

Department of Biochemistry
BIOC 4401A – Molecular Biology of DNA and RNA

Course Outline for Fall 2025

This course takes place at Western University, which is located on the traditional territories of the Anishinaabek, Haudenosaunee, Lūnaapéewak, and Chonnonton Nations, on lands connected with the London Township and Sombra Treaties of 1796 and the Dish with One Spoon Covenant Wampum.

Students who are in emotional and/or mental distress should refer to <https://www.uwo.ca/health/> for a complete list of options about how to obtain help.

1. Technical Requirements:



Stable internet connection



Laptop or computer

2. Important Dates:

Classes Begin	Reading Week	Classes End	Study day(s)	Exam Period
September 4	November 3–9	December 9	December 10	December 11–22

September 30, 2025: National Day for Truth and Reconciliation; non-instructional day

September 12, 2025: Last day to add or drop a Fall 12-week course

December 1, 2025: Last day to withdraw from a Fall 12-week course without academic penalty

3. Contact Information

Course Coordinator	Contact Information
Dr. David Edgell	dedgell@uwo.ca

Instructor(s)	Contact Information
Dr. David Edgell	dedgell@uwo.ca

Teaching Assistants	Contact Information
Amani Jaafar	ajaafar2@uwo.ca
Christian Natale	cnatale4@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, gene-editing, 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 4410A OWL-Brightspace site. Lecture times are 12:30-1:30pm Tuesday and Thursday in room The first lecture will be Thursday, September 4.

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

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Timetabled Sessions

Component	Date(s)	Time
Lecture	T/Th	12:20-1:30

- ☒ For some sessions asynchronous pre-work may be required. This will be described and assigned by the instruction in advance of those sessions.
- ☒ Attendance at sessions is required.

All course material will be posted to OWL Brightspace: <https://westernu.brightspace.com/d2l/login>. Any changes will be indicated on the OWL Brightspace site and discussed with the class.

If students need assistance, they can seek support on the [OWL Brightspace Help](#). Alternatively, they can contact the [Western Technology Services Helpdesk](#). They can be contacted by phone at 519-661-3800 or ext. 83800.

Current versions of all popular browsers (e.g., Safari, Chrome, Edge, Firefox) are supported with OWL Brightspace; what is most important is that you update your browser frequently to ensure it is current. All JavaScript and cookies should be enabled.

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 off-target sites
- Describe limitations of using Cas9 for therapeutic applications

Section 2

- Understand critical concepts in directed evolution
- Describe how complex libraries are created for use in directed evolution
- Be able to explain high-throughput screening technologies
- Understand the limitations of directed evolution and how false positives can arise
- Explain how directed evolution can be used to develop personalized gene editors for therapeutic applications
- Understand the limitations of developing bespoke gene editors
- Describe how gene editors are delivered for therapeutic applications

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

6. Course Content and Schedule

Week	Dates	Topic	Instructor
1	Sept 4–7	Introductory lecture	Edgell
2	Sept 8–14	Gene editing & DNA repair	Edgell
3	Sept 15–21	Gene editing & DNA repair	Edgell
4	Sept 22–28	Gene editing & DNA repair; case study #1	Edgell
5	Sept 29–Oct 5	Directed evolution & personalized gene therapy	Edgell
6	Oct 6–12	Directed evolution & personalized gene therapy	Edgell
7	Oct 13–19	Directed evolution & personalized gene therapy; case study 2	Edgell
8	Oct 20–Oct 26	Protein-DNA interactions	Edgell
9	Oct 27–Nov 2	Protein-DNA interactions	Edgell
10	Nov 3–9	Reading Week (starts November 3 rd 12:01 AM)	N/A
11	Nov 10–16	Protein-DNA interactions; case study 3	Edgell
12	Nov 17–23	RNAi, retrotransposons	Edgell
13	Nov 24–30	RNAi, retrotransposons	Edgell
14	Dec 1–7	RNAi, retrotransposons; case study 4	Edgell
15	Dec 8, 9	case study 4	Edgell

7. Participation and Engagement

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

8. Assessment and Evaluation

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

Assessment	Format	Weighting	Due Date	Flexibility
Case study 1	Short answer	Best 3 weighted at 28%; lowest at 11%	11:59 pm Sept 30	72 hour, no late penalty
Case study 2	Short answer		11:59 pm Oct 23	72 hour, no late penalty
Case study 3	Short answer		11:59 pm Nov 20	72 hour, no late penalty
Case study 4	Short answer		11:59 pm Dec 9	72 hour, no late penalty
Meme	Take home	5%	Before last class Dec. 9th	N/A

Case study weighting: $3 \text{ (highest marks)} \times 28\% + (\text{lowest mark}) \times 11\% = 95\%$

If a meme is not submitted the weight of this assessment will be transferred to the case studies; $3 \times 28\% \text{ high} + 16\% \text{ low}$

Designated Assessment: Instructors are permitted to designate one assessment per course per term as requiring supporting documentation to receive academic consideration. See below for information on academic consideration policy and missed course work. For this course the following assessment has been designated as requiring supporting documentation: **Case Study 4**

Information about flexibility in assessment

- ☒ Flexibility in assessment has been applied to this course; therefore, academic consideration requests may be denied on the assessments where flexibility is included
- ☒ This course uses alternate weighting for the case studies and the meme. This minimizes the impact of poor performance on any one assessment.
- ☒ This course employs flexible due dates for case studies. The assignment due dates can be found above in the course outline. For each assignment, students are expected to submit the assignment by the due date listed. Should illness or extenuating circumstances arise, students are permitted to submit their assignment up to 72 hours past the due date without a late penalty. Should students submit their assessment beyond 72 hours past the due date, a late penalty of 50% per day will be subtracted from the assessed grade. Requests for academic consideration supported by documentation must be submitted within 48 hours of the original due date. The instructor reserves the right to deny such academic considerations, given the due date flexibility provided. If you have a long- term academic consideration or an accommodation for disability that allows greater flexibility than provided here, please reach out to your instructor at least one week prior to the posted due date.

General information about assessments

- ☒ All assignments are due at 11:59 pm EST/EDT 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
- ☒ Written assignments will be submitted to Turnitin (statement in policies below)
- ☒ Students will have unlimited submissions to Turnitin
- ☒ Rubrics will be used to evaluate assessments and will be posted with the instructions
- ☒ 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
- ☒ Assessment re-grading could result in the mark, increasing, decreasing, or remaining the same
- ☒ Prior to the filing of a written request for relief, students must attempt to resolve the concern regarding a mark or grade through informal consultation with the instructor. If the student is dissatisfied with the decision of the instructor or does not receive a decision from the instructor, a written request for relief must be submitted to the Department Chair within three (3) weeks from the date that the mark was issued.

The table below outlines the University-wide grade descriptors.

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

Information about late or missed assessments:

- ☒ Late assessments without academic consideration will be subject to a late penalty 50% day
- ☒ An assessment cannot be submitted after it has been returned to the class
- ☒ All four case studies must be completed to pass the course. If a student does not submit a case study the student will receive a grade of INC and complete a similar assessment the next time the course is offered (Fall 2026)

INC (Incomplete Standing): If a student has been approved by the Academic Advising Office (in consultation with the instructor/department) to complete term work at a later date, an INC will be

assigned, which could impact program progression. 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 Advising to carry a full course load for the term the incomplete course work is scheduled.

SPC (Special examination): If a student has been approved by the Academic Advising Office to write a Special Examination and the final exam is the only outstanding course component, an SPC will be assigned. If the class has a makeup exam, the student is expected to write the makeup exam. If the class doesn't have a makeup for the final exam or the student misses the makeup for the final exam for reasons approved by the Academic Advising Office, the student will write the exam the next time the course is offered, which could impact program progression. Outstanding SPCs will reduce the course load for the term the exam is deferred as outlined in [Definitions of Types of Examinations](#) policy.

9. Communication

- ☒ Students should check the OWL Brightspace site every 24–48 hours
- ☒ Students should email their instructor(s) and teaching assistant(s) using [email, MS Teams, etc.]
- ☒ Emails will be monitored [daily]; students will receive a response in 24–48 hours

10. Office Hours

- ☒ A schedule for TA office hours for help with course content will be announced at the start of the term. These will be in-person meeting.
- ☒ Office hours can be booked with the course instructor/coordinator by email. These meetings can be in-person or virtual

11. Course Materials

- ☒ All resources will be posted on OWL Brightspace
- ☒ Students may need to find and access additional internet resources during their research for assessments

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:

- ☒ All course materials created by the instructor(s) are copyrighted and cannot be sold/shared/upload (e.g., Must Knows Facebook group, Course Hero, Chegg, ChatGPT, etc.)
- ☒ Recordings are not permitted (audio or video) without explicit permission
- ☒ Permitted recordings are not to be distributed

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.

1. Invest in a planner or application to keep track of your courses. Populate all your deadlines at the start of the term and schedule your time throughout the course.
2. Make it a daily habit to log onto OWL Brightspace to ensure you have seen everything posted to help you succeed in this class.
3. Follow checklists created on OWL Brightspace or create your own to help you stay on track.
4. Take notes as you go through the lesson material. Keeping handwritten notes or even 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.
6. Do not be afraid to ask questions. If you are struggling with a topic, check the online discussion boards or contact your instructor(s) and or teaching assistant(s).
7. Reward yourself for successes. It seems easier to motivate ourselves knowing that there is something waiting for us at the end of the task.

14. Western Academic Policies/Procedures and Statements

A. Absence from Course Commitments

Medical, Compassionate, or Extenuating Circumstances

Students missing course work for medical, compassionate, or extenuating circumstances can request academic consideration by completing a request at the [central academic consideration portal](#). Students are permitted one academic consideration request per course per term **without** supporting documentation. Note that supporting documentation is **always** required for academic consideration requests for examinations scheduled by the office of the registrar (e.g., December and April exams) and for practical laboratory and performance tests (typically scheduled during the last week of the term).

Students should also note that the instructor may **designate** one assessment per course per term that requires supporting documentation. This designated assessment is described elsewhere in this document. Academic consideration requests may be denied when flexibility in assessment has already been included. Examples of flexibility in assessment include when there are assessments not required for calculation of the final grade (e.g. 8 out of 10 quizzes) or there is flexibility in the submission timeframe (e.g. 72 hour no late penalty period).

Please note that any academic considerations granted in this course will be determined by the instructor of this course, in consultation with the academic advisors in your Faculty of Registration, in accordance with information presented in this course syllabus. Supporting documentation for academic considerations for absences due to illness should use the Student Medical Certificate or, where that is not possible, equivalent documentation by a health care practitioner.

Policy: [Academic Consideration – Undergraduate Students in First Entry Programs](#)

Procedures: [Student Medical Certificate](#)

Religious Holidays

Students should review the policy for Accommodation for Religious Holidays (Appendix 1). Where a student will be unable to write examinations and term tests due to a conflicting religious holiday, they should inform their instructors as soon as possible but not later than two weeks prior to writing the examination/term test. In the case of conflict with a midterm test, students should inform their instructor as soon as possible but not later than one week prior to the midterm.

Policy: [Accommodation for Religious Holidays](#)

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.

Policy: [Definitions of Types of Examinations](#)

B. Academic Appeals and Scholastic Offences

Students can file a **request for relief from academic decisions** if the request is based on one or more grounds listed in the policy. Requests for relief generally fall into three categories, which are also listed in the policy. All requests for relief must be supported by evidence. A request for relief from academic decisions process was formally referred to as an appeal. Refer to the policy and procedures about further details and timelines.

Policy: [Requests for Relief from Academic Decisions](#)

Procedures: [Undergraduate Student Academic Requests for Relief](#)

Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a scholastic offence.

Policy: [Scholastic Offences](#)

Procedures: [Undergraduate Scholastic Offences](#)

Students may **appeal** some academic and scholastic disciplinary decisions by a Dean or their designate, to the Senate Review Board Academic (SRBA).

Policy: [Senate Review Board Academic Appeals](#)

Procedures: [Senate Review Board Academic Appeals](#)

C. 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.

Policy: [Academic Accommodation for Students with Disabilities](#)

D. 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.

E. 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.

Policy: [Undergraduate Course Credit](#)

Procedures: [Discovery Credits](#)

F. Statement on the Use of Generative Artificial Intelligence (AI)

Within this course, students are permitted to use AI tools exclusively for information gathering and preliminary research purposes. These tools are intended to enhance the learning experience by providing access to diverse information sources. However, it is essential that students critically evaluate the obtained information, exercise independent thinking, and engage in original research to synthesize and develop their own ideas, arguments, and perspectives. The use of AI tools can serve as a starting point for exploration, with students expected to uphold academic integrity by appropriately attributing all sources and avoiding plagiarism. Assignments and/or lab reports should reflect the students' own thoughts and independent written work. By adhering to these guidelines, students contribute to a responsible and ethical learning environment that promotes critical thinking, independent inquiry and allows them to produce original written contributions.

G. Turnitin and other similarity review software

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. 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 [Turnitin.com](https://www.turnitin.com).

15. BMSUE Academic Policies and Statements

A. 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 and this will be documented as a Scholastic Offence. Non-programmable calculators are only allowed when indicated by the instructor. The program is not responsible for stolen/lost or broken devices.

B. Copyright and Audio/Video Recording Statement

Course materials produced by faculty are 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.

C. 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** in this course are rounded to the nearest whole number based on the first decimal place. For example, a grade of 74.49 or lower will be rounded to 74, whereas 74.50 or higher will be rounded to 75.

Marks **WILL NOT** be arbitrarily increased to the next grade or GPA, e.g., a 79 will **NOT** be increased to an 80, and 84 **WILL NOT** be increased to an 85, etc. The mark attained is the mark you achieved, and

the mark assigned; requests for arbitrary mark increasing will be denied. Marks will be assigned based on assessments in the syllabus and no extra work or tasks will be assigned to increase a mark.

Course grade rounding provisions, as described above, differ from cumulative and term averages. Cumulative and term averages will be calculated to two decimal places and rounded to the nearest whole number with .45 rounded up, for the purposes of admission to and progression in modules, scholarship retention, and Dean's Honour List.

Policy: [Marks/Grades; Definitions of Grades; Grading Scale for Undergraduate Students](#)

16. Support Services

Students who are in emotional/mental distress should refer to Mental Health @Western <https://www.uwo.ca/health/> for a complete list of options about how to obtain help.

Statement on Gender-Based and Sexual Violence

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 the following website:

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.

Other important links:

- [Academic Advising \(Science and Basic Medical Sciences\)](#)
- [Learning Development and Success](#)
- [Office of the Registrar](#)
- [Wellness & Wellbeing](#)
- [Western USC Services](#)

Appendix 1: Western University Academic Policies and Procedures

The policies and procedures listed in this syllabus are outlined in the table below. In some cases, a policy does not include an accompanied procedures document.

Academic Policy	Name of Policy/Procedure	Links
General Policy	Marks/Grades; Definitions of Grades; Grading Scale for Undergraduate Students	Policy
General Policy	Structure of the Academic Year	Policy
Registration, Progression, Graduation	Course Numbering Policy, Essay Courses, and Hours of Instruction	Policy
Registration, Progression, Graduation	Undergraduate Course Credit	Policy • Procedures
Examinations	Definitions of Types of Examinations	Policy
Examinations	Evaluation of Academic Performance	Policy
Examinations	Examination Conflicts	Policy
Rights and Responsibilities	Academic Accommodation for Students with Disabilities	Policy
Rights and Responsibilities	Accommodation for Religious Holidays	Policy
Rights and Responsibilities	Policy on Academic Consideration – Undergraduate Students in First Entry Programs	Policy • Procedures

Rights and Responsibilities	Requests for Relief from Academic Decisions (Undergraduate)	Policy • Procedures
Rights and Responsibilities	Requests for Relief from Academic Decisions (Graduate)	Policy • Procedures
Rights and Responsibilities	Scholastic Offences (Undergraduate)	Policy • Procedures
Rights and Responsibilities	Senate Review Board Academic Appeals	Policy • Procedures