

The University of Western Ontario  
Department of Biology  
Winter 2024

**Biology 4260B: CELLULAR SYSTEMS BIOLOGY**

**1. Course Information**

Systems biology attempts to understand complex biological processes through the use of a holistic, rather than a reductionist paradigm. The course focuses on the use of interdisciplinary systems-level methods to understand both gene regulatory networks and biochemical reaction networks. In addition to providing a theoretical foundation for the study of dynamic biological systems, the course also aims to highlight the practical application of derived models using examples from the current literature. The application of systems-level knowledge to the emerging discipline of synthetic biology will also be discussed. While mathematical modeling forms an integral part of the course, the material presented is both suitable for, and accessible to, fourth year Biology and Medical Sciences students. **Prerequisite(s):** Completion of at least 1.5 Biology courses at the 3000 level or above. Priority to YR 4 HSP modules or Hons DBL Major modules offered by the Department of Biology. **Extra Information:** 2 lecture hours, 1 tutorial/lecture hour, 0.5 course. Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will 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.

**2. Instructor Information and Delivery Mode**

**Instructor:** Dr. Jim Karagiannis

**Office:**

**Office Hours:**

**Phone:** ext. 80975

**Email:** jkaragia@uwo.ca

**Lectures:**

**Tutorials:**

All emails to Dr. Karagiannis must contain "Bio4260B" in the subject line. Students must use their Western (@uwo.ca) email address.

### 3. Course Materials

Students should visit OWL (<http://owl.uwo.ca>) on a regular basis for news and updates. This is the primary method by which information will be disseminated. Students are responsible for visiting OWL on a regular basis. 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.

A textbook will not be used as a learning resource due to the great speed with which the discipline has advanced in recent years. Instead, the course will make extensive use of contemporary articles from the field's most respected journals.

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

### 4. Technical Requirements

- Stable internet connection
- Computer with working microphone and webcam (microphone and webcam will only be required if circumstances force a return to fully online learning)
- Online Insight Maker account (free)

### 5. Course Objectives and Topics

To better understand complex biological systems through the identification and characterization of common “design principles” that are conserved throughout evolution and that can be understood using a simple mathematical framework. Topics of study will include:

- Mathematical Foundations
- Introduction to Mathematical Models
- Modelling Chemical Reaction Networks
- Modelling the Cell Cycle
- Transcriptional Networks
- Negative Autoregulation
- Positive Autoregulation
- Feedforward Loops
- Temporal Programs
- Robustness of Protein Circuits
- Optimal Gene Circuit Design

## 6. Learning Outcomes

- Students will develop the mathematical skills needed to describe and analyze biochemical reaction networks and apply these skills within a broader biological context
- Using modelling software, students will be able to construct sets of ordinary differential equations (ODEs) to describe and analyze dynamic biological systems (e.g., cell cycle control systems)
- Students will be able to define a network motif and relate its biological function to selective pressures experienced over evolutionary time
- Students will be able to construct models of common transcriptional circuits (negative autoregulation, positive autoregulation, feedforward loops) and analyze these systems with respect to their temporal and regulatory characteristics
- Students will relate their newly developed knowledge of systems biology to the rational design of synthetic gene circuits
- Students will be able to critically analyze high impact articles from the primary literature and assess their contribution to the continuing development of the discipline of systems biology

## 7. Evaluation

The mark breakdown will be as follows:

<b>Quiz #1:</b>	10%
<b>Quiz #2:</b>	10%
<b>Quiz #3:</b>	10%
<b>Quiz #4:</b>	10%
<b>Modelling Assignment #1:</b>	10%
<b>Modelling Assignment #2:</b>	10%
<b>Presentation:</b>	15%
<b>Participation:</b>	5%
<b>Final Exam</b> (to be scheduled by the registrar):	20%

Assignments will be handed in individually. Presentations will be carried out in groups. Missed components (for which relief/consideration has been approved) will result in a reweighting of the mark breakdown.

Please note that this course adheres to the university-wide descriptors for the meaning of letter grades:

A+	90-100	One could scarcely expect better from a student at this level
A	80-89	Superior work which is clearly above average
B	70-79	Good work, meeting all requirements, and eminently satisfactory
C	60-69	Competent work, meeting requirements
D	50-59	Fair work, minimally acceptable
F	below 50	Fail

## 8. Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

### **Assessments worth less than 10% of the overall course grade:**

Not applicable to Bio4260B.

### **Assessments worth 10% or more of the overall course grade:**

For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy at [https://uwo.ca/univsec/pdf/academic\\_policies/appeals/academic\\_consideration.pdf](https://uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration.pdf)

The Student Medical Certificate is available at

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/medicalform.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf)

### **Absences from Final Examinations**

If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

## 9. Accommodation and Accessibility

### Religious Accommodation

When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

<https://multiculturalcalendar.com/ecal/index.php?s=c-univwo>

### Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/Academic%20Accommodation abilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation%20abilities.pdf)

## 10. Academic Policies

The website for Registrarial Services is <http://www.registrar.uwo.ca>. In accordance with policy, [https://www.uwo.ca/univsec/pdf/policies\\_procedures/section1/mapp113.pdf](https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf), 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 their official university address is attended to in a timely manner.

The use of non-programmable calculators will be allowed in tests and exams.

**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 Web site:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/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>).

## 11. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: <https://www.uwo.ca/sci/counselling/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

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 [https://www.uwo.ca/health/student\\_support/survivor\\_support/get-help.html](https://www.uwo.ca/health/student_support/survivor_support/get-help.html).

To connect with a case manager or set up an appointment, please contact [support@uwo.ca](mailto:support@uwo.ca).

Learning-skills counsellors at the Student Development Centre (<https://learning.uwo.ca>) 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.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: <https://www.uwo.ca/se/digital/>.

Additional student-run support services are offered by the USC <https://westernusc.ca/services/>.

## 12. Land Acknowledgment

We acknowledge that Western University is located on the traditional lands of the Anishinaabek, Haudenosaunee, Lūnaapéewak and Attawandaron peoples, on lands connected with the London Township and Sombra Treaties of 1796 and the Dish with One Spoon Covenant Wampum. This land continues to be home to diverse Indigenous peoples (e.g. First Nations, Métis and Inuit) whom we recognize as contemporary stewards of the land and vital contributors of our society.

More information about Indigenous Services (<https://indigenous.uwo.ca/>) and this Land Acknowledgement (<https://communications.uwo.ca/comms/land-acknowledgement/>) are available.