



BIOC*4540 Enzymology

Winter 2024

Section(s): 01

Department of Molecular and Cellular Biology

Credit Weight: 0.75

Version 1.00 - December 19, 2023

1 Course Details

1.1 Calendar Description

This is a laboratory-intensive course where the topics studied include enzyme active sites and the mechanisms of enzyme action; enzyme kinetics and regulation; recombinant proteins and site-directed mutagenesis as tools for understanding enzymes.

Pre-Requisites: BIOC*3560 (may be taken concurrently), BIOC*3570

Co-Requisites: BIOC*3560 (may be taken concurrently), BIOC*3570

1.2 Course Description

This is a required Biochemistry fourth-year course on the subject of Enzyme Structure, Function and Mechanism. It features a laboratory component (approximately 5 laboratory modules) and an Independent Study where the students research an enzymology topic and present a PowerPoint seminar with a partner.

Students must pass (mark of 50% or better) **both** the laboratory component (30%) **and** the theory component (70%) to obtain a final passing mark in the course. In cases where this standard is not reached, the final mark assigned will be either the mark calculated as given above or 47%, whichever is *less*. College policy precludes changes to the marking scheme for individual students, except in case of illness.

1.3 Timetable

- Lectures: Tuesday and Thursday from 10:00 AM – 11:20 AM in GRHM 2310
Lecture content may be synchronous and/or asynchronous
- Laboratory sections will be held during your scheduled lab period in SSC 4111

1.4 Final Exam

The final exam is on April 23, 2024 at 11:30 AM for 2 hours, check WebAdvisor or details.

2 Instructional Support

2.1 Instructional Support Team

Instructor:	Siavash Vahidi Dr.
Email:	svahidi@uoguelph.ca
Telephone:	+1-519-824-4120 x53833
Office:	SSC 2253
Office Hours:	By appointment
Lab Co-ordinator:	Colin Cooper Dr.
Email:	ccoope08@uoguelph.ca
Office:	SSC 3502
Office Hours:	By Appointment

3 Learning Resources

3.1 Required Resources

Lab coat and safety glasses (Equipment)

Lab coat and safety glasses.

Computer with internet access (Equipment)

A computer, with internet access and a webcam, that is capable of running Respondus/Lockdown software.

3.2 Recommended Resources

Principles in Biochemistry (Readings)

- No single textbook is sufficient for the lecture material but Lehninger: Principles in Biochemistry (Lehninger 5th, 6th, or 7th editions) Chapter 6 serves as the basis for basic enzyme understanding and theory and this chapter should be read and carefully studied.
- On reserve

3.3 Additional Resources

Introduction to Proteins: Structure, Function, and Motion (Textbook)

Amit Kessel, Nir Ben-Tal (2018) Introduction to Proteins: Structure, Function, and Motion, 2

nd Edition (Chapman and Hall, CRC; published April 11, 2018)

- on reserve

Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding, Series in Structural Biology (Textbook)

Alan Fersht (2017) Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding, Series in Structural Biology – vol. 9 (2017), World Scientific Co. Pte. Ltd, Hakensack, New Jersey.

- on reserve

Enzymes: Biochemistry, Biotechnology and Clinical Chemistry (Textbook)

Trevor Palmer (2007) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, 2nd edition, Albion Press.

- on reserve

3.4 Note

- A number of related texts have been placed on reserve as resources and to provide background information on the various topics discussed in the course (see Course Subject Outline).
- The Adobe Acrobat (*.pdf) files for each Powerpoint lecture will be available for download from the Courselink website and each lecture will be made available at least 2 weeks before the specified lecture date.

3.4 Additional Texts

- All indicated additional texts, papers and treatises are available at the Reserve Desk at the library on two hour loan.

4 Learning Outcomes

Objectives: (i) To integrate the practical aspects of enzymology with the kinetic theories to provide a mechanistic overview of enzyme activity and regulation in cells; (ii) to prepare students to confidently and competently work with enzyme systems in both Academia and Industry; and (iii) to give students the experience to research an enzymology topic, prepare and deliver a Powerpoint presentation.

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Analyze and plot enzyme kinetic data and study the effect of several variables on the kinetics of enzymes.
 2. Learn how to use molecular visualization and bioinformatic tools/software, including PyMOL, to study and analyze enzyme structure and function.
 3. Perform a literature research on a specific enzyme topic
 4. Prepare and deliver a Powerpoint seminar to your peers
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5 Teaching and Learning Activities

5.1 Course Subject Outline

I. Lectures

- Lect#1: Introduction and Fundamentals of Protein-Ligand Interactions
- Lect#2: Michaelis-Menten Kinetics and considerations for setting up an enzyme assay
- Lect#3: Enzyme Purification and Enzyme Assay
- Lect#4: Graphical Analysis of Kinetic Data, Methods to measure dissociation constants
- Lect#5: Enzymes Classification and reaction rate theories
- Lect#6: Multi-substrate Reactions and Substrate-Binding Analysis
- Lect#7: Enzyme activity regulation: Allostery – Part 1
- Lect#8: Enzyme activity regulation: Allostery – Part 2
- Lect#9: Midterm Exam **Feb 6, 2024**
- Lect#10: Acid/base catalysis
- Lect#11: Enzyme Inhibition Mechanism - Part 1
- Lect#12: Enzyme Inhibition Mechanism - Part 2

READING WEEK

- Lect#13: Enzyme Inhibition Mechanism - Part 3

II. Modern topics in enzymology

- Lect#14: Student Presentations (n = 3 presentations, groups of 2 students)

- Lect#15: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#16: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#17: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#18: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#19: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#20: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#21: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#22: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#23: Student Presentations (n = 3 presentations, groups of 2 students)
- Lect#24: Student Presentations (n = 3 presentations, groups of 2 students)

6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Mid-term	20
Laboratory	30
Independent Study/Seminar	20
Participation	5
Final Exam	25
Total	100

6.2 Assessment Details

Midterm (20%)

Date: Tue, Feb 6, 10:00 AM, In-Class

- There will be a Mid-term Examination (80 min) involving multiple choice and short/long-answer questions.
- The Mid-term will be given in-class time to ensure no conflict with other activities.
- All the lecture material will be tested as part of the mid-term.

Laboratory Component (30%)

Date: SSC 4111

Lab periods will begin the week of January 15th during your scheduled day of the week.

Lab grades will be composed of an enzyme kinetics Assignment (15%) and a Lab Report

(15%).

Lab Reports will be monitored with anti-plagiarism software (e.g. Turnitin). Lab reports are completed and written by students individually. The use of Artificial Intelligence is not permitted when generating material for assessments unless permission has been given by an instructor in writing. AI detection software may be used according to University policy.

Independent Study/Seminar (20%)

- Commencing with Lecture#14 (**Feb 29, 2024**), we will have three Powerpoint presentations per lecture period with each seminar being a group effort (two students per team). The presentations will be 15 min in length followed by a 5-min question period. Each team member will receive an **identical mark** for the presentation, including the ability to answer questions--this activity is meant to be a team-effort and not two individuals presenting separately. Therefore, choose your partner wisely since you must work well with your them to make the best team-based presentation possible! The independent study/seminar is worth 25%; additionally there is a 10% participation mark where you have to provide feedback/question to your peer (details to be discussed as part of **Lecture #7**). Therefore, it is important to help each other and to work as a team! It is paramount to remember that anything that you include or say during your presentation is open to questions from the audience, so you should ensure that you fully understand it. A seminar rubric will be used for the evaluation of the seminars. Dr. Vahidi, Dr. Cooper, and the TAs will complete evaluation forms for each presentation.
- Students must form a two-person team by **Feb 6, 2024** and the team must choose a case-study enzymology topic from the topics list for their presentation by **Feb 6, 2024** (4 pm). Under exceptional circumstances, Dr. Vahidi might clear a topic proposed by a student group. Dr. Cooper will schedule the presentation dates for all the teams through CourseLink. If you are unable to present your seminar on the scheduled date due to a valid excuse, a separate written project/assignment will be given.
- Presenting via Zoom or remotely is not option. All presentations must be done in person.

Participation (5%)

Participation will be graded during student seminars and may consist of peer feedback and content related to seminars.

See CourseLink and attend **Lecture#7** for more details.

Final Exam (25%)

Date: Tue, Apr 23, 11:30 AM - 1:30 PM, Location TBD

A final exam covering all components of the lectures and student seminars.

7 Course Statements

7.1 Instructor & Course Evaluation

As part of the evaluation process in the Department of Molecular and Cellular Biology, written comments on the Course and/or the Instructors' teaching performance may be sent to the Chair, Department of Molecular and Cellular Biology, at any time. Such letters must be signed. Departmental Evaluations will also be conducted near the end of the semester. Copies of evaluations will be made available to the Instructor after submission of the final grade.

7.2 Course Add and Drop

Notification is not needed for dropping the course before the DROP deadline. Program approval is only needed for drops and adds if your category is "Special" or "Provisional".

7.3 Recording of Lecture Materials

By enrolling in a course, unless explicitly stated and brought forward to their instructor, it is assumed that students agree to the possibility of being recorded during lecture, seminar or other "live" course activities, whether delivery is in-class or online/remote.

If a student prefers not to be distinguishable during a recording, they may:

1. turn off their camera
2. mute their microphone
3. edit their name (e.g., initials only) upon entry to each session
4. use the chat function to pose questions.

Students who express to their instructor that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with their instructor.

7.4 Online Behaviour

Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student

- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online
- Discriminating against fellow students, instructors and/or TAs
- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your user name and password
- Recording lectures without the permission of the instructor

8 Department of Molecular and Cellular Biology

Statements

8.1 Academic Advisors

If you are concerned about any aspect of your academic program:

- Make an appointment with a program counsellor in your degree program. [B.Sc. Academic Advising](#) or [Program Counsellors](#)

8.2 Academic Support

If you are struggling to succeed academically:

- Learning Commons: There are numerous academic resources offered by the Learning Commons including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills. You can also set up individualized appointments with a learning specialist. <http://www.learningcommons.uoguelph.ca/>
- Science Commons: Located in the library, the Science Commons provides support for physics, mathematic/statistics, and chemistry. Details on their hours of operations can be found at: <http://www.lib.uoguelph.ca/get-assistance/studying/chemistry-physics-help> and <http://www.lib.uoguelph.ca/get-assistance/studying/math-stats-help>

8.3 Wellness

If you are struggling with personal or health issues:

- Counselling services offers individualized appointments to help students work through personal struggles that may be impacting their academic performance. <https://www.uoguelph.ca/counselling/>
- Student Health Services is located on campus and is available to provide medical attention. <https://www.uoguelph.ca/studenthealthservices/clinic>
- For support related to stress and anxiety, besides Health Services and Counselling

Services, Kathy Somers runs training workshops and one-on-one sessions related to stress management and high performance situations.

<http://www.selfregulationskills.ca/>

8.4 Personal information

Personal information is collected under the authority of the University of Guelph Act (1964), and in accordance with Ontario's Freedom of Information and Protection of Privacy Act (FIPPA) <http://www.e-laws.gov.on.ca/index.html>. This information is used by University officials in order to carry out their authorized academic and administrative responsibilities and also to establish a relationship for alumni and development purposes.

For more information regarding the Collection, Use and Disclosure of Personal Information policies please see the Undergraduate Calendar.

(<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/intro/index.shtml>)

8.5 Course Offering Information Disclaimer

Please note that course delivery format (face-to-face vs online) is subject to change up to the first-class day depending on requirements placed on the University and its employees by public health bodies, and local, provincial and federal governments. Any changes to course format prior to the first class will be posted on WebAdvisor/Student Planning as they become available.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website

<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website

<https://www.ridgetownc.com/services/accessibilityservices.cfm>

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

9.9 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).
