1. Course Information

Biochemistry 3382A: Biochemical Regulation

Fall Term 2018

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:

Tuesday and Thursday 10:30-11:30 am, Natural Science Room 7
Friday 2:30-3:30 pm, Natural Science Room 7

Tutorials:

Tuesday 5:30-6:30 pm, Natural Sciences Room 7

Pre-requisite:

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>
<th>Phone</th>
<th>Office Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. David Edgell (Course Coordinator)</td>
<td><a href="mailto:dedgell@uwo.ca">dedgell@uwo.ca</a></td>
<td>MBL C111</td>
<td>661-3133</td>
<td>Thursday 1-3pm</td>
</tr>
<tr>
<td>Dr. Ilka Heinemann</td>
<td><a href="mailto:ilka.heinemann@uwo.ca">ilka.heinemann@uwo.ca</a></td>
<td>MBL C108</td>
<td>850-2949</td>
<td>TBD</td>
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<tr>
<td>Dr. Derek McLachlin</td>
<td><a href="mailto:dmclach3@uwo.ca">dmclach3@uwo.ca</a></td>
<td>MSB 349</td>
<td>661-3072</td>
<td>Thursday 1-3 pm</td>
</tr>
<tr>
<td>Graduate Teaching</td>
<td>Sander Roy, <a href="mailto:aroy82@uwo.ca">aroy82@uwo.ca</a></td>
<td></td>
<td>TBD</td>
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<tr>
<td>Assistants</td>
<td>Ben Joris, <a href="mailto:bjoris@uwo.ca">bjoris@uwo.ca</a></td>
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OWL: Students with OWL issues should see: [https://owl.uwo.ca/portal/site/owldocs](https://owl.uwo.ca/portal/site/owldocs)

3. Course Content

Learning outcomes:

After successfully completing this course, students should be able to:

- 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 defence 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
- work in a team to prepare and deliver an effective oral presentation summarizing a published scientific paper, as well as a written summary aimed at a general scientific audience
SECTION 1 Dr. Derek McLachlin (September 6 – September 21)
Nucleic Acid Structure – DNA and RNA
DNA Supercoiling
Nucleotide metabolism
DNA replication (prokaryotic and eukaryotic)

SECTION 2 Dr. Ilka Heinemann (September 25 – October 30)
Recombination & DNA repair
RNA world
Prokaryotic transcription
Prokaryotic transcriptional regulation
Eukaryotic transcription
Eukaryotic gene expression
Protein-DNA interactions
RNA splicing

SECTION 3 Dr. David Edgell (November 1 – December 4)
RNA turnover and mRNA stability
miRNA-mediated gene regulation
Mobile genetic elements
CRISPR systems
Recombinant DNA technology
Genome editing
Next generation sequencing and associated applications
Synthetic biology
Case studies in synthetic biology and synthetic genomes

4. Course Materials

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.

Recommended Text:


It is recommended that Biochemistry Honors Specialization students taking both 3381A and
3382A buy the hardcopy or the e-book version of the textbook. This textbook will serve as a
reference for 4th year Biochemistry courses. Students have the option of buying individual
chapters online from the publisher. The cost per chapter is ~$4.95. The hardcopy is available at
the Campus Bookstore. The e-book and individual chapters can be purchased at:

https://login.cengage.com/cb/login.htm
5. Evaluation:

<table>
<thead>
<tr>
<th>Component</th>
<th>Date</th>
<th>% of Final Grade</th>
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<tbody>
<tr>
<td>Midterm #1 (McLachlin section)</td>
<td>Thurs. Sep. 27</td>
<td>20</td>
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<tr>
<td>Midterm #2 (Heinemann section)</td>
<td>Thurs. Nov. 9</td>
<td>30</td>
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<tr>
<td>Final exam (Edgell section)</td>
<td>TBD</td>
<td>35</td>
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<tr>
<td>Oral presentation</td>
<td>TBD</td>
<td>10</td>
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<tr>
<td>Written summary</td>
<td>TBD</td>
<td>5</td>
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The midterms and final exam will consist primarily of short answer questions and problems based on materials from lectures, assigned textbook readings and other assigned readings. There will be few, if any, multiple choice questions. Midterm #2 and the final exam are not cumulative. The final exam will take place during the December exam period as scheduled by the Registrar’s Office.

Students will give a group oral presentation focused on a published paper, and will submit a short written summary of the paper and conclusions appropriate for a general scientific audience. Presentations will occur during the Tuesday tutorial session (5:30-6:30). Not all tutorial sessions will be used for presentations, as sessions closest to the midterm exams will be used for review.

A detailed outline and marking rubrics are provided in a separate document. Briefly, at the beginning of the term, the instructors will divide the class into groups of 4 students. Each group will be responsible for presenting an 8-10 minute talk (plus 2 mins of questions) on a paper related to material taught in the lectures. On a first-come, first-served basis, groups will choose 1) a paper they would like to present from a provided list (or groups may suggest a paper), and 2) the date on which they will present. 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 whose material relates to the presentation and a TA, with a modifier determined by members of the group. The group must also submit a short summary (maximum 750 words) of the paper appropriate for a scientific lay audience, along the lines of a Nature News and Views article.

Policy on the Rounding and Bumping of Marks:
All students will be treated equitably and evaluated based only on their actual achievement. 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, and 74.5 becomes 75). Marks will not be bumped to the next grade or GPA (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.
6. Additional Information/Statements

Statement on Student Conduct

Western’s Code of Student Conduct (see [https://www.uwo.ca/univsec/pdf/board/code.pdf](https://www.uwo.ca/univsec/pdf/board/code.pdf)) prohibits assault, harassment, intimidation, threats, or coercion, as well as discrimination based on grounds including race, ethnic origin, sex, sexual orientation, gender identity, and disability. Students in this course are expected to speak and act in ways that maintain an environment in which all people feel safe and respected.

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](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](http://www.turnitin.com)).

Statement on Use of Electronic Devices

For all tests and exams, it is the policy of the Schulich School of Medicine & Dentistry and the Department of Biochemistry that any electronic devices, (e.g., cell phones, tablets, cameras, MP3 players, Apple Watches, etc.) 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 a prohibited device will receive a grade of zero on the test or exam. Non-programmable calculators are allowed only when indicated by the instructor. The Department of Biochemistry is not responsible for stolen, lost, or broken devices.

Statement on Use of Personal Response Systems (“Clickers”)

Instructors in this course may choose to use personal response systems. Students should refer to the Guidelines for Students on the Use of Personal Response Systems (“Clickers”) at: [http://www.uwo.ca/univsec/pdf/academic_policies/exam/courseoutlines.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/exam/courseoutlines.pdf)

Absence from course commitments

Medical/Compassionate Relief Program Policy

It is current policy that students who are unable to write a test or examination or other form of course evaluation are required to obtain a medical certificate that is taken to the Academic Counseling Office, NCB 280 (for Science and Basic Medical Science students), or to the appropriate Home Faculty Counseling Office. In the case of an unexpected absence on
compassionate grounds, documentation is also requested. Such documentation must be submitted by the student directly to the Academic Counseling office and not to the instructor. An academic counselor in that office will review and either approve or deny the accommodation request. It will be the Academic Counseling office that will determine if accommodation is warranted. This policy applies to all forms of assessment, including evaluations that are less than 10%.

A. Absence for medical illness:

Students must familiarize themselves with the Policy on Accommodation for Medical Illness for Undergraduate Students, located at: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

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. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Academic Counselling Office immediately.

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

If, because of illness, a student is unable to attend the oral presentation on the date specified, the group will proceed in the student’s absence, and the absent student will make a solo presentation at a later date.

B. Absence for non-medical reasons:

If you have course timetable conflicts with the examination times, contact Lindsay Ralph (lhabere@uwo.ca), the Biochemistry Undergraduate Co-ordinator in the Biochemistry Departmental Office (Medical Sciences Building 342) at least two weeks before the examination.

In these circumstances, special arrangements will be made to write midterms tests or exams in advance of the regularly scheduled midterm test or exam.

C. 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.

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.

Support Services:

Registrarial Services: http://www.registrar.uwo.ca

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

USC Student Support Services: http://westernusc.ca/services/

Student Development Services: http://www.sdc.uwo.ca

Student Health Services: http://www.shs.uwo.ca/

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