Faculty of Science Course Syllabus
Department of Biochemistry & Molecular Biology
BIOC 3400
Nucleic Acid Biochemistry and Molecular Biology — Fall Term, 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. 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 the part of Mi'kma'ki known as Nova Scotia for over 400 years.

Lecturers: Dr. John Archibald, Department of Biochemistry & Molecular Biology (Coordinator)
Room 9R1, Tupper Medical Building Email: john.archibald@dal.ca

Dr. James Davey, Department of Biochemistry & Molecular Biology
Room 10M1, Tupper Medical Building Email: james.davey@dal.ca

Dr. Claudio Slamovits, Department of Biochemistry & Molecular Biology
Room 8B, Tupper Medical Building Email: claudio.slamovits@dal.ca

Lab Instructors: Dr. Hyo-Sung Ro, Department of Biochemistry & Molecular Biology
Room 2L-C2, Tupper Link Email: hyo-sung.ro@dal.ca

Dr. Shawn Xiong, Department of Biochemistry & Molecular Biology
Room 8-J3, Tupper Medical Building Email: shawn.xiong@dal.ca

Lectures: M W F 9:35-10:25 AM Theatre B, Tupper Medical Building

Laboratories:

Weekly 3-hr laboratory session will take place on Wed. (B01), Thur. (B02), or Fri. (B04) in **Tupper 8J-01**.

Wednesday	2:35 - 5:25 PM	Room 8J-1, Tupper Medical Building (Xiong)
Thursday	2:35 - 5:25 PM	Room 8J-1, Tupper Medical Building (Ro)
Friday	2:35 - 5:25 PM	Room 8J-1, Tupper Medical Building (Ro)

More information regarding the lab schedule, lab manual, and lab assessment will be provided on Brightspace.
Our first lab starts on September 10th (B01), 11th (B02) or 12th (B04).

Lecture delivery: In-person (lectures will be recorded and posted). Please note that **in-person attendance is strongly encouraged.**

Course Description

This class focuses on the relationship of structure to function in RNA and DNA. Methods of studying the primary, secondary and tertiary structures of nucleic acids are explored in **lectures** and in the l**aboratory**. Enzymatic mechanisms for biosynthesis, rearrangement, degradation and repair of nucleic acid molecules are studied, as are the processes of replication, transcription and translation. In this context, nucleic acid biochemistry is emphasized as a basis for understanding storage and transfer of biological information. Molecular biological techniques are based on underlying principles of nucleic acid biochemistry and will be described in that context.

Course Prerequisites / Restrictions

BIOL2020, BIOL2030 and BIOC2610 (with a grade of B-minus or better), CHEM2401 and 2402, as well as BIOC2300; or instructor's permission.

Course Objectives / Learning Outcomes

- Recognize different types of non-coding RNAs, and recognize/identify their roles in gene expression.
- Explain the steps of protein synthesis identifying the differences between prokaryotes and eukaryotes.
- Distinguish the nucleotides that compose DNA and RNA.
- Given DNA sequence data design (probes), recognize their use in different techniques such as PCR, microarray, Southern blotting.
- Predict the fate of a protein based on features of the primary sequence.
- Apply/use knowledge on DNA replication to explain the behavior of these molecules in different stages and under specific conditions (UV, analogs, salt concentration).
- Distinguish between RNA dependent and DNA dependent Polymerases and identify the process where they are involved.
- Explain the process of chain termination DNA sequencing.
- Explain the processing (splicing, editing) of RNA (mRNA, tRNA, rRNA). Predict the effects of mutations in the primary RNA sequence.
- Given a DNA sequence and restriction enzyme data, analyze a band pattern in a gel and generate a restriction map.
- Identify the specific nucleotide and recognize the distinguishing features.
- Interpret data obtained from electrophoresis-based methods (e.g., blotting, restriction enzyme, PFGE, gel mobility assays and CHIP).
- Based on the properties of the polynucleotides predict the outcome of differential chemical or enzymatic treatment.
- Design a strategy for manipulating DNA molecules in particular scenarios (e.g., Radio labeling and sub cloning).
- Distinguish the differences between prokaryotes and eukaryotes in terms of genome organization, gene structure, and expression and DNA replication.
- Given a type of DNA damage explain the repair mechanisms that can occur.
- Identify/recognize and explain the roles of the major proteins involved in the process of DNA replication/RNA synthesis and its regulation.
- Distinguish the differences in DNA packaging/chromatin organization between prokaryotes and eukaryotes.

- Identify the RNA molecules that participate protein synthesis and explain their contributions.
- Predict the mRNA and the amino acid sequence given a DNA sequence.
- Explain the contribution of DNA packaging/chromatin to gene expression and regulation.
- Provide evidence for the roles of catalytic RNA in different cellular process such as protein synthesis and RNA splicing.
- Identify techniques to study DNA packaging/chromatin (e.g., CHIP, DNA sensitivity).

Course Materials

Recommended / suggested text: Cox, Doudna, and O'Donnell: ***Molecular Biology (Principles and Practice***), 2nd Edition (2015).

Paper and digital copies are available through the Dalhousie bookstore here

Although this text is recommended, no single textbook covers all material in the course, and none is absolutely required. Lectures will be drawn from a variety of sources, including the recent literature. Copies of slides shown in online lectures will be available on the course Brightspace page (see below). For much of the material in the course, any modern textbook of biochemistry and/or molecular biology will provide the basic background. In addition to the 2nd edition of *Molecular Biology (Principles and Practice*) by Cox et al., the following general texts are clearly written and well-illustrated, and encompass much of the material that will be presented in the course:

-Voet and Voet: ***Biochemistry*** (4th Edn, 2011)
-Nelson and Cox: ***Lehninger Principles of Biochemistry*** (5th Edn, 2008)
-Voet and Voet: ***Biochemistry*** (3rd Edn, 2004)
-Matthews, van Holde and Ahern: ***Biochemistry*** (2000)
-Lodish *et al.*: ***Molecular Cell Biology*** (5th edn., 2003)
-Nelson and Cox: ***Lehninger Principles of Biochemistry*** (3rd edn., 2000)

Course website*:*

Information relating to the lectures and exams, including PDF copies of lecture materials, will appear on Brightspace. The course Brightspace page will also contain information about labs, including weekly tasks/assignments, answers to frequently asked questions, changes to lab schedules / assignments, etc.

Course Assessment

The final grade will be determined as follows:

30%	two mandatory midterm examinations (15% each; October 1st and 31st)
30%	laboratory
40%	final examination (scheduled by the Registrar)

Please note: The final examination is cumulative. Students who do not receive passing grades in the midterms *and* the final exam will not pass the course (no exceptions).

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

Policy for students repeating a BIOC course with an integral lab component (BIOC 3300, BIOC 3400, BIOC 3700) — Students who have previously taken BIOC 3300, BIOC 3400, or BIOC 3700 and passed the laboratory component will not be allowed to retake the lab component if they redo the course. The previous lab marks will be used to assign the grade for the lab component based on the weight given to this component in the prospectus for the course in the year it is retaken.

Policies on missed examinations, assignments, etc.:

- A student who cannot attend a midterm examination due to illness must notify the lecturer, course coordinator, or department office either prior to, or within, 48 hrs of the examination.
- The student must also submit a **Student Declaration of Absence (SDA) Form** (through the course Brightspace page or via e-mail) **within three (3) calendar days following the last day of absence**. Absence for non-medical or non-emergency reasons is not acceptable unless prearranged with the course coordinator / lecturer.
- A missed examination for which no satisfactory arrangement has been made will be given a mark of zero.
- Special 'make-up' exams (if offered) will normally be written within 7 calendar days after the missed exam.
- **The Student Declaration of Absence form can only be submitted up to two (2) separate times per course during a term.** Students who exceed this limit must inform their 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 discretion of the course coordinator to disallow any further Student Declarations and deny alternate arrangements.

Lecture schedule

DATE	DAY	TOPIC	LECTURER
Sept. 3	Wed	1. Introduction	James Davey (JD)
5	Fri	2. Nucleosides and nucleotides	JD
8	Mon	3. Polynucleotide structure (1)	JD
10	Wed	4. Polynucleotide structure (2)	JD
12	Fri	5. Nucleases; DNA/RNA modifying enzymes	JD
15	Mon	6. DNA replication (1): introduction	JD
17	Wed	7. DNA replication (2): DNA polymerases	JD
19	Fri	8. DNA replication (3): biochemical mechanism	JD
22	Mon	9. DNA replication (4): biochemical mechanism	JD
24	Wed	10. DNA replication (5) eukaryotes	JD
26	Fri	11. DNA repair (1)	JD
29	Mon	12. DNA repair (2)	JD
Oct. 1	Wed	**MID-TERM EXAM #1**	**JD**
Oct. 3	Fri	13. Denaturation, renaturation of nucleic acids	John Archibald (JA)
6	Mon	14. Restriction enzymes/restriction analysis	JA
8	Wed	15. Recombinant DNA (1)	JA
10	Fri	16. Recombinant DNA (2)	JA
13	Mon	***NO LECTURE (Thanksgiving)***	
15	Wed	17. Recombinant DNA (3)	JA
17	Fri	18. Nucleic acid sequencing	JA
20	Mon	19. Gene structure, prokaryotic vs. eukaryotic	JA
22	Wed	20. Transcription and its control (1)	JA
24	Fri	21. Transcription and its control (2)	JA
27	Mon	22. Transcription and its control (3)	JA
29	Wed	23. Chromatin dynamics and transcription	JA
Oct. 31	Fri	**MID-TERM EXAM #2**	**JA**
Nov. 3	Mon	24. Genetic code	Claudio Slamovits (CS)
5	Wed	25. Transfer RNA	CS
7	Fri	26. Ribosome structure, function, rRNA processing	CS
Nov.10-14	**M-F**	***NO LECTURES (Fall study week)***	
17	Mon	27. Translation (1)	CS
19	Wed	28. Translation (2)	CS
21	Fri	29. Post-translation modification and transport	CS
24	Mon	30. mRNA processing: spliceosome, snRNAs	CS
26	Wed	31. RNA editing; catalytic RNAs	CS
28	Fri	32. Non-coding RNAs: micro-RNA, siRNA,	CS
Dec. 1	Mon	33. Special topics	CS
Dec. 3	Wed	34. Review	CS

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 Mi'kmaq and Indigenous Relations (including the Elders in Residence program, Land Acknowledgements, Understanding Our Roots, and much more) can be found at: https://www.dal.ca/about/mission-vision-values/mikmaq-indigenous-relations.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/mission-vision-values/global-relations.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/campus_life/ssc.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: https://www.dal.ca/about/mission-vision-values/equity-diversity-inclusion-and-accessibility/about-office-equity-inclusion.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/content/dam/www/about/leadership-and-governance/governing-bodies/code-student-conduct.pdf

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/content/dam/www/about/leadership-and-governance/university-policies/fair-dealing-policy.pdf

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.