NOTE: If a COVID-19 resurgence prevents face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at times indicates in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). Remaining assessments may be conducted online at the discretion of the instructor.

1. General Course Information

Biochemistry 4410A: Molecular Biology of DNA and RNA
Fall Term 2021

The use of fundamental techniques in molecular biology and genomics are illustrated using examples from classic and current literature. Selected topics include the molecular biology of HIV and SARS-CoV-2 and drug screening, telomere biology and the intersection between RNAi, retrotransposons and RNA editing.

Lectures:
Assuming that in-person teaching is allowed this year, we will be using a flipped classroom format for this course. Lecture material will be made available in the form of videos posted on the course OWL site. Live classroom time will be used to discuss lecture material and for student group presentations. Live classroom time will be held Tuesday’s and Thursday’s from 12:30-1:30 pm starting September 9, 2021 in MSB 282.

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

Senate regulation regarding the student’s responsibility regarding requisites:
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.

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 Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

2. Instructor Information
**Instructors**

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<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Office</th>
<th>Phone</th>
<th>Office Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. David Haniford</td>
<td><a href="mailto:haniford@uwo.ca">haniford@uwo.ca</a></td>
<td>MBL C204</td>
<td>84013</td>
<td>NA</td>
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<tr>
<td>(Course Coordinator)</td>
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**TA:** Elizabeth Connelly (econnell@uwo.ca)

**3. Course Web site OWL** BIOCHEM 4410A 001 FW21

Students with OWL issues should see: [https://owl.uwo.ca/portal/site/owldocs](https://owl.uwo.ca/portal/site/owldocs)

**4. Course Outline**

**Course Topics**

**Section 1: Molecular Biology of HIV, SARS-CoV-2 and the development of antiviral drugs**

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

Introduction to HIV
Defining a factor (APOBEC3G) that confers a non-permissive HIV infection phenotype
The APOBEC3-Vif axis – mechanisms of Vif and APOBEC3 action
High throughput screening for small molecules that inhibit HIV Vif
APOBEC3B as a source of mutation in cancer

**Section 2: Telomere Biology**

Introduction to telomere biology
Linking telomeres to cancer
Telomerase as a target for anticancer drugs
Regulation of telomerase recruitment to telomeres
TERRA and its impact on telomerase recruitment and telomeric chromatin structure
Live cell imaging of TERRA in cancer cells

**Section 3: Intersection between RNA interference, retrotransposons and RNA editing**

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 4: Student Group Projects

Students will be divided into groups and each group will have the following tasks to complete.

1. Short review of a paper covered in lecture or a critique/assessment of a research proposal – written and an oral component for both tasks. The written component will be made available to all members of the class. The oral component will be presented during class time.
2. Short research proposal – each group will write a short research proposal linked to a topic (your choice) covered in the course.

Learning Outcomes – Section Specific

Section 1

After completion of this section students should be able to:

Describe the corona virus 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 corona virus transcription and replication take place

Describe how RNA modifications influence RNA function

Describe how in vitro primer extension assay is used to measure RdRp activity

Describe the mechanisms by which nucleoside inhibitors block corona virus 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 resistance 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 infection

Describe the basics of high throughput screening for small molecule inhibitors

**Section 2**

After completion of this section students should be able to:

Describe how telomeres are replicated

Describe the link between telomere length, cell proliferation and cancer

Describe approaches for modulating telomere dynamics in vivo

Describe the role of subtelomeres and TERRA in recruitment of telomerase to short telomeres

Describe how telomeres and telomerase can be visualized in real-time in live cells

Describe how TERRA binding proteins can be isolated

Describe the role of TERRA in telomeric chromatin assembly

Describe how CRISPR is used to modify cell lines for live cell imaging

**Section 3**

After completion of this section students should be able to:

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

**Learning Outcomes - General**

After completion of this course students should be able to:

Critically read scientific literature in molecular biology
Design research strategies to further our understanding of molecular biology mechanisms

Design high-throughput screens for developing small molecule inhibitors of therapeutically important target molecules

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

Identify appropriate information sources for answering questions relating to molecular biology

Work in a group setting to develop communication, teamwork and leadership skills

5. Course Materials

In Resource folder of course Owl site you will find:
   (i) Research papers and technical videos
   (ii) Lecture videos and Power point slides for lectures
   (iii) Student summaries/Research Proposal Critiques
   (iv) Assignments
   (v) Instructions for course assignments

6. Evaluation

Take-home assignment 1 (COVID and HIV) (30%) – Due Oct 19, 2021 at 6PM

Take-home assignment 2 (Telomere Biology and Retrotransposons and RNAi) (40%) – Due last day of exam period at 6 PM

*Group Research Paper Summary or Research Proposal Critique (10% for written component and 5% for oral component)

*Group Research Proposal (15%)

*Indicates rolling time-line – written component for group summary or research proposal critique will be due on the day of the oral presentation.

*Due December 6, 2021 at 6PM.

All written assignments will be submitted electronically to the course web site on or before the indicated due dates and will be screened for plagiarism with turn-it-in software.
7. Special Examinations

A Special Examination is any examination other than the regular or Supplemental Examinations, 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 as outlined below:

First Term Half Course: 1st Thursday in January following the beginning of classes.

Special Examinations must be written at the University or recognized exam center or an Affiliated University College, and supersede any lectures, tutorials, laboratories, etc., in which the student is registered. Note that students are responsible for any coursework, etc., missed while writing the Special Examination.

When a grade of Special (SPC) or Incomplete (INC) appears on a student's record, the notations will be removed and replaced by a substantive grade as soon as the grade is available.

8. Rounding of marks

Final grades in 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, while 74.5 becomes 75). Marks WILL NOT be bumped to the next grade or GPA level (e.g., an 84 will NOT be bumped up to an 85). The mark attained is the mark you achieved and the mark assigned; requests for mark bumping will be denied, in accordance with Bachelor of Medical Science Undergraduate Education policy.

9. Statement on Academic Offences

“Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following website: http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf .”

“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 The University of Western Ontario and Turnitin.com (http://www.turnitin.com ).”

“Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.”
10. Absence from course commitments
Students must complete all of the course evaluations (2 take-home assignments plus 2 group work assignments) – there will be no re-weighting of marks due to a missed evaluation. Assignments are to be submitted electronically to the course Owl site on or before the indicated due dates. **You will lose 10% of the total value of the assignment per day submitted late.**

**Policy on Academic Consideration for Student Absences**

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a **self-reported absence** or via the **Academic Counselling** unit. Students have two self-reports to use throughout the academic year; absence from course commitments including tests, quizzes, presentations, labs, and assignments that are worth 30% or less can be self-reported. Self-reported absences cover a student for 48 hours (yesterday + today or today + tomorrow). Your instructor will receive notification of your consideration; however, you should contact your instructor immediately regarding your absence. Students are expected to submit missed work within 24 hours of the end of the 48-hour period. Please review details of the **university’s policy on academic consideration for student absences.**

If you have used both their self-reported absences or will miss more than 48 hours of course requirements, a Student Medical Certificate (SMC) should be signed by a licensed medical or mental health practitioner, and you should contact academic counselling. **Science and BMSc students can contact academic counselling through the Help Portal:** [https://www.uwo.ca/sci/counselling/](https://www.uwo.ca/sci/counselling/)

Support Services:

Registrarial Services: [http://www.registrar.uwo.ca](http://www.registrar.uwo.ca)

Academic Counselling (Science and Basic Medical Sciences): [http://www.uwo.ca/sci/undergrad/academic_counselling/index.html](http://www.uwo.ca/sci/undergrad/academic_counselling/index.html)

USC Student Support Services: [http://westernusc.ca/services/](http://westernusc.ca/services/)

Student Development Services: [http://www.sdc.uwo.ca](http://www.sdc.uwo.ca)

Student Health Services: [http://www.shs.uwo.ca/](http://www.shs.uwo.ca/)

Students who are in emotional/mental distress should refer to Mental Health@Western [http://www.uwo.ca/uwocom/mentalhealth/](http://www.uwo.ca/uwocom/mentalhealth/) for a complete list of options about how to obtain help.

11. Diversity Statement
“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.”