Introduction to Biochemistry Syllabus

Department of Biochemistry & Molecular Biology

BIOC 2300 Fall 2025

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 Instructors

Name	Email	Office Hours
Kathryn Vanya Ewart (Instructor)	vewart@dal.ca	Book meeting
Petra Kienesberger (Instructor)	pkienesb@dal.ca	Schedule via email
Emmanuel Tshimanga (Teaching assistant)	BIOC2300@dal.ca	n/a

Course Description

This online 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.

Note
Students are advised to also take CHEM 2401.03 and CHEM 2402.03

Course Prerequisites
BIOL 1010.03 (or equivalent), CHEM 1011.03 (or equivalent) and CHEM 1012.03 (or equivalent); all with grades of C or higher, or instructor's consent.

Course 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 is often much more helpful to assess your knowledge of these concepts through questions. Therefore, a prior knowledge inventory has been constructed in the form of an ungraded readiness test. Please see below for details.

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
Electrostaic 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	Identifiy 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
Ka and pKa	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

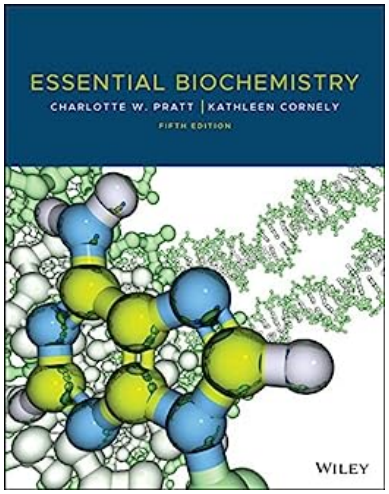
BIOL 1010:
Describe the process by which carbohydrates, lipids and proteins are assembled from monomers and identify their functional roles in the eukaryotic cell.
Describe the structure and function of the organelles found in eukaryotic cells, demonstrating an appreciation for the overall architecture 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 any missing conceptual knowledge and thus providing a means for you to catch up and become better prepared for the upcoming course content.

Student Resources/Course Material

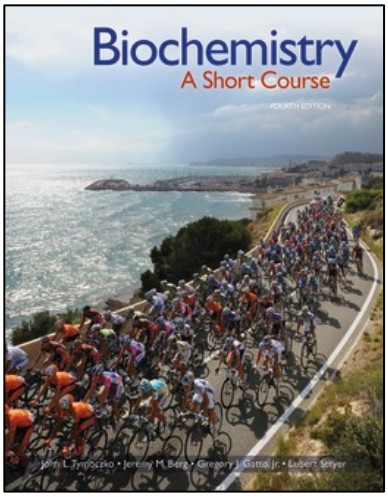
- Study materials, including PDF files of lecture notes, lecture videos, assigned readings and links to online videos will be available in Brightspace.

- The purchase of a course textbook is not required. Any reputable and reasonably up-to-date biochemistry textbook would suffice for background information. However, the following two are the ones most recommended for those who wish to obtain a textbook:



Essential Biochemistry

(5th edition, 2022) by Pratt & Cornely



Biochemistry: A Short Course

(4th edition, 2019) by Tymoczko; Berg; Gatto; & Stryer

- Within our class, there are multiple ways to keep in touch with the instructional team. In the table on the next page, we highlight the purpose of each method of communication:

Method of Communication	Purpose	Advantage
Brightspace Discussion Board	Ask any questions on the course content & administration.	Fast response, easily accessible, open for everyone to see and share.
Course email: BIOC2300@dal.ca	Ask **short** course content-related questions.	Managed by our teaching assistant; response within 48 hours; only for short content questions
Dr. Ewart's Office Hours: Book meeting	• Ask questions on course administration • Request 1-on-1 or 1-on-a-few meetings for feedback, exam review, content help, etc.	• Short, efficient and effective • Confidential
Dr. Kienesberger's Office Hours: schedule via email	• Request 1-on-1 or 1-on-a-few meetings for feedback, exam review, content help, etc.	• Short, efficient and effective • Confidential
Dr. Ewart's email: vewart@dal.ca Dr. Kienesberger's email: pkienesb@dal.ca	In case our office hours do not fit your schedule, we can meet at a time that works for you.	Flexible and private.
Anonymous Feedback: Feedback	This form allows you to provide constructive feedback so that we can improve throughout the course.	Easy to complete, anonymous, and concerns can be addressed immediately.

Course Structure

The course will involve several components.

1. **Lecture files and videos:** As noted above, lecture material will be available as PDF files and in video form in Brightspace.

2. **News assignment:** A short writing assignment worth 2.5% will allow students to reflect on biochemistry in the news and on their goals for the course.

3. **Practice problems:** Problems will be posted regularly for individual and/or group practice.

4. **Low-stakes assessments:** In addition to the typical midterm and final exams, eight online quizzes will be assigned for submission on specific dates (mostly Sundays) at 11:59 p.m. Students will have two attempts for each quiz and the lowest quiz mark for the semester will be eliminated, resulting in the remaining 7 quizzes counting, worth 2.5% each.

5. **Independent study**: This course will require substantial independent study of the material in order to develop broadly based and in-depth knowledge of the methods and concepts covered.

6. **Communication and assistance:**
The TA can assist students with questions by email, as indicated above. Appointments for consultation or extra help can also be set up by scheduling a meeting using the links above. As noted above, students who cannot meet in these intervals are welcome to contact instructors by email to schedule different meeting times.

Assessment

Evaluation will include the following components:

Assessment*	**Deadlines and exam dates**	**Weight (%)**
Eight online quizzes	Specific dates (mostly Sundays) at 11:59 p.m. (following each quiz assignment)	17.5
Midterm exam 1 (non-cumulative)	Wednesday, October 15th at 7:00 p.m. in the Rowe Management Bldg., room 1028	20
News assignment	Sunday, November 2nd at 11:59 p.m.	2.5
Midterm exam 2 (non-cumulative)	Wednesday, November 19th at 7:00 p.m. in in the Rowe Management Bldg., room 1028	20
Final exam (cumulative)	In the Dalhousie final exam schedule, (date and location TBA)	40

NOTES:

1. Only the top 7 quiz grades will count. The quiz with the lowest grade will not be counted.

2. If both midterm exams are written, the midterm exam with the higher grade of the two will count for the entire midterm mark (40%). If only one midterm exam is written, that exam will be worth 40%. If no midterm exams are written, the final exam will be worth 80%.

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)	

Course Policies on Missed or Late Academic Requirements

- The written assignment will be docked 0.5 marks per day if submitted late.
- If a student is unable to complete the written assignment at the scheduled time due to illness or for other valid reasons, the student must submit a **Student Declaration of Absence** form (available on Brightspace) either electronically or in printed form within 3 days of the event. A maximum of 2 declarations of absence will be accepted per student. If a declaration of absence is submitted for an assignment, students then have five extra days to complete the assignment before marks are docked as described above.
- Quizzes cannot be submitted after the set deadlines. Therefore, the declaration of absence has no effect on quizzes.
- There will be **no make-up midterm** exams. If a midterm exam is missed, then the remaining midterm will count for 40% of the final grade. If no midterm exams are written, the final exam will automatically count for 80%.
- The final exam is compulsory. If missed, a make-up exam must be written.
- **Travel for holidays will not be accommodated.**

Course Policies related to Academic Integrity

- Students are expected to complete their online quizzes and writing assignments independently.

Learning Objectives

Welcome to Introduction to Biochemistry (BIOC 2300), 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 students 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.

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Syllabus continues below

Course Schedule

Date	Item	Topic
NOTE: Eight quizzes will be given in Brightpace. Please be aware of notices.		
September 23rd-28th	Introductory Lecture	Introduction to the course
	Lecture 1	Aqueous chemistry
	Lecture 2	Acid-base chemistry and buffers
September 29th-October 5th	Lecture 3	Amino acids and proteins: primary structure
	Lecture 4	Secondary, tertiary, and quaternary protein structuture
	Lecture 5	Isolating and analyzing proteins
October 6th-12th	Lecture 6	Protein function I
	Lecture 7	Protein function II
	Lecture 8	How enzymes work
October 15th	Exam	Midterm exam on Lecture lectures 1-8 at 7:00-8:30 p.m. in person
October 13th-19th	Review session	Evening review session on Teams
	Lecture 9	Enzyme kinetics
	Lecture 10	Lipids and membranes
October 20th-26th	Lecture 11	Nucleic acids I
	Lecture 12	Nucleic acids II
	Lecture 13	Carbohydrate form and function
November 2nd	Due date	Biochemistry news assignment
October 27th-November 2nd	Lecture 14	Glycobiology: sugars beyond energy storage
	Lecture 15	Overview of glycogen metabolism
	Lecture 16	Thermodynamics: flux of biochemical reactions
November 3rd-16th (regular week + study break)	Lecture 17	Glycolysis: nuts & bolts of glycolytic reactions
	Lecture 18	Glycolysis & fermentation in health and disease
	Lecture 19	Gluconeogenesis: the "reverse" of glycolysis?
November 19th	Exam	Midterm exam on Lecture lectures 9-18 at 7:00-8:30 p.m. in person
November 17th-23rd	Review	Evening review session on Teams
	Lecture 20	Tricarboxylic acid cycle (TCA): when breath becomes air
	Lecture 21	Oxidative phosphorylation I: Electron transport chain
November 24th-November 30th	Lecture 22	Oxidative phosphorylation II: Tabulating ATP production
	Lecture 23	Fatty acid oxidation: nuts and bolts of beta oxidation
	Lecture 24	Fatty acid oxidation in health & diseases
December 1st-7th	Lecture 25	Fatty acid synthesis: nuts & bolts of fatty acid synthesis
	Lecture 26	Fatty acid synthesis in health & diseases
	Lecture 27	Introduction to amino acid metabolism
December 8th-10th	Review	Review session on Teams (TBA)
December exam period	Exam	Final exam on entire course (concentrating on material since midterm 2) in person at time and location TBA

Blue:	Dr. Ewart
Orange:	Dr. Kienesberger
Grey:	Both
Yellow:	Evaluated items

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.