



BIOCHEMISTRY BIOC4410A: Molecular Biology of RNA and DNA

Course Syllabus for Fall 2023



1. Technical Requirements:

Stable internet connection



Laptop or computer

2. Important Dates:

Classes Begin	Reading Week	Classes End	Study day(s)	Exam Period
September 7	October 30–	December 8	December 9	December 10–22
	November 5			

* November 13, 2023: Last day to drop a first-term half course without penalty

** September 29, 2023 is National Day for Truth and Reconciliation and is a non-instructional day

3. Contact Information

Course Coordinator	Contact Information
Dr. David Edgell	dedgell@uwo.ca
Instructor(s) or Teaching Assistant(s)	Contact Information
David Edgell (Instructor)	dedgell@uwo.ca
Elizabeth Connelly (TA)	econnell@uwo.ca
Raagul Sivacumar (TA)	rsivacum@uwo.ca

4. Course Description and Design

Delivery Mode: in-person

The use of fundamental and emerging techniques in molecular biology and genomics will be illustrated using in-class lectures, examples from the current scientific literature and selected case studies. Selected topics include the molecular biology of SARS-CoV-2, CRISPR, geneediting, DNA repair, protein-DNA interactions and gene regulation, and the RNA world.

All classes this year are in-person, unless otherwise instructed by the University. Lecture material will be posted on the BIOC4410A OWL site.

Prerequisite(s): Biochemistry 3381A and Biochemistry 3382A.

Timetabled Sessions

Component	Date(s)	Time
Lecture		

Attendance at sessions is required

All course material will be posted to OWL: http://owl.uwo.ca. Any changes will be indicated on the OWL site and discussed with the class.

If students need assistance, they can seek support on the <u>OWL Help page</u>. Alternatively, they can contact the <u>Western Technology Services Helpdesk</u>. They can be contacted by phone at 519-661-3800 or ext. 83800.

<u>Google Chrome</u> or <u>Mozilla Firefox</u> are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click <u>here.</u>

5. Learning Outcomes

Upon successful completion of this course, students will be able to:

-Critically read scientific literature in molecular biology

-Identify appropriate information sources for answering questions relating to molecular biology -Design research strategies to further our understanding of molecular biology mechanisms, including directed-evolution and high-throughput screens

-Describe to the lay public how detailed understanding of molecular processes involving DNA and RNA impact on diseases such as COVID-19, cancer and cystic fibrosis

-Be able to discuss advantages and limitations of therapeutic gene editing to the lay public including technical and ethical concerns

Section 1

-Describe the classification scheme for CRISPR systems, including the different protein and RNA components

-Describe how spacer sequences are processed and captured by type II CRISPR systems -Understand the different mechanistic steps in DNA cleavage by Cas9, including the rate-limiting steps in the reaction

-Understand the relationship between Cas9 cleavage and DNA repair pathways in gene editing

-Describe the concept of off-target effects and how this applies to gene editing

-Discuss advantages and limitations of different methodologies for experimentally identifying offtarget sites

-Describe limitations of using Cas9 for therapeutic applications

Section 2

-Describe the coronavirus life cycle

-Discuss advantages and disadvantages of direct and sequence-by-synthesis methods of nucleic acid sequencing

-Understand how RNA sequencing data is presented

-Describe how coronavirus transcription and replication take place

-Describe how RNA modifications influence RNA function

-Understand critical concepts in directed evolution

-Describe how complex libraries are created for use in directed evolution

-Be able to explain high-throughput screening with emphasis on yeast surface display

-Describe the differences and similarities between nanobodies and antibodies

Section 3

-Describe the biochemical interactions between proteins and DNA

-Discuss relative contributions of biochemical interactions to affinity and specificity for protein-DNA interactions

-Describe and discuss limitations of the different methods for displaying consensus DNA-binding sites

-Describe strategies by which eukaryotic transcription factors bind biologically relevant sites -Discuss the role of p53 as the guardian of the genome

-Understand the functional role that disease-associated mutations have on p53 function

-Be able to use sequence biological sequence databases to identify p53 mutations

Section 4

-Be able to discuss the concept of the RNA world and other prebiotic chemistry

-Describe the different types of catalytic RNAs and their cellular functions

-Describe mechanisms of retrotransposition

-Discuss the retrotransposon storm hypothesis for ALS

-Describe how RNA editing regulates RNA interference and DNA transposition

-Critically evaluate the hypothesis that prebiotic nucleic acid was composed of arsenic instead of phosphate

6. Course Content and Schedule

Week	Dates	Торіс	Instructor
1	Sept 7	Introductory lecture	Edgell
2	Sept 12 & 14	Gene editing & DNA repair	Edgell
3	Sept 19 & 21	Gene editing & DNA repair	Edgell
4	Sept 26 & 28	Case study #1; gene editing	Edgell
5	Oct 3 & 5	Coronavirus	Edgell
6	Oct 10 & 12	Directed evolution	Edgell
7	Oct 17 & 19	Case study #2; COVID-19 nanobodies	Edgell
8	Oct 24 & 26	DNA-binding proteins/gene regulation	Edgell
9	Oct 30–Nov 5	Reading Week	N/A
10	Nov 7 & 9	DNA-binding proteins/gene regulation	Edgell
11	Nov 14 & 16	Case study #3: p53 & cancer	Edgell
12	Nov 21 & 23	Retrotransposons	Edgell
13	Nov 28 & 30	Retrotransposons & RNA world	Edgell
14	Dec 5 & 8	RNA world & case study #4	Edgell

7. Participation and Engagement

- Students are expected to participate and engage with content as much as possible
- Students can also participate by interacting in the forums with their peers and instructors

8. Evaluation

Below is the evaluation breakdown for the course. Any deviations will be communicated.

Assessment	Format	Weighting	Due Date
Case study #1	Take home	20%	5pm, Oct 3 rd , 2023
Case study #2	Take home	25%	5pm, Oct 24 th , 2023
Case study #3	Take home	25%	5pm, Nov 21 st , 2023
Case study #4	Take home	25%	5pm, Dec 22 nd , 2023
Meme	Take home	5%	5pm, Dec

- All assignments are due at 5pm EST unless otherwise specified
- Students are responsible for ensuring that the correct file version is uploaded; incorrect submissions including corrupt files could be subject to late penalties (see below) or a 0
- Students can work in groups for the assignments but each student must submit answers in their own words
- Written assignments will be submitted to Turnitin (statement in policies below)
- Students will have unlimited submissions to Turnitin

- After an assessment is returned, students should wait 24 hours to digest feedback before contacting their evaluator; to ensure a timely response, reach out within 7 days
- Any grade appeals on assignments must be received within 1 week of the grade being posted.

Click <u>here</u> for a detailed and comprehensive set of policies and regulations concerning examinations and grading. The table below outlines the University-wide grade descriptors.

-	90-100	One could scarcely expect better from a student at this level
	80-89	Superior work which is clearly above average
	70-79	Good work, meeting all requirements, and eminently satisfactory
	60-69	Competent work, meeting requirements
	50-59	Fair work, minimally acceptable
	below 50	Fail

Information about late or missed evaluations:

- Late assessments without accommodation will be subject to a late penalty 5%/day
- ☑ If the meme is not submitted by the due date the 5% will be transferred to the last completed assignment
- An assessment cannot be submitted after it has been returned to the class
- ✓ If a student misses an assignment and has an approved extension from Academic Counselling the student can submit the assignment until marks are released for that assignment. If the missed assignment is not submitted within that time, the weight of a missed assignment will be transferred to the next assignment. If the last assignment is missed; the completed assignments will be equally re-weighted to 95% of the course mark
- At least three of the four assignments must be completed to pass the course. If three assignents are not completed, the student is Incomplete Standing (INC).

INC (Incomplete Standing): If a student has been approved by the Academic Counselling Office (in consultation with the instructor/department) to complete term work at a later date, an INC will be assigned. Students with INC will have their course load in subsequent terms reduced to allow them to complete outstanding course work. Students may request permission from Academic Counselling to carry a full course load for the term the incomplete course work is scheduled.

9. Communication:

- Students should check the OWL site every 24–48 hours
- Students should email their instructor(s) and teaching assistant(s) using email
- Emails will be monitored daily; students will receive a response in 24–48 hours
- This course will use the OWL forum for discussions
- Students should post all course-related queries on the OWL discussion forum so that everyone can access the questions and responses

10. Office Hours:

- Contact Dr. Edgell by email (<u>dedgell@uwo.ca</u>) to set up time for office visit.
- TAs will hold office hours on Wednesday 4-5pm in MSB 340.

11. Resources

All resources will be posted in OWL

12. Professionalism & Privacy:

Western students are expected to follow the Student Code of Conduct. Additionally, the following expectations and professional conduct apply to this course:

- $ec{black}$ All course materials created by the instructor(s) are copyrighted and cannot be sold/shared (e.g., Must Knows Facebook group, Course Hero, Chegg, etc.)
- Recordings are not permitted (audio or video) without explicit permission
- Permitted recordings are not to be distributed
- Students will be expected to take an academic integrity pledge before some assessments

Western is committed to providing a learning and working environment that is free of harassment and discrimination. All students, staff, and faculty have a role in this commitment and have a responsibility to ensure and promote a safe and respectful learning and working environment. Relevant policies include Western's Non-Discrimination/Harassment Policy (M.A.P.P. 1.35) and Non-Discrimination/Harassment Policy - Administrative Procedures (M.A.P.P. 1.35).

Any student, staff, or faculty member who experiences or witnesses' behaviour that may be harassment or discrimination **must report the behaviour** to the Western's Human Rights Office. Harassment and discrimination can be human rights-based, which is also known as EDI-based, (sexism, racism, transphobia, homophobia, islamophobia, xenophobia, antisemitism, and ableism) or non-human rights-based (personal harassment or workplace harassment).

13. How to Be Successful in this Class:

Students enrolled in this class should understand the level of autonomy and self-discipline required to be successful.

- Invest in a planner or application to keep track of your courses. Populate all your 1 deadlines at the start of the term and schedule your time throughout the course.
- Make it a daily habit to log onto OWL to ensure you have seen everything posted to help 2. you succeed in this class.
- Follow weekly checklists created on OWL or create your own to help you stay on track. 3.
- Take notes as you go through the lesson material. Keeping handwritten notes or even 4. notes on a regular Word document will help you learn more effectively than just reading or watching the videos.
- 5. Connect with others. Try forming an online study group and try meeting on a weekly basis for study and peer support.
- Do not be afraid to ask questions. If you are struggling with a topic, check the online 6. discussion boards or contact your instructor(s) and or teaching assistant(s).
- Reward yourself for successes. It seems easier to motivate ourselves knowing that there 7. is something waiting for us at the end of the task.

14. Western Academic Policies and Statements

Absence from Course Commitments

A. Absence for medical illness:

Students must familiarize themselves with the Accommodation for Illness Policy.





A student seeking academic accommodation for the meme (which is worth 5% of the course mark) is given an automatic 48 hr extension when the course coordinator is contacted the student. If the meme is not submitted within 48 hrs the meme weighting is transferred to last assignment.

If you are unable to meet a course requirement for any **work worth 10% or greater** due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Academic Counseling as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. Please note that the format of a make-up test, exam, or assignment is at the discretion of the course coordinator.

A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Record's Release Form (located in the Dean's Office) for visits to Student Health Services. The form can found be at: http://www.uwo.ca/univsec/pdf/academic policies/appeals/medicalform.pdf

B. Absence for non-medical reasons:

Student absences might also be approved for non-medical reasons such as religious holidays and compassionate situations. Please review the policy on <u>Accommodation for Religious Holidays</u>. All non-medical requests must be processed by Academic Counselling. Not all absences will be approved; pay attention to the academic calendar and final exam period when booking any trips.

C. Special Examinations

A Special Examination is any examination other than the regular examination, and it may be offered only with the permission of the Dean of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents. To provide an opportunity for students to recover from the circumstances resulting in a Special Examination, the University has implemented Special Examinations dates. These dates as well as other important information about examinations and academic standing can be found <u>here.</u>

Academic Offenses

Scholastic offences are taken seriously, and students are directed <u>here</u> to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence.

Accessibility Statement

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Accessible Education (AE) at 661-2111 x 82147 for any specific question regarding an accommodation or review <u>The policy on Accommodation for Students with Disabilities</u>

Correspondence Statement

The centrally administered **e-mail account** provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner. You can read about the privacy and security of the UWO email accounts <u>here</u>.

Discovery Credit Statement

Students are permitted to designate up to 1.0 Discovery Credit course (or equivalent) for pass/fail grading that can be counted toward the overall course credits required for their degree program. The details of this policy and the deadlines can be found <u>here</u>.

Turnitin and other similarity review software

All assignments will be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. Students will be able to view their results before the final submission. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between Western University and <u>Turnitin.com</u>.

15. BMSUE Academic Policies and Statements

Cell Phone and Electronic Device Policy (for in-person tests and exams)

The Schulich School of Medicine & Dentistry is committed to ensuring that testing and evaluation are undertaken fairly across all our departments and programs. For all tests and exams, it is the policy of the School that any electronic devices, e.g., cell phones, tablets, cameras, smart glasses, smart watch or iPod are strictly prohibited. These devices MUST be left either at home or with the student's bag/jacket at the front of the room and MUST NOT be at the test/exam desk or in the individual's pocket. Any student found with one of these prohibited devices will receive a grade of zero on the test or exam. Non-programmable calculators are only allowed when indicated by the instructor. The program is not responsible for stolen/lost or broken devices.

Copyright and Audio/Video Recording Statement

Course material produced by faculty is copyrighted and to reproduce this material for any purposes other than your own educational use contravenes Canadian Copyright Laws. You must always ask permission to record another individual and you should never share or distribute recordings.

Rounding of Marks Statement

Across the Basic Medical Sciences Undergraduate Education programs, we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement. *Final grades* on this course, irrespective of the number of decimal places used in marking individual assignments and tests, will be calculated to one decimal place and rounded to the nearest integer, e.g., 74.45 becomes 74, and 74.50 becomes 75. Marks WILL NOT be bumped to the next grade or GPA, e.g., a 79 will NOT be bumped up to an 80, an 84 WILL NOT be bumped up to an 85, etc. The mark attained is the mark you achieved, and the mark assigned; requests for mark "bumping" will be denied.

Statement on the use of ChatGPT and other Artificial Intelligence (AI) Platforms

16. Support Services

The following links provide information about support services at Western University.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have

experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Academic Counselling (Science and Basic Medical Sciences)

Appeal Procedures

Registrarial Services

Student Development Services

Student Health Services