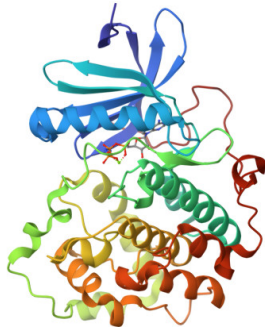


# BIOC 2300 - Introduction to Biochemistry

## Winter 2025

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.



A kinase in the Hippo pathway

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 that part of Mi'kma'ki known as Nova Scotia for over 400 years.



### Instructional Team Information:

Instructor/Facilitator:	Course Contact:	Office:
Dr. David Langelaan	BIOC2300@dal.ca	Tupper 8-F1
Dr. Shawn Xiong (coordinator)		Tupper 8-J03
Meghan Hamilton		Tupper 8-J01
Yang-yang Zuo		Tupper 8-J01



### Meeting Information:

Time:	M/W/F 10:35 AM – 11:25 AM
Location:	Studley Campus: KENNETH C ROWE MANAGEMENT 1028
Format:	Semi-Flipped class: Mon./Wed. – Lectures; Fri. – Practice



### Course Description:

BIOC 2300 (CREDIT HOURS: 3). This course surveys basic topics and concepts of Biochemistry. The structures, properties and metabolic inter-relations of proteins, carbohydrates and lipids are considered together with an introduction to nutrition and metabolic control. Although mammalian examples predominate, some consideration of special aspects of biochemistry of microbes and plants is included.



### Course Prerequisites:

BIOL 1010.03 (or equivalent), CHEM 1011.03 and 1012.03 (or equivalent), all with grades of C or higher, or instructor's consent. Students are advised to also take CHEM 2401.03 and CHEM 2402.03. EXCLUSIONS: BIOC 2200.03



## Prior Knowledge from CHEM 1011/1012 & BIOL 1010:

The following tables highlight the prior knowledge you will need to ease into BIOC 2300. Please use the information provided here as a guide for review and catch-up. It's often abstract to simply look at these terms; and it's much more helpful to see these concepts in questions. As a result, we have constructed **prior knowledge inventory in the form an ungraded readiness test**, see below for detail.

CHEM 1011:	CHEM 1012:
Determining limiting reagents	Equilibrium and reaction quotient
Solution concentration: molarity	Equilibrium constant
Dilution	Relationship between the Equilibrium Constant and Gibbs Energy
Electron affinity	Apply Le Chatelier's Principle to predict the effect of perturbing an equilibrium
Electronegativity	Relate the Reaction Quotient to the Equilibrium Constant
Electrostatic interaction and ionic bonding	Calculate Gibbs Energy under standard and nonstandard conditions
Resonance	Enthalpy
Covalent bonding	Entropy
Non-covalent interactions	Gibbs free energy
Electronegativity and bond polarity	Assigning oxidation number
Molecular polarity and dipole moment	Identify oxidation and reduction processes
Column chromatography	Reduction potential and its relationship to Gibbs free energy
Delocalized electron model	Functional groups
Acid and base chemistry (strong vs weak)	Identify chiral centers
K <sub>a</sub> and pK <sub>a</sub>	UV/Vis spectroscopy
pH	NMR
Buffer and buffer capacity	Beer's law
Henderson-Hasselbalch equation	Catalyst and its effect on activation energy and reaction rate

BIOL 1010:
Describe the process by which carbohydrates, lipids and proteins are assembled from monomers and identify their functional roles in the eukaryotic cell.
Describe the structure and function of the organelles found in eukaryotic cells, demonstrating an appreciation for the overall architecture of the cell.
Identify the components of biological membranes, including the various types of membrane proteins.
Explain the fluid mosaic model and describe how membranes exhibit selective permeability.
Describe the role of ATP as the energy currency in the cell and appreciate its importance for driving cellular work.
List the key products and features of glycolysis, the citric acid cycle, and oxidative phosphorylation and understand the flow of energy through the entire process.
Identify the mechanism by which a signal is transmitted into the cell via G protein Coupled Receptors and Tyrosine Kinase Receptors.
List several examples of second messengers and describe how each is involved in signal transduction pathways.
Describe the basic chemical structure of deoxyribonucleic acid (DNA) and how it differs from ribonucleic acid (RNA); what role does each molecule play in the transfer of information from genotype (DNA) to phenotype (protein) and the deciphering of the genetic code.
Describe the basic principles of DNA technology/Biotechnology, its applications and the ethical and societal implications of this technological revolution.
Describe the most basic similarities and differences between Bacteria, Archaea and Eukaryotes.
Describe the phenomenon of (primary) endosymbiosis and its role in the origins of mitochondria and plastids

**Biochemistry Readiness Test:** To help you review and assess your prior knowledge, we highly encourage you to practice the Biochemistry Readiness Test on *Brightspace*. Please note, this test is not for credit, but rather for you to learn by diagnosing your conceptual weakness and thus providing a means for you to catch up and become better prepared for the upcoming course content.



## Course Objectives / Learning Outcomes:

Welcome to *Introduction to Biochemistry*, where you will begin to learn how life works at the molecular level. Biochemistry is at the nexus of the physical, natural and medical sciences, yet has developed its own language and culture that are distinct from those disciplines. The knowledge and tools of biochemistry and molecular biology will continue to be at the forefront of discoveries in medicine and biotechnology, driving advances in such areas as molecular and personalized medicine, nanotechnology, agriculture, environmental remediation, and evolution. The concepts and skills obtained in this course will prepare you for more advanced training in biochemistry & molecular biology for careers in biotechnology, biomedical research, medicine, and other health professions.

*At the end of this course, you will be able to:*

1. Use your knowledge of fundamental principles of chemistry and physics (e.g. molecular bonding, thermodynamics, kinetics) to explain important concepts in biochemistry.
2. Describe and interrelate the hierarchical levels of protein structure (1° to 4°) and provide examples of how this structure relates to the function (or dysfunction) of various classes of proteins.
3. Explain how enzymes can increase the rates of biochemical reactions at the molecular level, and how enzymes may be inhibited and regulated.
4. Outline the major pathways by which precursor biomolecules (carbohydrates, lipids, amino acids) are synthesized and degraded, and the key points at which these pathways are regulated.
5. Describe how organisms obtain, store, and utilize energy through metabolic interconversion of biomolecules.
6. Understand how metabolic pathways are controlled to maintain homeostasis of organisms under normal physiological conditions, and how this may be disrupted by certain pathological states.
7. Place biochemical events within a genomic and cellular context.
8. Relate/apply the fundamental biochemical concepts to your life and your daily activities.



## Course Expectation:

Access all course materials via Brightspace at <https://dal.brightspace.com/>

	Course Expectation for Semi-Flipped Classes
<b>Pre-class</b>	<ul style="list-style-type: none"> <li>• Mon. &amp; Wed. – preview lecture notes</li> <li>• Fri. – watch the video lectures to prepare for flipped class</li> </ul>
<b>In-class</b>	<ul style="list-style-type: none"> <li>• Mon. &amp; Wed. – Interactive lectures</li> <li>• Fri. – Practice on worksheets<sup>#</sup> in the flipped class</li> </ul>
<b>Post-class</b>	<ul style="list-style-type: none"> <li>• Complete quizzes before next class</li> <li>• Work on additional practice questions<sup>^</sup></li> </ul>

<sup>#</sup> Answers to In-class worksheets and case studies will not be published online but will be available during Biochemistry Resources Center.

<sup>^</sup> Answers to additional practice questions outside of the classes will be published online.



## Student Support:

Within our class, there are multiple ways to keep in touch with the instructional team.

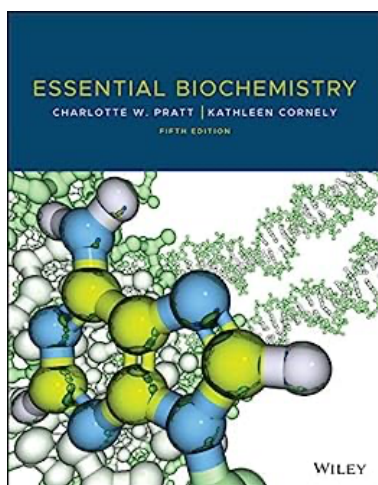
Below, we highlight the purpose of each method of communication:

Method of Communication	Purpose	Advantage	Turn-around
Brightspace Discussion Board	Ask any questions on the course content & administration.	Fast response, easily accessible, open for everyone to see and share.	Every 1-2 hours from 9 – 5 PM
Course email: <a href="mailto:BIOC2300@dal.ca">BIOC2300@dal.ca</a>	Ask <b>short</b> course content & administration related questions.	Managed by the instructors	8 hours to 1 day
Biochemistry Resource Center: Mon.-Fri. 12-2PM @ Tupper 8-J01  <ul style="list-style-type: none"> <li>• <i>Meg:</i></li> <li>• <i>Yang-yang:</i></li> <li>• <i>Dr. Xiong:</i></li> <li>• <i>Dr. Langelaan:</i></li> </ul>	<ul style="list-style-type: none"> <li>• Provides an open and accessible place to study and work individually or in a small group.</li> <li>• Nurture a community of learning biochemistry.</li> <li>• Meeting with TAs and Instructors</li> </ul>	<ul style="list-style-type: none"> <li>• In-person help session throughout the week</li> <li>• Work and learn in a supervised environment.</li> <li>• Clarify general misconceptions/confusion.</li> <li>• Discuss learning strategies.</li> </ul>	Weekly and immediate feedback
Dr. Xiong's email: <a href="mailto:shawn.xiong@dal.ca">shawn.xiong@dal.ca</a>	For any administration related questions and/or private conversations	<ul style="list-style-type: none"> <li>• Flexible and private.</li> <li>• Short but highly effective and efficient;</li> </ul>	8 hours to 1 day

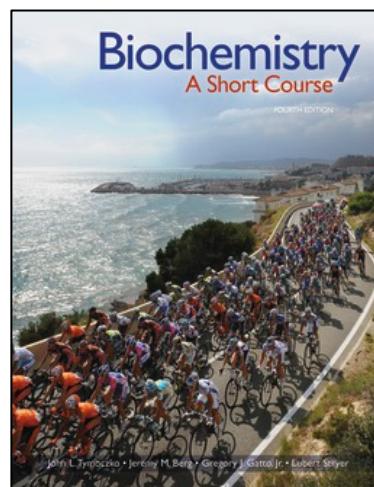


## Course Textbook:

The following two books are recommended but NOT required for those who are interesting in reading in depth about the topics we discuss in class.



**Essential Biochemistry**  
(5th edition, 2022)



**Biochemistry: A Short Course**  
(4th edition, 2019)



## Course Assessment:

Assessment	Date	Weight (%)
Online quizzes <sup>a</sup>	Per class	15
Term Test 1 <sup>b</sup>	Feb. 12 <sup>th</sup> , 6:30 – 8:00 PM	20
Term Test 2	Apr. 2 <sup>nd</sup> , 6:30 – 8:00 PM	20
Final Exam <sup>c</sup>	<i>Scheduled by registrar</i>	45

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale: [https://www.dal.ca/campus\\_life/academic-support/grades-and-student-records/grade-scale-and-definitions.html](https://www.dal.ca/campus_life/academic-support/grades-and-student-records/grade-scale-and-definitions.html)

**Note:** Numeric grades will be rounded to the nearest whole number before being converted to a letter grade. No exceptions will be made.

**<sup>a.</sup> Online quizzes** consist of 3-5 questions that will be:

- released right after each class.
- due before the next class.
- 2 attempts, the highest score taken for grade calculation.
- 3 lowest quizzes will be dropped from the final grade calculation.

**<sup>b.</sup> Term Tests** are non-cumulative:

- You have 90 minutes to write each term test.
- **Cue sheet** will be provided before and during each test.
- **Term Test 1 covers lectures #1-15.**
- **Term Test 2 covers lectures #15-29.**
- Locations: Two McCain Auditoria, more detailed seating will be provided before the scheduled term tests.

**<sup>c.</sup> Final exam** is cumulative and will be scheduled by the registrar during the final's week in April.

- **Cue sheet** will be provided before and during the final exam.
- To recognize that learning is a process, students' final exam score will be automatically used to compare and replace any written term tests that had a lower percentage.
- **Final exam covers lectures #1 – 32.**



## Course Policies on Missed or Late Academic Requirements:

**Missed or late quizzes:** Due the nature of the online quizzes, extensions will not be provided for missed quizzes, and a grade of 0 will be given to any late submissions.

- 3 lowest quizzes will be dropped from the final grade calculation.

**Missed term test(s):** Term tests are non-cumulative.

- The dates of the term tests are carefully chosen to accommodate multifaith holidays as recommended by the Dal's Multifaith Calendar.
- There will be no make-up term tests.
- If a midterm exam is missed, then the remaining midterm and final exam will be prorated to 30% and 55% respectively.
- If no midterm exams are written, the final exam will be prorated to 85%.

**Missed Final exam:** Final exam is cumulative.

- In response to the recent changes in the provincial health care regulation – *Nova Scotia employers can no longer request a sick note unless an employee is absent for more than five working days or has already had two absences of five or fewer working days in the previous 12-month period*, Dalhousie University no longer requires a doctor's note for missing final exams. Instead, an additional SDA is accepted for missing the final exam. Students must notify both course instructors prior to the absence and submit the completed SDA form for the final exam no later than 48 hours after the scheduled exam to be considered for a make-up exam. The date and time of the make-up exam will be available to qualified individuals within 72 hours after the scheduled exam.
- Make-up final exam in the past have always been scheduled on the last day of the final exam period or the first day after the final exam period.
- Travelling during the final exam period will not be accommodated.

**Please note**, even though we are not strictly asking for explanation of absence nor the submission of SDA (for greater accessibility), our course still operates under the guidance of the university policies on short and long leave of absence.

- In accordance with the short leave of absence policy - *Students can submit a maximum of two separate Student Declaration of Absence forms per course during a term and one SDA for the final exam.*
- For major or chronic illness and other long-term or recurring absences, students should seek professional care, refer to the University's [Student Accommodation Policy](#), and register with an advisor at the [Advising and Access Services Center](#).



## Anticipated course schedule 2025

Month	Date	Date	Lecture #	Class	Instructor	Multi-Faith Calendar	
January	6th	Mon.	1	<i>Introduction &amp; Concepts review</i>	Entire Instructional Team	Armenian Christmas	
	8th	Wed.	2	Aqueous chemistry	Langelaan		
	10th	Fri.	3	Acid-base chemistry & buffers <b>(Flipped)</b>	Langelaan		
	13th	Mon.	4	Amino acids and proteins: primary structure	Langelaan	Mahāyāna New Year	
	15th	Wed.	5	Secondary, tertiary and quaternary protein structure	Langelaan		
	17th	Fri.	6	Nucleic acids, genomics, and DNA technology <b>(Flipped)</b>	Langelaan		
	20th	Mon.	7	Isolating and analyzing proteins	Langelaan		
	22nd	Wed.	8	Protein function I: hemoglobin and antibodies	Langelaan		
	24th	Fri.	9	Protein function II: structural & motor proteins <b>(Flipped)</b>	Langelaan		
	27th	Mon.	10	How enzymes work	Langelaan		
	29th	Wed.	11	Enzyme kinetics and inhibition	Langelaan	Chinese Lunar New Year - Year of the Snake	
	31st	Fri.	12	Lipids and membranes <b>(Flipped)</b>	Langelaan		
February	3rd	Mon.	13	Membrane transport	Langelaan		
	5th	Wed.	14	Protein function III: light absorption and emission	Langelaan		
	7th	Fri.	<b>Munro day, university closed.</b>				
	10th	Mon.	15	Thermodynamics	Langelaan		
	12th	Wed.	Term Test 1 Review in class Term Test 1 @ 6:30 PM - 8:00 PM		Langelaan		
	14th	Fri.	16	Molecular interactions	Langelaan		
	17th	Mon.	<b>Nova Scotia Heritage Day, university closed.</b>				
	19th	Wed.	<b>Winter study break (except students in co-op, clinics, or internships).</b>				
	21st	Fri.	<b>Winter study break (except students in co-op, clinics, or internships).</b>				
	24th	Mon.	17	<i>Review: Beer, Wine, &amp; Spirit: a transition from Orgo to Bioc</i>	Xiong		
	26th	Wed.	18	Carbohydrate: How much sugar is your drink?	Xiong		
	28th	Fri.	19	Glycobiology: Glucosamine supplement for joint or diabetes? <b>(Flipped)</b>	Xiong	Losar - Tibetan New Year	
March	3rd	Mon.	20	Glycogenolysis: A boy cannot exercise.	Xiong	Ramaḍān	
	5th	Wed.	21	Glycogenesis: A malnourished infant with an enlarged liver.	Xiong	Ramaḍān	
	7th	Fri.	22	Glycolysis: How to survive 0% oxygen? <b>(Flipped)</b>	Xiong	Ramaḍān	
	10th	Mon.	23	Non-oxidative respiration: A DUI case without drinking.	Xiong	Ramaḍān	
	12th	Wed.	24	Gluconeogenesis: Examine multifaceted roles of Metformin.	Xiong	Ramaḍān	
	14th	Fri.	25	Tricarboxylic Acid Cycle (TCA): A case of dog poisoning. <b>(Flipped)</b>	Xiong	Holi / Sikh New Year's Day / Ramaḍān	
	17th	Mon.	26	Oxidative Phosphorylation: Drugs target electron transport chain.	Xiong	Ramaḍān	
	19th	Wed.	27	Oxidative Phosphorylation: A case of DNP poisoning.	Xiong	Ramaḍān	
	21st	Fri.	28	Fatty Acid Oxidation: A case of ketogenic diet gone wrong. <b>(Flipped)</b>	Xiong	Nowruz (Fasli) / Navroz (Nowruz) / Ramaḍān	
	24th	Mon.	29	Fatty Acid Oxidation: A case of alcohol induced ketoacidosis.	Xiong	Ramaḍān	
	26th	Wed.	30	Fatty Acid Synthesis: A case of Green Hulk's disease.	Xiong	Ramaḍān	
	28th	Fri.	31	Fatty Acid Synthesis: Favism and Glucose-6-Phosphate Dehydrogenase Deficiency. <b>(Flipped)</b>	Xiong	Ramaḍān	
	31st	Mon.	32	Amino acid metabolism: A glutamine metabolic switch supports erythropoiesis.	Xiong	'Id al-Fiṭr	
April	2nd	Wed.	Term Test 2 Review Term Test 2 @ 6:30 PM - 8:00 PM		Xiong		
	4th	Fri.	Final Exam Review		Langelaan	QiMing	
	7th	Mon.	Final Exam Review		Xiong		
<b>Final Exam - TBD</b>							

Note, the proposed schedule may be subject to change due to school cancelation.

## University Policies and Statements

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

### 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](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](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](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](mailto:elders@dal.ca)).

**Information:** [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

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

<https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&chapterid=-1&topicgroupid=31821&loaduseredits=False>

### University Grading Practices

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/grading-practices-policy.html](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](https://www.dal.ca/campus_life/academic-support/advising.html)

**Science Program Advisors:** <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

**Indigenous Student Centre:**  
[https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

**Black Students Advising Centre:** [https://www.dal.ca/campus\\_life/communities/black-student-advising.html](https://www.dal.ca/campus_life/communities/black-student-advising.html)

**International Centre:** [https://www.dal.ca/campus\\_life/international-centre/current-students.html](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](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](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.html](https://www.dal.ca/campus_life/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](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>