

Biochemistry
4420A Molecular Biology of Proteins

Course Syllabus for Fall 2023



Western University is committed to a **thriving campus**; therefore, your health and wellness matter to us! The following link provides information about the resources available on and off campus to support students: <https://www.uwo.ca/health/> Your course coordinator can also **guide you** to resources and/or services should you need them.

1. Technical Requirements:



Stable internet connection



Laptop or computer

2. Important Dates:



Classes Begin		Classes End
Thursday, September 7, 2023		Thursday, December 8, 2023
* November 13, 2023: Last day to drop a first-term half course without academic penalty		
Reading Week	Study day(s)	Exam Period
October 30–November 5	December 9	December 10–22

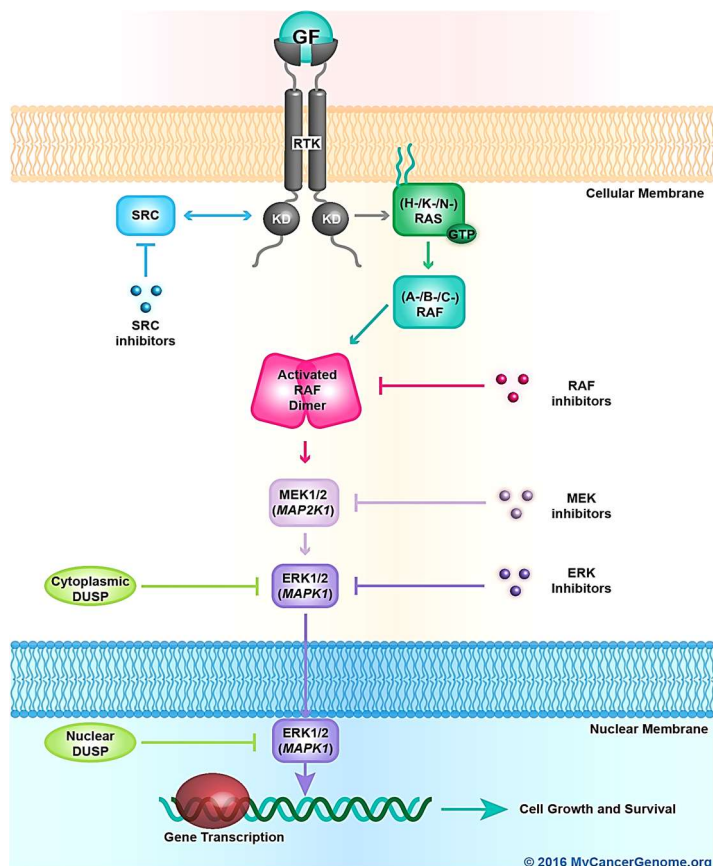
3. Contact Information



Course Coordinator	Contact Information
Dr. James (Wing-Yiu) Choy	jchoy4@uwo.ca
Instructor(s) or Teaching Assistant(s)	Contact Information
Dr. Brian Shilton (Instructor)	bshilton@uwo.ca
Dr. Gary Shaw (Instructor)	gshaw1@uwo.ca
Viveka Pimenta (TA)	vpiment2@uwo.ca
Wenhan Zhang (TA)	wzhan564@uwo.ca

4. Course Description and Design

Biochemistry is a discipline focused on achieving a molecular-level understanding of how macromolecules function in biological systems. Proteins are often represented in textbooks and scientific literature as various simple shapes. For example, the MAP kinase signalling pathway can be illustrated as follows:



Cartoon diagrams with squares, circles, or triangles representing proteins can show the connections between molecules in a pathway; however, these diagrams offer little information about what is actually happening at an atomic and molecular level. For example, it is not clear why certain mutations in the receptor tyrosine kinase (RTK) can cause it to signal in an unregulated and inappropriate manner. Other questions concern the nature of the interactions that result in the "activation" of signalling molecules. For example, in the diagram above, how does the interaction between the RTK and RAS allow RAS to activate RAF?

For a biochemist, diagrams such as the one above are unsatisfying because they do not explain why or how these processes occur at the molecular level. Characterization of events at the molecular level allows one to understand why certain ligands or mutations have particular effects. Knowledge of the molecular structure, chemistry and driving forces facilitates drug design and discovery, and opens the door for molecular engineering.

Given the vast number of protein-mediated interactions, processes, and pathways in living systems, it is daunting to consider actually being able to understand them all at a detailed molecular level. The good news is that we have sufficient knowledge of how proteins work that their functions can be framed and understood using general principles. The aim of this course is to uncover and discuss the general principles that govern protein structure, folding, and stability; their interactions with other molecules; their ability to catalyze complex chemical reactions; and their biogenesis and degradation.

Delivery Mode: in-person

Timetabled Sessions

Component	Date(s)	Time
Lecture		
Tutorial*		

* please note that tutorials may not run every week.

All course material will be posted to OWL: <http://owl.uwo.ca>. Any changes will be indicated on the OWL site and discussed with the class.

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.

[Google Chrome](#) or [Mozilla Firefox](#) are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click [here](#).

5. Learning Outcomes



Upon successful completion of this course, students will be able to:

- Relate molecular properties of proteins to their biological functions.
- Explain the molecular mechanism of ubiquitination and the roles ubiquitination plays in protein degradation and neurological disease.
- Describe how changes in protein structure, stability, and dynamics can contribute to disease.
- Understand the role of energy in protein stability, conformational dynamics, catalysis, and binding.
- Know the fundamental differences between folded and intrinsically disordered proteins.

6. Course Content and Schedule



Dates	Topic	Instructor
Sept 7	Course Introduction Discovery Ubiquitination	Choy & Shaw
Sept 12	Identification of the Enzymes I	Shaw
Sept 14	Identification of the Enzymes II	Shaw
Sept 19	The N-end Rule	Shaw
Sept 21	Ubiquitin and polyubiquitin chain recognition	Shaw
Sept 26	Measuring Ubiquitination Activity	Shaw
Sept 28	Identification of Ubiquitin Sites and Chain Types	Shaw
Oct 3	Ubiquitination and Neurological Disease	Shaw
Oct 5	Therapeutic Opportunities in Ubiquitin Pathway	Shaw
Oct 10	Ligand Binding and Conformation	Shilton
Oct 12	Energetic Barriers and Transition States	Shilton
Oct 17	Protein Dynamics	Shilton
Oct 19	Dynamic Energy Landscape in DHFR Catalysis	Shilton
Oct 24	Allostery and Equilibrium	Shilton
Oct 26	Dynamics and Mechanism	
Oct 30–Nov 5	Reading Week	N/A
Nov 7	Allostery in Hemoglobin	Shilton
Nov 9	Allostery, Catalysis, and Energetic Landscapes	Shilton
Nov 14	Evolution of Kinase Energetic Landscapes	Shilton
Nov 16	Introduction to Intrinsically Disordered Proteins	Choy
Nov 21	Functions of Intrinsically Disordered Proteins	Choy
Nov 23	Coupled Folding and Binding I	Choy
Nov 28	Coupled Folding and Binding II	Choy
Nov 30	Intrinsically Disordered Proteins as Drug Targets	Choy
Dec 5	Protein Misfolding & Diseases I	Choy
Dec 7	Protein Misfolding & Diseases II	Choy

7. Participation and Engagement



- ☒ Students are expected to participate and engage with content as much as possible
- ☒ Students can also participate by interacting in the forums with their peers and instructors

8. Evaluation

Below is the evaluation breakdown for the course. Any deviations will be communicated.

Assessment	Weighting	Released Date	Due Date
Assignment #1 (Shaw section)	15%	Sept 28	Oct 12
Assignment #2 (Shilton section)	15%	Oct 26	Nov 16
Video Assignment	25%	Sept 14	Nov 7
Assignment #3 (Choy section)	10%	Nov 24	Dec 8
Final exam (All sections)	35%		TBA

- ☒ All assignments are due at 11:55 pm EST unless otherwise specified
- ☒ Students are responsible for ensuring that the correct file version is uploaded; incorrect submissions including corrupt files could be subject to late penalties (see below) or a 0
- ☒ Written assignments will be submitted to Turnitin (statement in policies below)
- ☒ Students will have 1 submission to Turnitin
- ☒ Rubrics will be used to evaluate assessments and will be posted with the instructions
- ☒ A student might not receive the same grade as their group members if it is determined that the distribution of work was not equal
- ☒ After an assessment is returned, students should wait 24 hours to digest feedback before contacting their evaluator; to ensure a timely response, reach out within 7 days
- ☒ Any grade appeals on assignments must be received within 3 weeks of the grade being posted.



Click [here](#) for a detailed and comprehensive set of policies and regulations concerning examinations and grading. The table below outlines the University-wide grade descriptors.

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

Information about late or missed evaluations:

- ☒ Late assessments without accommodation will be subject to a late penalty 5%/day
- ☒ An assessment cannot be submitted after it has been returned to the class.

INC (Incomplete Standing): If a student has been approved by the Academic Counselling Office (in consultation with the instructor/department) to complete term work at a later date, an INC will be assigned. Students with INC will have their course load in subsequent terms reduced to allow them to complete outstanding course work. Students may request permission from Academic Counselling to carry a full course load for the term the incomplete course work is scheduled.

SPC (Special examination): If a student has been approved by the Academic Counselling Office to write a Special Examination and the final exam is the only outstanding course component, an SPC will be assigned. If the class has a makeup exam, the student is expected to write the makeup exam. If the class doesn't have a makeup exam or the student misses the makeup exam for reasons approved by the Academic Counselling Office, the student will write the exam the next time the course is offered. Outstanding SPCs will reduce the course load for the term the exam is deferred as outlined in [Types of Examinations](#) policy.

9. Communication:



- ☒ Students should check the OWL site every 24–48 hours
- ☒ Students should set their OWL preferences so that they are notified of announcements and discussions
- ☒ Questions and discussions are encouraged during the class time
- ☒ This course will use forum on OWL and the tutorials for questions and discussions outside of class
- ☒ All course-related queries should be posted to the appropriate OWL forum so that everyone can access the questions and responses
- ☒ Students can contact their instructor(s) and teaching assistant(s) by email for queries not directly related to the course material.

10. Office Hours:



Regular office hours are not scheduled. For questions or discussion, students should contact the instructors or teaching assistant to arrange an appointment. The teaching assistants will schedule office hours in the weeks prior to assignment due dates.

11. Resources



There is no single text that provides adequate coverage of the course material; however, much of the material is covered in the following chapters of three recent books:

The Molecules of Life (John Kuryan, Boyana Konforti, David Wemmer)

Chapter 4 Protein Structure 4.1 - 4.44

Chapter 10 Chemical Potential and the Drive to Equilibrium 10.19 - 10.29

Chapter 12 Molecular recognition 12.1 - 12.11

Chapter 13 Specificity of macromolecular recognition 13.10 - 13.21

Chapter 14 Allostery

Chapter 18 Folding 18.1-18.12, 18.17-18.22

How Proteins Work (Mike Williamson)

Chapter 4 Protein Interactions in vivo 4.3 and 4.5

Chapter 6 Protein Flexibility and Dynamics

Proteins: Concepts in Biochemistry (Paulo Almeida)

Chapter 1 Statistical Thermodynamics of Biological Macromolecules

Chapter 6 Binding, Allostery, and Cooperativity.

These texts are available from the Taylor Library and can be obtained as electronic or hard-copy versions:

The Molecules of Life

<https://books.google.ca/books?id=jwcPBAAQBAJ>

How Proteins Work (free PDF download from within university)

<https://www.taylorfrancis.com/books/9780429061844>

Proteins: Concepts in Biochemistry (free PDF download from within university)

<https://www.taylorfrancis.com/books/9780429258817>

- ☒ Additional reading material will be specified by the instructors and will either be available through Western Libraries or made available through the 4420A OWL site page.

12. Professionalism & Privacy:



Western students are expected to follow the [Student Code of Conduct](#). Additionally, the following expectations and professional conduct apply to this course:

- ☒ All course materials created by the instructor(s) are copyrighted and cannot be sold/shared (e.g., Must Knows Facebook group, Course Hero, Chegg, etc.)
- ☒ Recordings are not permitted (audio or video) without explicit permission
- ☒ Permitted recordings are not to be distributed

Western is committed to providing a learning and working environment that is free of harassment and discrimination. All **students**, staff, and faculty have a role in this commitment and have a responsibility to ensure and promote a safe and respectful learning and working environment. Relevant policies include Western's [Non-Discrimination/Harassment Policy](#) (M.A.P.P. 1.35) and [Non-Discrimination/Harassment Policy – Administrative Procedures](#) (M.A.P.P. 1.35).

Any **student**, staff, or faculty member who experiences or witnesses' behaviour that may be harassment or discrimination **must report the behaviour** to the Western's [Human Rights Office](#). Harassment and discrimination can be human rights-based, which is also known as EDI-based, (sexism, racism, transphobia, homophobia, islamophobia, xenophobia, antisemitism, and ableism) or non-human rights-based (personal harassment or workplace harassment).

13. How to Be Successful in this Class:



Students enrolled in this class should understand the level of autonomy and self-discipline required to be successful.

1. Invest in a planner or application to keep track of your courses. Populate all your deadlines at the start of the term and schedule your time throughout the course.
2. Make it a daily habit to log onto OWL to ensure you have seen everything posted to help you succeed in this class.
3. Follow weekly checklists created on OWL or create your own to help you stay on track.
4. Take notes as you go through the lesson material. Keeping handwritten notes or even notes on a regular Word document will help you learn more effectively than just reading or watching the videos.
5. Connect with others. Try forming an online study group and try meeting on a weekly basis for study and peer support.
6. Do not be afraid to ask questions. If you are struggling with a topic, check the online discussion boards or contact your instructor(s) and or teaching assistant(s).
7. Reward yourself for successes. It seems easier to motivate ourselves knowing that there is something waiting for us at the end of the task.

14. Western Academic Policies and Statements

Absence from Course Commitments

A. Absence for medical illness:

Students must familiarize themselves with the [Accommodation for Illness Policy](#).

A student seeking academic accommodation for any **work worth less than 10%** must contact the instructor or follow the appropriate Department or course specific instructions provided on the course outline. Instructors will use good judgment and ensure fair treatment for all students when considering these requests. You are not required to disclose details about your situation to your instructor; documentation is not required in this situation, and you should not send any pictures to your instructor.

If you are unable to meet a course requirement for any **work worth 10% or greater** due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Academic Counseling 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 and the instructor has been informed. Please note that the format of a make-up test, exam, or assignment is at the discretion of the course coordinator.

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

B. Absence for non-medical reasons:

Student absences might also be approved for non-medical reasons such as religious holidays and compassionate situations. Please review the policy on [Accommodation for Religious Holidays](#). All non-medical requests must be processed by Academic Counselling. Not all absences will be approved; pay attention to the academic calendar and final exam period when booking any trips.

C. Special Examinations

A Special Examination is any examination other than the regular examination, and it may be offered only with the permission of the Dean 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. To provide an opportunity for students to recover from the circumstances resulting in a Special Examination, the University has implemented Special Examinations dates. These dates as well as other important information about examinations and academic standing can be found [here](#).

Academic Offenses

Scholastic offences are taken seriously, and students are directed [here](#) to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence.

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 Accessible Education (AE) at 661-2111 x 82147 for any specific question regarding an accommodation or review [The policy on Accommodation for Students with Disabilities](#)

Correspondence Statement

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 his/her official university address is attended to in a timely manner. You can read about the privacy and security of the UWO email accounts [here](#).

Discovery Credit Statement

Students are permitted to designate up to 1.0 Discovery Credit course (or equivalent) for pass/fail grading that can be counted toward the overall course credits required for their degree program. The details of this policy and the deadlines can be found [here](#).

Turnitin and other similarity review software

Generative artificial intelligence (AI) tools, such as ChatGPT, cannot be used for assignments in this course. All assignments will 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 Western University and [Turnitin.com](https://www.turnitin.com).

15. BMSUE Academic Policies and Statements

Cell Phone and Electronic Device Policy (for in-person tests and exams)

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 that any electronic devices, i.e., cell phones, tablets, cameras, smart glasses, smart watches, 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 program is not responsible for stolen/lost or broken devices.

Copyright and Audio/Video Recording 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. You must always ask permission to record another individual and you should never share or distribute recordings.

Rounding of Marks Statement

Across the Basic Medical Sciences Undergraduate Education programs, 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.

16. Support Services

The following links provide information about support services at Western University.

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.

[Academic Counselling \(Science and Basic Medical Sciences\)](#)

[Appeal Procedures](#)

[Registrarial Services](#)

[Student Development Services](#)

[Student Health Services](#)