1. Course Information

Biochemistry 3382A: Biochemical Regulation

Fall Term 2019/20

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-145 (NS-145)

Friday 2:30-3:30 pm Natural Science Room-7 (NS-7)

Tutorials:

Tuesday 5:30-6:30 pm

Natural Sciences Room 7 (NS-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. Chris Brandl</td>
<td><a href="mailto:cbrandl@uwo.ca">cbrandl@uwo.ca</a></td>
<td>MBL C210</td>
<td>850-2949</td>
<td>TBD</td>
</tr>
<tr>
<td>Dr. Derek McLachlin</td>
<td><a href="mailto:Derek.McLachlin@schulich.uwo.ca">Derek.McLachlin@schulich.uwo.ca</a></td>
<td>MSB349</td>
<td>661-3072</td>
<td>Thursday 1-3 pm</td>
</tr>
<tr>
<td>Graduate Teaching Assistants</td>
<td>Dalton Ham, Mallory Frederick</td>
<td></td>
<td></td>
<td>TBD</td>
</tr>
</tbody>
</table>

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 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

SECTION 1 Dr. Derek McLachlin  (September 5 – September 20)
Nucleic Acid Structure – DNA and RNA
DNA Supercoiling
Nucleotide metabolism
DNA replication (prokaryotic and eukaryotic)

SECTION 2 Dr. Chris Brandl (September 24 – October 22)
Transcription overview
Eukaryotic basal transcription factors
Yeast molecular biology
Eukaryotic transcriptional activators
Chromatin and transcription
Introduction to systems biology

SECTION 3 Dr. David Edgell (October 24 – December 5)
Recombination & DNA repair & genome editing
RNA world
RNA splicing
miRNA-mediated gene regulation
Mobile genetic elements
CRISPR systems
Recombinant DNA technology
Next generation sequencing and associated applications
Synthetic biology
Case studies in synthetic biology and synthetic genomes

4. Course Materials

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

Students in Biochemistry modules are advised to purchase “Writing in the Biological Sciences”, 3rd edition (2019), by Angelika H. Hofmann. This book has excellent information on written and oral communication (including preparing CVs and applying for jobs), and should be helpful in this course as well as Biochemistry 3381A and 3380G.

5. Evaluation:

<table>
<thead>
<tr>
<th>Assessment</th>
<th>% of final grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm #1</td>
<td>20</td>
</tr>
<tr>
<td>Midterm #2</td>
<td>30</td>
</tr>
<tr>
<td>Final exam</td>
<td>35</td>
</tr>
<tr>
<td>Oral presentation</td>
<td>10</td>
</tr>
<tr>
<td>Written summary</td>
<td>5</td>
</tr>
</tbody>
</table>

(1) There will be two midterms. The first midterm will cover Dr. McLachlin’s section. The first midterm will be worth 20% of the final mark. The second midterm will cover Dr. Brandl’s section. The second midterm will be worth 30% of the final mark.

Midterm #1 will be on the evening of Thursday, September 26

Midterm #2 will be on the evening of Wednesday, October 30

(2) The final exam will cover the remaining lectures from Dr. Edgell’s section. It will be worth 35% of the final mark.

The midterm and final exams will primarily consist of short answer and problems based on materials from lectures, assigned textbook readings and other assigned reading. There are no multiple choice questions. The final exam will not be cumulative.

Unless otherwise indicated, the use of electronic devices will not be permitted for the midterm tests and final exam.

(3) 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%. 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. Presentations will occur during the Tuesday tutorial session (5:30-6:30). Not all tutorial sessions will be used for presentations as those sessions close to the midterm exams will be set aside for review. 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
the instructor lecturing at the time of the presentation, the course TA, members of the group, and
the other groups at the tutorial session. The short 1-page summary short be appropriate for a
scientific lay audience along the lines of a Nature News and Views article. 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

“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 Cell Phone and Electronic Devices**
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 and the Department of Biochemistry 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 Department of Biochemistry is not responsible for stolen/lost or broken devices.

7. Absence from course commitments

**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-reporting of absence or via the Academic Counselling Office of the Faculty of Science located in NCB 280, and can be contacted at scibmsac@uwo.ca.

**NEW!!** For further information, please consult the university’s policy on academic consideration for student absences as there are updates to the academic consideration procedures. 
[https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf)

The policy on Accommodation for Religious Holidays can be found here: 

**A. Absence for medical and non-medical reasons:**

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](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf)

A Western Student Medical Certificate (SMC) is required when a student is seeking academic accommodation. This documentation should be obtained at the time of the initial consultation with the physician/nurse practitioner or walk-in clinic. 

**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 your 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%.

**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](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](http://www.health.uwo.ca/mental_health)

**Student Health Services:** [https://www.uwo.ca/health/shs/index.html](https://www.uwo.ca/health/shs/index.html)

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