The University of Western Ontario
Department of Biology
Fall 2025

Biology 4260A: 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's Designate (Department/Program Counsellors and Science Academic Advisors) 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.

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 "Bio4260A" in the subject line. Students must use their Western (@uwo.ca) email address.

3. Course Materials

All course material will be posted to OWL: https://westernu.brightspace.com/. Students are responsible for checking the course OWL site regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class. If students need assistance with the course OWL site, they can seek support on the OWL Brightspace 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 in the course 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

- Computer
- Stable internet connection
- 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:

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

Assignments will be completed 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. General Information About Missed Coursework

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:
https://registrar.uwo.ca/academics/academic_considerations/
All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

- Final Exam (Defined by policy)
- Group Presentation (Designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration)

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under Special Examinations), especially for those who miss multiple final exams within one examination period.

9. Religious Accommodation

When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays: https://www.edi.uwo.ca.

10. 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 Accommodation_disabilities.pdf.

11. Academic Policies

The website for Registrar Services is https://www.registrar.uwo.ca/.

In accordance with policy,

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 is allowed during 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:

https://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).

12. Support Services

Please visit the Science & Basic Medical Sciences Academic Advising 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.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Learning-skills counsellors at Learning Development and Success (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/.

13. Schedule

DATE	LECTURE TIME	TUTORIAL TIME
	Lecture #1	
		No Tutorial
	Lecture #2	
	Lecture #3	
		No Tutorial
	Lecture #4	
	Lecture #5	
		Optional Help Session
	Quiz #1	
	Lecture #6	
		Optional Help Session
	Lecture #7	
	Lecture #8	
		Optional Help Session
	Lecture #9	
	Lecture #10	
		Optional Help Session
	Quiz #2	
	Lecture #11	
		Optional Help Session
	Lecture #12	
	Lecture #13	
		Optional Help Session
	Lecture #14	
	Lecture #15	
		No Tutorial
	READING WEEK (No Classes)	**READING WEEK (No Tutorial)**
	Quiz #3	
	Lecture #16	
		Presentations #1 and #2
	Lecture #17	
	Lecture #18	

		Presentations #3 and #4
	Lecture #19	
	Lecture #20	
		Presentations #5 and #6
	Quiz #4	
	Presentations #7 and #8	
		Presentations #9 and #10