

**Faculty of Science Course Syllabus**  
**Department of Biochemistry & Molecular Biology**  
**BIOC 2300**  
**Introduction to Biochemistry**  
**Winter 2023**

*Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.*

*We acknowledge the histories, contributions, and legacies of the African Nova Scotian people and communities who have been here for over 400 years.*

<b>Instructors:</b>	<b>E-mail</b>	<b>Office location</b>
Dr. David Langelaan (coordinator)	<a href="mailto:dlangela@dal.ca">dlangela@dal.ca</a>	Tupper 8-F1
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<b>Teaching Assistants:</b>		
TBD	<a href="mailto:BIOC2300@dal.ca">BIOC2300@dal.ca</a>	
TBD	<a href="mailto:BIOC2300@dal.ca">BIOC2300@dal.ca</a>	

## Course Elements

**Lectures:** 2 hours per week in person (recorded) and 1 hour per week online (asynchronous)

**Practice and review (P+R) sessions:** 1 hour per week in person (not recorded)

**Lecture and P+R sessions:** MWF 10:35-11:25 in Rowe 1028; see schedule below.

**Help sessions:** Two different in-person 1-hour sessions facilitated by teaching assistants. Time and location will be announced in class and on Brightspace.

**Our office hours: Tuesday 11 am-12 pm; Friday 1-2 pm, location TBD**

**Course delivery:** In-person lectures and practice & review sessions. Approximately 1 lecture per week delivered asynchronously online. In-person TA help sessions. The midterms and final exams will only be held in-person.

## 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.

FORMAT: In-person and online.

## Course Prerequisites

BIOL 1010.03 and 1011.03 (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.

**Key knowledge expected prior to the course:** Chemical calculations (concentration, units and significant figures), chemical bonding and intermolecular interactions, properties of aqueous solutions, pH, dissociation of weak acids and bases, equilibrium constants, buffers (CHEM 1011); basic thermodynamics (enthalpy, entropy and Gibbs free energy), organic functional groups, chirality, chemical reactions and rate equations (CHEM 1012); eukaryotic cell structure, membranes and organelles, genes, DNA and RNA, the central dogma of molecular biology (replication, transcription and translation), simple Mendelian inheritance, fundamentals of biological evolution and animal biology (BIOL 1010/1011).

## Course Exclusion

BIOC 2200

## 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 (along with the closely related discipline of 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 the fundamental biochemical concepts to your life and your daily activities.

## Course Delivery and Communications

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).

**Lectures:** Delivered in person or as pre-recorded videos on Panopto. Posting online lectures allows us to use class time for Practice and Review (P+R) sessions, where you can interact with the instructors, ask questions, and work together on practice questions. We will not introduce new material in the P+R sessions. Coming to P+R sessions decreases the time you need to study individually, making them an effective use of your time. The course schedule includes lecture titles and indicates which lecture that week will be posted online. We strongly recommend listening to the relevant online lecture before attending a P+R session. Please note that, in rare cases, we may change which lecture is online. All tests and exams will be in-person.

**Help sessions:** Are held by the teaching assistants. The time and location will be announced in class and on Brightspace.

**Snow days, and other university closures:** In the case of a short-term (one or two days) university closure: 1. In-person lectures will be provided online as pre-recorded videos without a change in the course schedule. 2. In-person P+R sessions will be held synchronously on Brightspace, if possible. 3. In-person exams will be re-scheduled and held in person during the next following lecture slot. The lecture replaced by the re-scheduled exam will be posted online as a pre-recorded video. In the case of longer-term university closures, university regulations and recommendations will be followed.

**Brightspace:** All content, including the syllabus, lecture notes, online lectures, and quizzes will be accessible through Brightspace. In-person lectures will be recorded and made available after the lecture on Brightspace.

**Office hours and contact details:** Instructors will hold weekly office hours twice per week. Additionally, teaching assistants are available to answer course content questions by email at [BIOC2300@dal.ca](mailto:BIOC2300@dal.ca). Questions will be answered, if possible, within two days, excluding the weekend. Common questions will be added in anonymized form to a Frequently Asked Questions FAQ section on the course Brightspace page. Questions related to general course organization and management, class policies, exam schedules, medical issues, should be addressed to the coordinator (D. Langelaan) at [dlangela@dal.ca](mailto:dlangela@dal.ca).

## Course Textbook and Resources

The recommended textbook is '*Essential Biochemistry*' (5th edition, 2022) by Pratt & Cornely (Wiley). The textbook can be purchased as a digital version only, or as a digital + print book. The

digital version, which is available in WileyPLUS, also includes resources such as additional practice questions, exercises, and animated figures, and is accessible only for the duration of the term. Access codes for WileyPLUS can be purchased through the bookstore or online through the Brightspace course site; digital and print versions can be purchased through the bookstore.

WileyPLUS Student Site: <http://wileyplus.wiley.com/student-resources-support/>”

The purchase of the textbook is recommended, but not mandatory. The weekly quizzes (see assessment) do not require access to the online version of the textbook, and we will post non-graded practice questions on Brightspace with access to all students in the course.

Other useful textbooks for the course are listed below, or on the **Biochemistry Library Guide** website at <http://dal.ca.libguides.com/c.php?g=257047>.

“Biochemistry” by Tymocko, Berg and Stryer (2011)

“Molecular Biology of the Cell” by Alberts *et al* (2015)

“Harper’s Illustrated Biochemistry” by Rodwell *et al* (2015) *available online*

“Biochemistry: Essential Concepts” by Hardin and Knopp (2013) *available online*

A variety of free resources on biochemistry, cell and molecular biology are also available on the Internet, including:

Khan Academy videos: searchable YouTube videos on many topics

(<https://www.khanacademy.org/>)

Ahern K, Rajagopal I “Biochemistry Free and Easy” (*full service biochemistry textbook with bonus songbook; downloadable for iPad or as PDF*)

<http://biochem.science.oregonstate.edu/biochemistry-free-and-easy>

Interactive Concepts in Biochemistry (*games and animations from Wiley*):

<http://www.wiley.com/legacy/college/boyer/0470003790/animations/animations.htm>

## Course Assessment

Component	Date	Weight (%)
Online quizzes	Weekly	10
Test 1	February 6	15
Test 2	March 10	15
Test 3	March 31	15
Final exam	<i>Scheduled by registrar</i>	45

**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)	

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

**Midterms** will take place in-class and consist of 20-30 multiple choice and short answer questions.

Weekly **online quizzes** will be posted every Friday on Brightspace. The course offers 11 quizzes consisting of 10-15 MCQs based on the week's material. 10 of the 11 quizzes will be counted towards the final grade, the quiz with the lowest grade will be dropped automatically in Brightspace at the end of the course. Each quiz will be available for a one-week period until the following Friday at midnight. Online quizzes will be graded automatically (2 attempts, highest mark counts).

Students are allowed to use lecture notes, textbooks, and online resources to answer the quiz questions, and are allowed to work together with other students. However, remember that midterm and final exams are in person without online resources or lecture notes, and it can be beneficial to also practice answering questions without these materials, in preparation for the in-person exams. Answers will be made available after the quiz has closed online.

## Course Policies on Missed or Late Academic Requirements

**Missed quizzes:** There will be no extensions for missed quizzes, and a grade of 0 will be given to any late quiz submissions.

**Missed midterms:** A student who misses a midterm test due to illness must submit a Student Declaration of Absence Form through the course Brightspace page within three (3) calendar days following the last day of absence. **There will be no make-up midterm tests!** If one midterm test is missed, the weighting of the other midterms and final exam will be increased to 20%, and 50%, respectively. If two midterm tests are missed, the marks from the remaining midterm and final exam will be worth 25% and 65%, respectively. If all three midterms are missed, a grade of 0 will be given for the 3<sup>rd</sup> midterm (worth 25%) and the final exam will still only be worth 65% of the final grade. All quizzes together will be worth 10% in any case. 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 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 following link for further information on the University policy regarding Long-term absence: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/misled-or-late-academic-requirements-due-to-student-absence.html](https://www.dal.ca/dept/university_secretariat/policies/academic/misled-or-late-academic-requirements-due-to-student-absence.html)

**Missed Final exam:** A student who misses the final examination due to illness must notify the course coordinator or department office within 48 h, and must submit a Student Declaration of Absence. If necessary, a make-up final examination will be held shortly after the end of the official exam period, and typically before May 1. Students who need to write a makeup exam are expected to be available during this period.

### **Course Policies related to Academic Integrity**

**Quizzes:** Weekly quizzes are held online, and students are allowed to use textbook and online resources. Students are allowed to work together on answering the quizzes.

**Midterm and final exams:** These exams will be held in person. Each student must answer the questions individually without consulting a textbook or online resources. Calculators are required (to be brought by students, smart phone calculators are not allowed). Some reference resources will be provided during the exam. Exam questions are the intellectual property of the instructors and may not be copied or photographed during exam review.

**Study groups:** The course does not provide formal study groups. However, study groups are highly encouraged, and students can ask the course coordinator for help in connecting with others. Studying in a group and explaining concepts to each other is very helpful for understanding the concepts taught in this course.

## Course schedule 2023

Date			Lecture Number & Topic Mon., Wed., Fri. 10:35-11:25 AM @ Rm 1028 KC Rowe Building		Lecturer
<b>Jan</b>	9	M	1	Course introduction/what is biochemistry?	Langelaan
	11	W	2	Aqueous chemistry	Langelaan
			3	Acid-base chemistry and buffers ( <i>online</i> )	Langelaan
	13	F		<i>Practice and review</i>	Langelaan
	16	M	4	Nucleic acids, genomics, and DNA technology ( <i>online</i> )	Langelaan
	18	W	5	Amino acids and proteins: primary structure	Langelaan
	20	F	6	Secondary, tertiary and quaternary protein structure	Langelaan
				<i>Practice and review</i>	Langelaan
	23	M	7	Isolating and analyzing proteins ( <i>online</i> )	Langelaan
	25	W	8	Protein function I: hemoglobin, antibodies	Langelaan
	27	F	9	Protein function II: structural & motor proteins	Langelaan
				<i>Practice and review</i>	Langelaan
	30	M	10	Protein function III: light absorption and emission	Langelaan
<b>Feb</b>	1	W	11	How enzymes work	Langelaan
	3	F	<b>Munro Day</b>		
	6	M	Test Lectures 1-10 <sup>a</sup>		
	8	W	12	Enzyme kinetics and inhibition	Langelaan
	10	F	13	Lipids and membranes	Langelaan
	13	M	14	Membrane transport	Langelaan
			15	Molecular interactions ( <i>online</i> )	Langelaan
	15	W		<i>Practice and review</i>	Langelaan
	17	F	16	Carbohydrate: Form & Function	Xiong
<b>STUDY BREAK FEB 20 - Feb 24</b>					
	27	M	17	Glycobiology: Sugar Beyond Energy Storage ( <i>online</i> )	Xiong
<b>Mar</b>	1	W	18	Glycogenolysis: Breaking Down Glycogen	Xiong
	3	F	19	Glycogenesis: Building Up Glycogen	Xiong
				<i>Practice and review</i>	Xiong
	6	M	20	Glycolysis: Nuts & Bolts of Glycolytic Reactions	Xiong
	8	W	21	Glycolysis & Fermentation in Health & Diseases	Xiong
	10	F	Test Lectures 11-19 <sup>a</sup>		
			22	Thermodynamics: Flux of Biochemical Reactions ( <i>online</i> )	Xiong
	13	M	23	Gluconeogenesis: the "Reverse" of Glycolysis?	Xiong
	15	W	24	Tricarboxylic Acid Cycle (TCA): When Breath Becomes Air	Xiong
	17	F		<i>Practice and review</i>	Xiong
	20	M	25	Oxidative Phosphorylation I: Electron Transport Chain	Xiong
	22	W	26	Oxidative Phosphorylation II: Tabulating ATP production	Xiong
	24	F	27	Fatty Acid Oxidation: Nuts & Bolts of $\beta$ -oxidation	Xiong
	27	M	28	Fatty Acid Oxidation in Health & Diseases	Xiong
			29	Fatty Acid Synthesis: Fatty Acid Synthesis ( <i>online</i> )	Xiong
	29	W		<i>Practice and review</i>	Xiong
	31	F	Test Lectures 20-28 <sup>a</sup>		
<b>Apr</b>	3	M	30	Fatty Acid Synthesis in Health & Diseases	Xiong
	5	W	31	Amino Acid Degradation: Fueling Carb & Fat catabolism	Xiong
	7	F	<b>Good Friday</b>		
	10	M	32	Amino Acid Synthesis: Building on Carbohydrate Metabolism	Xiong
	11	T		Course review	DL & SX
<b>Final exams Apr 13-25</b>					

<sup>a</sup> In case of university closure the test will be held during the next available class

## 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&loaduserredits=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>

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

**Dalhousie COVID-19 information and updates:** <https://www.dal.ca/covid-19-information-and-updates.html>

## ***Policy on Plagiarism – Dept. of Biochemistry & Molecular Biology***

### ***What is plagiarism?***

The Dalhousie University Undergraduate Calendar defines plagiarism as the “presentation of the work of another as if it were one’s own”. Plagiarism is a form of academic fraud. The Department is committed to protecting honest students against the devaluation of their work by students who resort to plagiarism.

Some examples of plagiarism include (but are not restricted to):

- Submitting as your own work any material created, in whole or in part, by someone else, **including material created in collaboration with other students**, unless specifically allowed by the course instructor and credited appropriately.
- Paraphrasing extensively or copying from sources such as the Internet, journal articles, or books (including textbooks) without crediting the original author or source.
- Using another student’s laboratory data, unless specifically allowed by the course instructor and credited appropriately.
- Submitting, in whole or in part, any work that has been submitted in another course, or re-submitting the same work in different years of the same course.

### ***How can plagiarism be detected?***

If required by the Instructor, work submitted for credit must be submitted in electronic as well as hard copy form.

Submissions may be screened by one or both of the following methods:

- A pattern recognition program that compares all submissions with one another as well as submissions from previous years. Every individual has a unique pattern of writing. This program will detect submissions that are derived from a common source, even if words or phrases have been changed.
- A third-party computer-based assessment system that compares submissions against a large database including previous submissions and Internet sources.

### ***What are the consequences of plagiarism?***

“Plagiarism is a serious academic offence which may lead to loss of credit [‘F’ in a course], suspension or expulsion from the University, or even the revocation of a degree.”<sup>†</sup> **At Dalhousie University, the Department is obligated to refer any cases of suspected plagiarism to the Senate Discipline Committee**, which will then conduct a hearing to evaluate the innocence or guilt of students alleged to have committed an act of plagiarism.

### ***How can accusations of plagiarism be avoided?***

You can avoid accusations of plagiarism by:

- Preparing all submissions independently and ensuring that they are expressed in your own unique writing style.
- Never sharing any written or electronic material with other students. You may discuss ideas with other students but you may not work with another student while preparing materials you are planning to hand in.
- Acknowledging any material paraphrased extensively or copied from sources such as the Internet, journal articles or textbooks. Paraphrasing of short phrases from the course textbook need not be acknowledged.
- Guarding all your work, both drafts and final submissions, to ensure that no one else can copy it. If you provide access to your work and someone copies it, then you may have to appear before the Senate Discipline Committee to establish that you are the original creator of the work. If you suspect that someone has taken any of your work, notify your course instructor immediately.
- Using only laboratory data that you actually collected in the lab. Altering laboratory data is not permitted. If your data are unusable, you must still report your own data along with any explanation as to why the data are unusable. You may then use data supplied by the lab instructor for analysis, but you must acknowledge such use.