecture-TP
8	Oct 24, 2024	Coronary artery disease and vascular disease	Lecture-PK
9	Oct 30, 2024	Biochemistry of metabolic cardiomyopathy	Lecture-PK
9	Oct 31, 2024	Literature discussion (relating to week 7, 8, & 9 lectures)	Literature Discussion/Presentation
		Mini Review Submission Deadline- November 01, 2024	
10	Nov 06, 2024	Biochemistry of ischemia-reperfusion injury	Lecture-TP
10	Nov 07, 2024	Biochemical basis of heart failure	Lecture-TP
13	Nov 20, 2024	Molecular mechanism of novel drugs for heart failure	Lecture-TP*
14	Nov 27, 2024	Literature discussion (relating to week 10 & 13 lectures)	Literature Discussion/Presentation
		Grant Submission Deadline- November 27, 2024	
14	Nov 28, 2024	Grant Proposal Presentations-1	Discussion/Presentation
15	Dec 04, 2024	Grant Proposal Presentations-2	Discussion/Presentation
		* denotes subject to change	

List of papers for literature discussion sessions

- 1. Sep 12, 2024,** Literature discussion (relating to week 1 & 2 lectures)
Circ Res. 2021;129(9):872-886. doi: 10.1161/CIRCRESAHA.121.319828
Cardiovasc Res. 2023; 119(1):221-235 doi: 10.1093/cvr/cvac077
eLife 2022;11:e75250. DOI: 10.7554/eLife.75250
J Am Coll Cardiol. 2015;66(3):261-272. doi: 10.1016/j.jacc.2015.05.020.
- 2. Sep 26, 2024,** Literature discussion (relating to week 3 & 4 lectures)
Am J Physiol Heart Circ Physiol 322: H1032–H1043, 2022.
Cell Death Differ. 2024;31(3):292-308. doi: 10.1038/s41418-023-01241-x
Cell Rep. 2020;33(6):108374. doi: 10.1016/j.celrep.2020.108374.
J Clin Invest. 2019;129(1):252-267. doi: 10.1172/JCI122064.
- 3. Oct 16, 2024,** Literature discussion (relating to weeks 5 & 6)
Cardiovasc Drugs Ther. 2022 Jun;36(3):383-397. doi: 10.1007/s10557-021-07267-y.
Cardiovasc Res . 2022 Jun 22;118(7):1742-1757. doi: 10.1093/cvr/cvab207
JCI Insight. 2022 Jun 30;e155475. doi: 10.1172/jci.insight.155475.
Circ Res. 2018;122(1):58-73. doi: 10.1161/CIRCRESAHA.117.311307
- 4. Oct 31, 2024,** Literature discussion (relating to week 7/8/9 lectures)
Diabetes Obes Metab . 2022 Jul 8. doi: 10.1111/dom.14814.
J Clin Invest . 2022 Mar 15;132(6):e150595. doi: 10.1172/JCI150595.
CVR 2022. 118(6):1492-1505. <https://doi.org/10.1093/cvr/cvab112>
Cell Metab. 2022;34(11):1875-1891.e7. doi: 10.1016/j.cmet.2022.08.017.
- 5. Nov 27, 2024,** Literature discussion (relating to week 10-15 lectures)
Circ Res. 2022 Jun 24;131(1):91-105. doi: 10.1161/CIRCRESAHA.122.321050
Cardiovasc Res. 2021 Jun 1;cvab182. doi: 10.1093/cvr/cvab182.
JACC Basic Transl Sci. 2023;8(4):422-435. doi: 10.1016/j.jacbts.2022.10.009
Circ Res. 2024. doi: 10.1161/CIRCRESAHA.124.324706.

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 the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.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-dal/internationalization.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/about-dal/agricultural-campus/student-success-centre.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: <http://www.dal.ca/cultureofrespect.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/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

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/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: <https://www.dal.ca/about/leadership-governance/academic-integrity/faculty-resources/ouriginal-plagiarism-detection.html>

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.