

# Intermediary Metabolism and Cell Biology Syllabus

## Department of Biochemistry and Molecular Biology BIOC 3300 Winter 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
Barbara Karten	<a href="mailto:bkarten@dal.ca">bkarten@dal.ca</a>	Mondays 3:30 pm
Neale Ridgway	<a href="mailto:nridgway@dal.ca">nridgway@dal.ca</a>	By appointment
Geoffrey Hesketh	<a href="mailto:Geoffrey.hesketh@dal.ca">Geoffrey.hesketh@dal.ca</a>	By appointment
Shawn Xiong	<a href="mailto:shawn.xiong@dal.ca">shawn.xiong@dal.ca</a>	Resource Centre

### Course Description

This course covers synthesis and catabolism of carbohydrates, lipids, and some nitrogen compounds. Metabolic regulation is emphasized, including factors influencing the rate at which compounds flow through selected pathways. Compartmentalization of, inter-relationships between and environmental impact on metabolic pathways are considered. Laboratory exercises examine the techniques used to study metabolic pathways.

**Course Prerequisites:** BIOC 2300.03 and BIOC 2610.03 (both with grades of B- or higher) and BIOL 2020.03 and BIOL 2030.03 and CHEM 2401.03 and CHEM 2402.03, or instructor's consent.

**Course Exclusions:** None

### Student Resources

Biochemistry Resource Centre: Dr. Xiong will be available most days, 11:30 am to 2 pm in 8J for questions regarding the lab part of the course.

Peer Mentorship: Upper year students offer regular mentorship sessions focusing on study techniques, general practice of core concepts of biochemistry, and career development.

## Course Structure

### *Course Delivery*

The course has 30 lectures and 3 review sessions. The entire course will be delivered in person. Lecture notes will be posted before the lecture on the course Brightspace page. The lectures will not be recorded. The laboratory part of the course has weekly in-person sessions (Tuesdays 2:30 to 5:30 pm); the schedule can be found on the course Brightspace page.

Students registered in the class will be able to access all course materials via **Brightspace** at <https://dal.brightspace.com/>; you can access this site using your Dal NetID and Password. If you need assistance using Brightspace, please contact the Help Desk at 902-494-2376 or [helpdesk@dal.ca](mailto:helpdesk@dal.ca).

Questions related to content should be addressed to the instructor of that part of the course. Question related to the laboratory section of the course should be addressed to Dr. Shawn Xiong ([shawn.xiong@dal.ca](mailto:shawn.xiong@dal.ca)). Questions related to general course organization and management, class policies, exam schedules, medical issues, should be addressed to the coordinator (B. Karten) at [bkarten@dal.ca](mailto:bkarten@dal.ca)

**Lectures:** 09:35 -10:25, Monday, Wednesday, Friday. Location: Dentistry 4116  
Lecture schedule is appended below and posted on Brightspace

**Laboratories:** 14:35-17:25 Tuesdays in Tupper 8J

**Tutorials:** None

## Course Materials

Many textbooks on Biochemistry and Cell Biology describe the content of this course and can be used as complementary resources. The recommended textbook is Fundamentals of Biochemistry, 5<sup>th</sup> edition, by Donald and Judy Voet and Charlotte Pratt, Wiley. <https://www.wiley.com/en-us/Fundamentals+of+Biochemistry:+Life+at+the+Molecular+Level,+5th+Edition-p-9781118918401>

## Assessment

### ***Assessment of Lecture Component***

Two midterm exams (50 min each) will be held during the normal lecture period and cover the material covered in the lectures as outlined in the lecture schedule. The final examination (3 hours) is scheduled by the registrar's office during the exam period and will cover material from the entire course. Midterms and final exams will have multiple choice and short answer questions. Neither the mid-term tests nor the final exam will be returned to students, but viewing may be arranged during office hours or by appointment.

*Alternate grading scheme:* If a midterm mark is higher than the mark for the corresponding part of the final, the mark for this part of the final exam can be replaced with the mark of the midterm. Higher marks in the final exam cannot be used to offset midterm exams.

### **Assessment of Laboratory Component**

The other component of the course is the laboratory. The laboratory education takes a multi-pronged approach, involving descriptive labs, inquiry labs, and dry lab exercises such as case studies, journal clubs, and research proposals. As a result, the laboratory is assessed based on the completion and quality of the associated pre- and post-laboratory exercises. Please see the laboratory compendium for more detailed information regarding to laboratory schedule, materials required, and laboratory assessments.

<b>Assessment</b>	<b>Weight (% of final grade)</b>	<b>Date</b>
Midterm 1	15	February 7, 2024
Midterm 2	15	March 15, 2024
Laboratory	30	
<u>Final examination***</u>	<u>40</u>	Scheduled by Registrar
Total	100	

**\*\*\* Note that regardless of the total mark, a passing grade in the final examination is required in order to pass the course. All exams are in-person.**

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 a midterm test due to illness should notify the instructor and the course coordinator as soon as possible, and **must submit a Student Declaration of Absence Form** through the course Brightspace page within three (3) calendar days following the midterm exam. There will be **no make-up mid-term tests!** If one midterm test is missed, the weighting of the final exam will be adjusted so that the questions on the final exam that pertain to the lecture material tested in the missed midterm will count double. 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 and only for absences of 3 days or shorter. Students who exceed one or both of these limits must inform their course instructor and course coordinator 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 instructors' discretion to disallow any further Student Declarations and deny alternate coursework arrangements. **Please refer to the link below for further information on the University policy regarding Long-term absence:**

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html](https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html)

**Missed Final Exam:** An additional SDA is accepted for missing the final exam. Students must notify the course coordinator as soon as possible and submit the completed SDA form for the final exam no later than 48 hours after the scheduled exam in order to be considered for a make-up exam. The date and time of the make-up exam will be provided to qualified individuals within 72 hours after the scheduled exam. Additional or alternative final exams will only be held under exceptional circumstances such as unforeseen medium to long term disabilities.

## Course Policies related to Academic Integrity

Policies regarding academic integrity will be posted as part of the instructions for each assignment.

All material posted on the Brightspace page is for your personal educational use only. Copying course material from this site for distribution (e.g. uploading material to a commercial third-party or public website, or otherwise sharing these materials with people who are not part of the class) outside of this site may be a violation of Copyright law. If you have questions regarding the use of materials, please contact the instructor/course coordinator.

## Learning Objectives

1. Recall basic principles of regulation of anabolic and catabolic pathways in biochemistry.
2. Explain how dietary carbohydrates, fats and proteins are converted to energy.
3. Analyze the quantity of energy produced from each dietary component.
4. Explain how metabolic pathways are controlled by compartmentalization within and between organelles and tissues.
5. Describe the reciprocal pathways of fatty acid synthesis and oxidation.
6. Recognize the structures and functions of glycerolipids.
7. Recognize high energy intermediates and their role in reaction energetics.
8. Discriminate the classes of lipoproteins by physical and chemical properties and their functions.
9. Describe the pathway for cholesterol biosynthesis and its regulation.
10. Predict the cellular responses to alterations in cholesterol metabolism.
11. Explain cellular pathways for protein transport and modification and their functional effects.
12. Describe proteasomal degradation as a pathway for protein turnover and quality control.
13. Recognize the role of lysosomes and autophagy in degradation and metabolic control.
14. Integrate amino acid catabolism and nucleotide metabolism with other metabolic pathways.
15. Recognize the connections of one-carbon metabolism to amino acid metabolism and epigenetic control of DNA transcription.
16. Describe cellular mechanisms of transport that enable the cell to maintain membrane asymmetry and the cellular distribution of lipids.
17. Recognize the endoplasmic reticulum as a membrane system in contact with other organelles.
18. Describe the mechanisms of receptor tyrosine kinase and G-protein coupled receptor signaling.
19. Describe the endosomal system for sorting, recycling, and degradation.
20. Associate insulin, glucagon, and epinephrine action with the body's metabolic state and the activity of metabolic pathways in different tissues.
21. Recall the steps of insulin and glucagon signaling, and associate possible disruptions of insulin signaling to the development of diabetes.
22. Integrate glucose metabolism and insulin action with diabetes and obesity.
23. Recognize adipose tissue as an endocrine organ and describe the changes in obesity.
24. Associate the principles of the central control of food intake with the development of obesity.

## Course Content: Lecture Schedule

Date		Lecture Topic	Instructor
January	Mon 8	1. Introduction to Metabolism	BK
	Wed 10	2. Glycolysis	BK
	Fri 12	3. Glycogen Metabolism	BK
	Mon 15	4. Citric Acid Cycle	BK
	Wed 17	5. Amino acid degradation, Urea Cycle	BK
	Fri 19	6. Electron Transport and Oxidative Phosphorylation	NR
	Mon 22	7. Mitochondrial Transporters	NR
	Wed 24	8. Nucleotides and One-carbon metabolism	NR
	Fri 26	9. Regulation of Fatty Acid Synthesis	NR
	Mon 29	10. Fatty Acid Modification	NR
	Wed 31	11. Regulation of Fatty Acid Oxidation	NR
February	Fri 2	<b>No Class – Munro Day</b>	
	Mon 5	<b>Review</b>	BK/NR
	Wed 7	<b>Midterm 1: Lectures 1 - 11</b>	BK/NR
	Fri 10	12. Phospholipid Metabolism	NR
	Mon 12	13. Triacylglycerol Metabolism	NR
	Wed 14	14. Cholesterol Synthesis and Regulation	NR
	Fri 16	15. Protein Synthesis, Targeting, Quality Control	NR/GH
	Mon 19	<b>No Class- Study Break (Heritage Day)</b>	
	Wed 21	<b>No Class- Study Break</b>	
	Fri 23	<b>No Class- Study Break</b>	
	Mon 26	16. Membrane trafficking, Vesicular transport	GH
	Wed 28	17. Endosomal system	GH
March	Fri 1	18. Lysosomes, Autophagy	GH
	Mon 4	19. ER, membrane contact sites, transfer proteins	GH
	Wed 6	20. Receptor mediated signaling (GPCR and RTK)	GH
	Fri 8	21. Nutrient-sensing signaling (mTOR)	GH
	Mon 11	22. Cancer signaling and cell biology	GH
	Wed 13	<b>Review</b>	NR/GH
	Fri 15	<b>Midterm 2: Lectures 12-22</b>	NR/GH
	Mon 18	23. Fast-Feed Cycle, Organ Specialization	BK
	Wed 20	24. Extracellular Lipid Transport: Lipoproteins	BK
	Fri 22	25. Lipoproteins and Atherosclerosis	BK
	Mon 25	26. Insulin and Glucagon Effects	BK
	Wed 27	27. Insulin and Glucagon Signaling	BK
	<b>Fri 31</b>	<b>No Class, Good Friday</b>	
April	Mon 1	28. Diabetes Type 1 and 2	BK
	Wed 3	29. Obesity and Food Intake Control	BK
	Fri 5	30. Integration	BK
	Mon 8	<b>Review</b>	BK
	Tue 9		

## 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](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at: [https://www.dal.ca/campus\\_life/communities/indigenous.html](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](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](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](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](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/dept/university\\_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.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.