Western University is committed to a **thriving campus**; therefore, your health and wellness matter to us! The following link provides information about the resources available on and off campus to support students: [https://www.uwo.ca/health/](https://www.uwo.ca/health/). Your course coordinator can also **guide you** to resources and/or services should you need them.

The Department of Biochemistry recognizes diversity of identity and experience as a source of strength that promotes excellence, innovation, flexibility and adaptability in our discipline. We embrace, nurture, value and celebrate this diversity.

### 1. Technical Requirements:

- **Stable internet connection**
- **Laptop or computer**

### 2. Important Dates:

<table>
<thead>
<tr>
<th>Classes Begin</th>
<th>Classes End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday, September 8, 2022</td>
<td>Thursday, December 8, 2022</td>
</tr>
</tbody>
</table>

* November 12, 2022: Last day to drop a first-term half course without academic penalty

<table>
<thead>
<tr>
<th>Reading Week</th>
<th>Study day(s)</th>
<th>Exam Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 31–November 6</td>
<td>December 9</td>
<td>December 10–22</td>
</tr>
</tbody>
</table>

### 3. Contact Information

<table>
<thead>
<tr>
<th>Course Coordinator</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>David Edgell</td>
<td><a href="mailto:dedgell@uwo.ca">dedgell@uwo.ca</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Instructor(s) or Teaching Assistant(s)</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>David Haniford (instructor)</td>
<td><a href="mailto:haniford@uwo.ca">haniford@uwo.ca</a></td>
</tr>
<tr>
<td>Elizabeth Connelly (TA)</td>
<td><a href="mailto:econnell@uwo.ca">econnell@uwo.ca</a></td>
</tr>
<tr>
<td>Dalton Ham (TA)</td>
<td><a href="mailto:dham5@uwo.ca">dham5@uwo.ca</a></td>
</tr>
</tbody>
</table>

Course materials cannot be sold/shared.
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 and examples from the current scientific literature. Selected topics include the molecular biology of SARS-CoV-2, intersection between RNAi, retrotransposons and RNA editing, CRISPR, and protein-DNA interactions.

All classes this year are in-person, unless otherwise instructed by the University. Lecture material will be posted on the BIOC4410A OWL site. Lecture times are 12:30-1:30pm Tuesday and Thursday in room MSB 282. The first lecture will be Thursday, September 8th.

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

**Course Topics**

**Section 1: Molecular Biology of HIV, SARS-CoV-2 and the development of antiviral drugs** (6 lectures, Sept. 13-29th, HANIFORD)

Introduction to coronaviruses  
Characterization of the SARS-CoV-2 transcriptome  
Nucleoside inhibitors of coronaviruses  
Defining the mechanism of remdesivir action and development of resistance mutations

**Section 2: Intersection between RNA interference, retrotransposons and RNA editing** (6 lectures, Oct 4-20th, HANIFORD)

Introduction to RNAi and retrotransposons  
L1 retrotransposition in brain – does L1 contribute to brain development?  
Retrotransposon storm model for Amyotrophic lateral sclerosis (ALS)  
RNA editing and control of transposon-mediated gene silencing

**Section 3: CRISPR: biology, mechanism and gene editing applications** (6 lectures, Oct 25-Nov 17th, EDGELL)

Introduction to CRISPR systems  
Biology of CRISPR systems – spacer acquisition, biological functions  
Mechanism of DNA cleavage by Cas9 and other CRISPR nucleases  
CRISPR applications – focus on therapeutic gene editing  
Engineering CRISPR nucleases for reduced off-target cleavage

**Section 4: Protein-DNA interactions: specificity and engineering** (6 lectures, Nov 22-Dec 8th, EDGELL)

Introduction to protein-DNA interactions  
How was the first transcriptional regulator discovered?  
Methodologies for identifying DNA-binding sites  
How do eukaryotic transcription factors bind specific sites?  
Can DNA-binding specificity be changed through protein engineering?
Timetabled Sessions

<table>
<thead>
<tr>
<th>Component</th>
<th>Date(s)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>T/Th</td>
<td>12:30-1:30pm</td>
</tr>
</tbody>
</table>

✔️ 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 OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

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

5. Learning Outcomes

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

- Critically read scientific literature in molecular biology
- Design research strategies to further our understanding of molecular biology mechanisms, including 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, ALS and AIDS
- Be able to discuss advantages and limitations of therapeutic gene editing to the lay public
- Identify appropriate information sources for answering questions relating to molecular biology

Section 1

- 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
- Describe how primer extension assay is used to measure RdRp activity
- Describe the mechanisms by which nucleoside inhibitors block coronavirus replication
- Describe how HIV replicates its genome and expresses its genes
- Describe the link between HIV genome replication and the capacity of HIV to develop resistant to anti-HIV drugs
- Describe approaches for defining an unknown gene whose expression causes phenotypic changes in a given cell line
- Describe how Vif protects HIV from host cell restriction
- Describe how APOBEC3 family members inhibit HIV replication
- Describe the basics of high throughput screening for small molecule inhibitors

Section 2

- Describe mechanisms of retrotransposition
- Describe pathways for the post-transcriptional regulation of gene expression by small non-coding RNAs
- Discuss the evidence supporting L1 retrotransposition in mouse neuronal precursor cells
- Discuss the retrotransposon storm hypothesis for ALS
- Describe how RNA editing regulates RNA interference and DNA transposition

Section 3
- 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
- Be able to compare and contrast different strategies for engineering of Cas9 variants with reduced off-target cleavage

Section 4
- Describe the biochemical interactions between proteins and DNA
- Discuss relative contributions of biochemical interactions to affinity and specificity for protein-DNA interactions
- Describe how the Lac repressor was isolated
- Be able to compare and contrast in vitro high-throughput methodologies for identifying DNA binding sites
- 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
- Describe the limitations of changing DNA specificity through protein engineering
- Describe strategies to change specificity of modular DNA-binding proteins
6. Course Content and Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topic</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sept 8</td>
<td>Introductory Lecture</td>
<td>Edgell</td>
</tr>
<tr>
<td>2</td>
<td>Sept 13 &amp; 15</td>
<td>Molecular Biology of HIV &amp; SARS-CoV-2</td>
<td>Haniford</td>
</tr>
<tr>
<td>3</td>
<td>Sept 20 &amp; 22</td>
<td>Molecular Biology of HIV &amp; SARS-CoV-2</td>
<td>Haniford</td>
</tr>
<tr>
<td>4</td>
<td>Sept 27 &amp; 29</td>
<td>Molecular Biology of HIV &amp; SARS-CoV-2</td>
<td>Haniford</td>
</tr>
<tr>
<td>5</td>
<td>Oct 4 &amp; 6</td>
<td>RNAi, retrotransposons, RNA editing</td>
<td>Haniford</td>
</tr>
<tr>
<td>6</td>
<td>Oct 11 &amp; 13</td>
<td>RNAi, retrotransposons, RNA editing</td>
<td>Haniford</td>
</tr>
<tr>
<td>7</td>
<td>Oct 18 &amp; 20</td>
<td>RNAi, retrotransposons, RNA editing</td>
<td>Haniford</td>
</tr>
<tr>
<td>8</td>
<td>Oct 25 &amp; 27</td>
<td>CRISPR</td>
<td>Edgell</td>
</tr>
<tr>
<td>9</td>
<td>Oct 31 – Nov 6</td>
<td>Reading Week</td>
<td>N/A</td>
</tr>
<tr>
<td>10</td>
<td>Nov 8 &amp; 10</td>
<td>CRISPR</td>
<td>Edgell</td>
</tr>
<tr>
<td>11</td>
<td>Nov 15 &amp; 17</td>
<td>CRISPR</td>
<td>Edgell</td>
</tr>
<tr>
<td>12</td>
<td>Nov 22 &amp; 24</td>
<td>Protein-DNA interactions</td>
<td>Edgell</td>
</tr>
<tr>
<td>13</td>
<td>Nov 29 &amp; Dec 1</td>
<td>Protein-DNA interactions</td>
<td>Edgell</td>
</tr>
<tr>
<td>14</td>
<td>Dec 6 &amp; 8</td>
<td>Protein-DNA interactions</td>
<td>Edgell</td>
</tr>
</tbody>
</table>

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

Evaluation

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

All course assessments are take-home. There is an assessment for each section of the course. The four (4) assessments are worth 25% of the final course mark each, and will probe students’ knowledge and understanding of the course material. Students may be required to read and interpret additional material (to be provided). Assessments will be posted on the OWL site at the end of each section. Students are responsible for submitting completed assignments to both Gradescope and Turnitin through the OWL course site. A mark of 5% will be deducted per day for late assignments.

Students can collaborate as they think through the answers to the assignments, but each student must submit their own, independently written answers. Assignments will be checked for plagiarism using the Turnitin software. Students that are caught plagiarizing will automatically receive a mark of 0 (zero) for that assignment.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Format</th>
<th>Weighting</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment #1 - Section 1</td>
<td>Take-home</td>
<td>25%</td>
<td>Oct. 6th, 2022</td>
</tr>
<tr>
<td>Assignment #2 - Section 2</td>
<td>Take-home</td>
<td>25%</td>
<td>Oct. 27th, 2022</td>
</tr>
<tr>
<td>Assignment #3 - Section 3</td>
<td>Take-home</td>
<td>25%</td>
<td>Nov. 24th, 2022</td>
</tr>
<tr>
<td>Assignment #4 – Section 4</td>
<td>Take-home</td>
<td>25%</td>
<td>Dec. 22nd, 2022</td>
</tr>
</tbody>
</table>
All assignments are due at 6PM 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.
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 3 weeks of the grade being posted.

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

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>90–100</td>
</tr>
<tr>
<td>A</td>
<td>80–89</td>
</tr>
<tr>
<td>B</td>
<td>70–79</td>
</tr>
<tr>
<td>B-</td>
<td>60–69</td>
</tr>
<tr>
<td>C</td>
<td>50–59</td>
</tr>
<tr>
<td>C-</td>
<td>below 50</td>
</tr>
</tbody>
</table>

Information about late or missed evaluations:

- Late assessments without accommodation will be subject to a late penalty 5%/day.
- The weight of a missed assignment will be transferred equally between the three other assignments.
- At least two assignments must be passed with a grade in each above 50 to pass the course. If more than two assignments are missed an INC will be assigned.

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.

SPC (Special examination): If a student has been approved by the Academic Counselling 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 exam or the student misses the makeup exam for reasons approved by the Academic Counselling Office, the student will write the exam the next time the course is offered. Outstanding SPCs will reduce the course load for the term the exam is deferred as outlined in Types of Examinations policy.

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

9. Office Hours:

Course materials cannot be sold/shared.
Contact Dr. Haniford or Dr. Edgell by email to set up time for office visit.
TAs will hold office hours will be held Wednesdays 4-5pm in MSB 340.

10. Resources

All resources will be posted in OWL as PDFs, PPTs, or other documents.

11. 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 (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

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).

12. 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 to ensure you have seen everything posted to help you succeed in this class.
3. Follow weekly checklists created on OWL 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.

13. 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 any work worth less than 10% must contact the instructor or follow the appropriate Department or course specific instructions provided on the course outline. Instructors will use good judgment and ensure fair treatment for all students when considering these requests. You are not required to disclose details about your situation to your instructor; documentation is not required in this situation, and you should not send any pictures to your instructor.

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 be found 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 Accommodation for Religious Holidays. 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 here.

Academic Offenses

Scholastic offences are taken seriously, and students are directed here 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 The policy on Accommodation for Students with Disabilities.

Correspondence Statement

Course materials cannot be sold/shared.
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 [here](#).

**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 [here](#).

**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 [Turnitin.com](#).

### 14. 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, i.e., cell phones, tablets, cameras, 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., 74.4 becomes 74, and 74.5 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.

**15. 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


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

Registrial Services

Student Development Services

Student Health Services