1. Course Information

Biochemistry 3382A: Biochemical Regulation

Fall Term 2020/2021

An organism or cell must be able to regulate itself to coordinate numerous processes, respond to changes in its environment, and grow and differentiate in an orderly manner. One of the main objectives of this course is to introduce various biochemical mechanisms involved in cellular regulation. The first series of lectures deals with the structure, dynamics, replication and repair of DNA – essential cellular processes that ensure faithful transmission of genetic material from generation to generation. The second set of lectures introduces key concepts in protein-DNA interactions, and how these interactions are crucial for regulating transcription of genes in both prokaryotes and eukaryotes. The third set of lectures of the course delves into cellular mechanisms that regulate mRNA abundance and stability. The last set of lectures will integrate topics into a discussion of synthetic biology and biotechnology. Specific case studies addressing how synthetic biology can be used for biotechnology and to benefit human health will be discussed in class.

Lectures:
Virtual synchronous (live) Zoom session – Fridays 2:30-3:30 pm
Virtual asynchronous (recorded) – weekly, ~1 hr (see below)

All of the remote learning sessions for this course will be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals under special circumstances. Please contact the instructor if you have any concerns related to session recordings.

Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Pre-requisites:

A minimum mark of 65% in either Biochemistry 2280A or 2288A; a minimum mark of 60% in either Chemistry 2213A/B or Chemistry 2273A; and a minimum mark of 60% in either Chemistry 2223B or 2283G.

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

<table>
<thead>
<tr>
<th>Instructors</th>
<th>Email</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. David Edgell</td>
<td><a href="mailto:dedgell@uwo.ca">dedgell@uwo.ca</a></td>
<td>MBL C111</td>
</tr>
<tr>
<td>(Course Coordinator)</td>
<td></td>
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<tr>
<td>Dr. Derek McLachlin</td>
<td><a href="mailto:dmclach3@uwo.ca">dmclach3@uwo.ca</a></td>
<td>MSB349</td>
</tr>
<tr>
<td>Mallory Frederick (TA)</td>
<td><a href="mailto:mfreder8@uwo.ca">mfreder8@uwo.ca</a></td>
<td></td>
</tr>
<tr>
<td>Kurt Loedige (TA)</td>
<td><a href="mailto:kloedige@uwo.ca">kloedige@uwo.ca</a></td>
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OWL:

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

3. Course Content

Learning outcomes:

- describe the different types of structures formed by nucleic acids, and make predictions about how biochemical processes and changes in sequence and environment affect nucleic acid structure, stability, and supercoiling
- with reference to specific proteins, explain the biochemical mechanisms of DNA replication, recombination, and repair, and how these processes are regulated
- formulate general strategies using techniques of synthetic biology to accomplish defined biotechnological goals
- describe the different mechanisms that control mRNA turnover, stability and decay in eukaryotic cells, and be able to explain differences between cis- and trans-acting factors that control mRNA expression levels
- formulate general strategies for cloning and expressing genes based on the different types of restriction endonucleases used in recombinant DNA technologies
- describe the RNA-based mechanisms used for genome defense in both bacteria and eukaryotes, and how these mechanisms have been adapted for use as genome-editing tools
- describe the different DNA repair mechanisms, and how defects in DNA repair pathways can cause human diseases
- explain the key molecular components of transcription, including both DNA and proteins, and be able to formulate strategies to control gene expression with these components
- describe the concepts behind the RNA world, and the transition from RNA-based organisms to DNA-based organisms
<table>
<thead>
<tr>
<th>Week</th>
<th>Instructor</th>
<th>Topics</th>
<th>Friday session</th>
<th>Tuesday Quiz</th>
<th>Wednesday Assignment Due Date</th>
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<tbody>
<tr>
<td>1</td>
<td>McLachlin</td>
<td>Nucleotide metabolism</td>
<td>Sep 11</td>
<td>Sep 15</td>
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<tr>
<td>2</td>
<td>McLachlin</td>
<td>Nucleic acid structure &amp; supercoiling</td>
<td>Sep 18</td>
<td>Sep 22</td>
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<td>3</td>
<td>McLachlin</td>
<td>Regulation of DNA replication</td>
<td>Sep 25</td>
<td>Sep 29</td>
<td>Wed Sep 30</td>
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<tr>
<td>4</td>
<td>Edgell</td>
<td>DNA repair</td>
<td>Oct 2</td>
<td>Oct 6</td>
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<tr>
<td>5</td>
<td>Edgell</td>
<td>DNA recombination</td>
<td>Oct 9</td>
<td>Oct 13</td>
<td>Oct 14</td>
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<tr>
<td>6</td>
<td>Edgell</td>
<td>Protein-DNA interactions</td>
<td>Oct 16</td>
<td>Oct 20</td>
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<td>7</td>
<td>Edgell</td>
<td>Prokaryotic gene regulation</td>
<td>Oct 23</td>
<td>Oct 27</td>
<td>Oct 28</td>
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<td>8</td>
<td>Edgell</td>
<td>Eukaryotic gene regulation</td>
<td>Oct 30</td>
<td>Nov 10</td>
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<td><strong>FALL STUDY BREAK Nov 1-8 – NO CLASSES</strong></td>
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<tr>
<td>9</td>
<td>Edgell</td>
<td>RNA-based gene regulation</td>
<td>Nov 13</td>
<td>Nov 17</td>
<td>Nov 18</td>
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<td>10</td>
<td>Edgell</td>
<td>Genome editing</td>
<td>Nov 20</td>
<td>Nov 24</td>
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<tr>
<td>11</td>
<td>Edgell</td>
<td>Synthetic biology</td>
<td>Nov 27</td>
<td>Dec 1</td>
<td>Dec 2</td>
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<tr>
<td>12</td>
<td>Edgell</td>
<td>Systems biology</td>
<td>Dec 4</td>
<td>Dec 8</td>
<td>Dec 9</td>
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4. **Course Materials**

There is no textbook for this course. All material will be delivered online through pre-recorded lectures. Problem sets or past exam questions will be posted during the week for the Friday live synchronous lecture.

5. **Evaluation:**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>% of final grade</th>
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<tr>
<td>Weekly quizzes – 2% each (best 10 of 12)</td>
<td>20</td>
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<tr>
<td>Assignments – 6 total, 5% each</td>
<td>30</td>
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<td>Final exam</td>
<td>30</td>
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<td>Oral presentation</td>
<td>10</td>
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<tr>
<td>Written summaries (two, each 5%)</td>
<td>10</td>
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The weekly quizzes are set for Tuesday 10:30 – 11:30am. You can complete the quiz anytime during that hour. Once started, you will have 20 minutes to complete the quiz that consists of 10 multiple choice questions. The quizzes will be done through the course OWL site. Your 10 best of the 12 weekly quizzes will count towards your final mark.

Assignments are more in-depth questions that will cover each week’s material and will consist of more problem-based questions. The assignments are a good indicator of the type of questions that will be on the final exam. The assignment is designed to take you about an hour to complete. Each assignment will be posted on the OWL site and is due by the indicated date. You should submit a PDF of your assignment to Gradedscope via a link that will be emailed to you. Late assignments will be accepted up to 48 hours past the due date, but 10% will be deducted for each 24 hours.

The final exam will be cumulative and cover material from the whole course. The exam will primarily consist of short answer and problems based on materials from lectures. There are no
multiple-choice questions on the final exam. The final exam date will be scheduled by the registrar’s office. The exam will be made available on OWL at the scheduled time and students must submit a PDF of their exam and answers to the OWL site at the end of the scheduled exam time. **Late exams will not be accepted.** Accommodation for students who cannot write the exam at the scheduled time is the responsibility of the student.

There will be a group project and oral presentation worth 10%. A short written summary of the paper and conclusions appropriate for a lay audience will be worth 5%, and a second written summary for a scientific audience will be worth 5%. A detailed outline will be provided at the start of the course. Briefly, at the beginning of the term, the class will be divided into groups of up to 4 students (this will be done by Dr. McLachlin and Dr. Edgell) and each group assigned a date for their presentation. Each group will be responsible for presenting an 8-10 minute talk (plus 2 mins of questions) on a topic that is related to the material taught in the lectures. Each student in the group is expected to participate in all aspects of the project, including the oral presentation. Grading of the presentations will be done by the instructor lecturing at the time of the presentation, the course TA, members of the group. The short 1-page summary should be appropriate for a general scientific audience along the lines of a Nature News and Views article (worth 5%). The lay summary (worth 5%) should be written along the lines of an article you might read in the Globe and Mail or the New York Times. More information on expectations for presentations and written summary, as well as a marking guide, will be provided at the start of the course.

**Policy on the Rounding and Bumping of Marks:**
Across the Basic Medical Sciences Undergraduate Education programs and within the department of Biochemistry 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.**

6. Additional Information/Statements

The website for the Office of the Registrar is [http://www.registrar.uwo.ca](http://www.registrar.uwo.ca)

**Copyright 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.

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 ).”

7. Accommodation, Illness Reporting and Academic Considerations

Accommodation Policies

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: Academic Accommodation for Students with Disabilities.

Academic Consideration for Student Absence

Students will have up to two (2) opportunities during the regular academic year to use an online portal to self-report an absence during the term, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student’s final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student’s final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are not met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.
For Western University policy on Consideration for Student Absence, see Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs
and for the Student Medical Certificate (SMC), see: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

**Religious Accommodation**

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar.

**Statement from the Academic Counselling Office, Faculty of Science (for Science and BMSc students)**

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Academic Counselling Office 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 by the Academic Counselling Office and the instructor has been informed.

**B. Special Examinations**

http://www.uwo.ca/univsec/pdf/academic_policies/exam/definitions.pdf

A Special Examination is any examination other than the regular final examination, and it may be offered only with the permission of the Dean/Academic Counselling Office 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. You may also be eligible to write the Special Examination if you are in a “Multiple Exam Situation”. See: http://www.registrar.uwo.ca/examinations/exam_schedule.html

A Special Examination must be written at the University or an Affiliated University College no later than 30 days after the end of the examination period involved. To accommodate unusual circumstances, a date later than this may be arranged at the time permission is first given by the Dean/Academic Counselling Office of the Faculty. The Dean/Academic Counselling Office will consult with the instructor and Department Chair and, if a later date is arranged, will communicate this to the Office of the Registrar.

If a student fails to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean/Academic Counselling Office in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination normally will be the scheduled date for the final exam the next time the course is offered.
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. Support Services:

Academic Counselling (Science and Basic Medical Sciences):
http://www.uwo.ca/sci/counselling

Accessibility: 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. The policy on Accommodation for Students with Disabilities can be found here:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf

Student Development Centre (SDC): Learning-skills counsellors at SDC are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling. http://www.sdc.uwo.ca

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

Student Health Services: https://www.uwo.ca/health/shs/index.html

Additional student-run support services are offered by the USC, http://westernusc.ca/services