



# BIOC\*4580 Membrane Biochemistry

Winter 2024

Section(s): 01

Department of Molecular and Cellular Biology

Credit Weight: 0.50

Version 1.00 - December 21, 2023

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## 1 Course Details

### 1.1 Calendar Description

This course is a molecular examination of the structure and functions of cell membranes, cell surfaces and associated structures. Topics may include: membrane lipids; membrane protein structure; membrane transporters; ATP production; cytoskeleton; cell surface carbohydrates; membrane biogenesis; signal transduction.

**Pre-Requisites:** BIOC\*3560 or BIOC\*3570

### 1.2 Course Description

We will (a) discuss structure-function relationships of membrane proteins, lipids, & carbohydrates; (b) explain the molecular basis and integrate data to explain cell physiology; (c) explore experimental tools of biochemistry, molecular biology, cell biology, and biophysics; (d) apply this knowledge to problems & new situations. A variety of teaching methods will be employed, including active learning, group work, and lectures, with regular homework and reading assigned.

### 1.3 Timetable

In-person lectures.

**Jan 8 - Feb 16:** Dr. Dawson: Mondays, Wednesdays and Fridays 11:30 am - 12:20 pm in RICH Room 2529

**Feb 26 - Apr 8:** Dr. Wijekoon: Mondays, Wednesdays, and Fridays from 11:30 am – 12:20 pm RICH Room 2529

RICH Room 2529 is not equipped with cameras for recording of lectures. Therefore, a hybrid option or recordings of lectures are not available.

## 1.4 Final Exam

Date: April 22, 2024

Time: 8:30-10:30 AM

Location: TBD

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

The exam will be held in-person. An online option will **NOT** be available.

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## 2 Instructional Support

### 2.1 Instructional Support Team

<b>Instructor:</b>	Dr. John Dawson
<b>Email:</b>	jdawso01@uoguelph.ca
<b>Telephone:</b>	519-824-4120 x53867
<b>Office:</b>	SSC2248

<b>Office Hours:</b>	<ol style="list-style-type: none"> <li>1. <b>Right after class</b> until about 1 pm right outside the classroom.</li> <li>2. <b>Email!</b> You'll get timely responses between 10 am and 5 pm from Monday to Friday.</li> <li>3. <b>Virtual meetings.</b> I'm happy to set up a virtual meeting with you between 10 am and 5 pm Mon-Tues and Thurs-Fridays (keeping Wednesdays open for other meetings).</li> </ol>
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<b>Instructor:</b>	Dr. Enoka Wijekoon
<b>Email:</b>	ewijekoo@uoguelph.ca
<b>Telephone:</b>	519-824-4120 x56095
<b>Office:</b>	SSC 3517
<b>Office Hours:</b>	Mon & Wed 2:00-3:00 PM in SSC 3517

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## 3 Learning Resources

### 3.1 Required Resources

Courselink (Website)

<https://courselink.uoguelph.ca>

- The **course outline, lecture schedule, and reading list** for the text-book are available at this site. The **lecture notes and/or slides** will be available before each lecture.
- Material will be posted as pdf files, which can be viewed and printed using Adobe Acrobat Reader.

### Teams (Software)

Teams may be used for virtual office hours in this course

## 3.2 Recommended Resources

### Office365 (Software)

<https://guelph.onthehub.com/WebStore/Welcome.aspx>

It is highly recommended that students have access to this software suite to complete course assignments requiring word processing, spreadsheet, and data analysis capabilities.

If students use other similar software, please ensure that you save your files in the required file format according to the assignment instructions.

### Lehninger Principles of Biochemistry (Textbook)

- "Lehninger Principles of Biochemistry" by Nelson & Cox (6th edition or newer)
- This is an excellent text for many senior level courses in biochemistry and other molecular bioscience fields, and is also very useful as a reference text at the graduate level. A course reading list is provided for this textbook. Copies of this book are on 2-hour Reserve in the McLibrary, as well as in the stacks, and it is available for sale in the Campus Bookstore. The 5<sup>th</sup> edition (2008) of this book is still very useful, whereas the 4th edition (2005) will not contain the new structural and proteomics information that has become available in the past few years.

## 3.3 Additional Resources

### An Introduction to Biological Membranes (Textbook)

- William Stillwell. AN INTRODUCTION TO BIOLOGICAL MEMBRANES: From Bilayers to Rafts. Elsevier - Academic Press (2013).
- This textbook has appeared in open-access in the fall of 2013. I have made the pdf available on-line. It appears to cover the course material broadly if not in-depth, and may be helpful as additional reading.

### Membrane Structural Biology (Textbook)

- M Luckey. Membrane Structural Biology. Cambridge, 2008. QH 601.L75

- Also available from the Library or TUG-Online

### 3.4 Assigned & Interesting Readings

**We assign readings from the internet throughout the course:**

1. regular homework readings to PREPARE for active learning in the classroom
2. review or primary experimental papers from the literature related to lecture material to APPLY YOUR KNOWLEDGE to problems and new situations.

### 3.4 In class use of electronics

Some lessons require the use of internet-enabled devices to research information during classtime. We may also be using services such as GoogleDrive or OneDrive to collect class information in lessons or outside of class.

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## 4 Learning Outcomes

### 4.1 Course Learning Outcomes

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

1. The student will show a detailed understanding of cell membranes, cell surfaces, and associated structures by:
  - 1) Understanding the structures, functional roles and biogenesis pathways of the major components of the membrane - lipids, carbohydrates and proteins;
  - 2) Explaining the molecular basis of the biochemical behaviours of membranes, and showing how these behaviours in turn explain key aspects of cellular physiology;
  - 3) Understanding the experimental approaches and tools used to investigate membrane systems;
  - 4) Understanding the role of the membrane in transport and signal transduction;
  - 5) Understanding the organization and role of the cytoskeleton and extra-cellular matrix;

6) Use critical thinking to apply this knowledge to new problems & situations.

Students will also practice working in teams in the classroom to gather information and apply knowledge to new data in preparation for assessments.

## 5 Teaching and Learning Activities

### 5.1 Lecture

Topics:

Week	Monday	Wednesday	Friday
1	<p><b>1. Jan 8</b></p> <p><b>Roles of Biological Membranes</b></p> <p>Review- structure and function of biological membranes</p>	<p><b>2. Jan 10</b></p> <p><b>Membrane Lipids</b></p> <p>Types of membrane lipids</p> <p>Structures and properties</p>	<p><b>3. Jan 12</b></p> <p><b>Membrane Self-assembly</b></p> <p>Amphipathic properties and forces involved</p> <p>Thermodynamic considerations</p>
2	<p><b>4. Jan 15</b></p> <p><b>Phase Behaviour of Lipids</b></p> <p>Compression isotherms</p> <p>Permeability, elasticity, fluidity</p>	<p><b>5. Jan 17</b></p> <p><b>Membrane Domains</b></p> <p>Lipid rafts and role of cholesterol</p>	<p><b>6. Jan 19</b></p> <p><b>Membrane Composition</b></p> <p>Liquid composition as a biomarker</p> <p>Non-random distribution of lipids</p>
3	<p><b>7. Jan 22</b></p> <p><b>Membrane Proteins</b></p> <p>Membrane protein dynamics</p>	<p><b>8. Jan 24</b></p> <p><b>Membrane Proteins</b></p> <p>Purification and reconstitution</p>	<p><b>9. Jan 26</b></p> <p><b>Quiz 1</b></p>
4	<p><b>10. Jan 29</b></p> <p><b>Cytoskeleton</b></p> <p>Introduction-types; focus on actin</p> <p>Membrane corrals</p>	<p><b>11. Jan 31</b></p> <p><b>Cytoskeleton</b></p> <p>Membrane movement</p> <p>Actin as a motor</p>	<p><b>12. Feb 2</b></p> <p><b>Cytoskeleton</b></p> <p>Movement 2</p> <p>Motor proteins</p>

5	<b>13. Feb 5</b> <b>Biogenesis of Lipids</b> Cholesterol Biosynthesis	<b>14. Feb 7</b> <b>Biogenesis of Lipids</b> Phosphatidylcholine Biosynthesis	<b>15. Feb 9</b> <b>Biogenesis of Lipids</b> Lipid biosynthesis-related diseases
6	<b>16. Feb 12</b> <b>Trafficking of membrane Components</b>	<b>17. Feb 14</b> <b>Trafficking of membrane Components</b>	<b>18. Feb 16</b> <b>Float Day - review / snow day</b>
<b>Feb 19 – Feb 23 WINTER BREAK</b>			
7	<b>19. Feb 26</b> Structural Organization of Membrane Proteins	<b>20. Feb 28</b> <b>Quiz 2</b>	<b>21. March 1</b> Structural Organization of Membrane Proteins
8	<b>22. March 4</b> Structural Organization of Membrane Proteins	<b>23. March 6</b> Structural Organization of Membrane Proteins	<b>24. March 8</b> Protein Structure Topology
9	<b>25. March 11</b> Protein Structure Topology	<b>26. March 13</b> Cell Surface Oligosaccharides	<b>27. March 15</b> <b>Quiz 3</b>
10	<b>28. March 18</b> Cell Surface Oligosaccharides	<b>29. March 20</b> Cell Surface Oligosaccharides	<b>30. March 22</b> Transport Across Membranes - overview
11	<b>31. March 25</b> Channels and Pores	<b>32. March 27</b> Active Transport	<b>March 29</b> <b>Holiday</b>
12	<b>33. April 1</b> Membranes and Signalling	<b>34. April 3</b> Membranes and Signalling	<b>35. April 5</b> Membranes and Signalling
13	<b>36. April 8</b> catch-up/float day		

## 5.2 Active Learning

### Classes

Some of the topics will be explored through **active learning** techniques:

- where students review the content BEFORE class.
- IN CLASS, students analyze primary literature in groups
- students answer questions that apply the content reviewed to the research in groups.  
Answers are submitted to a Dropbox on CourseLink
- new groups are formed and another paper and set of questions are answered  
Answers are submitted to a Dropbox on CourseLink
- AFTER class, the answers to questions are reviewed by the instructor / TA to provide feedback to the students

The focus of this approach is to further develop **self-directed learning** (before class), **working in teams** (during class) and **preparation for assessment**, since the content and types of questions addressed in class are assessed on exams.

## 5.3 Feedback and Review

A variety of feedback and review activities may be used:

1. weekly feedback regarding concepts and check-ins with each other to determine challenging ideas and support each other
  2. in-class Kahoot! competitions.
  3. study questions pertaining to the material.
  4. the review sessions are an opportunity to discuss the topics to be examined in the class.
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## 6 Assessments

### 6.1 Marking Schemes & Distributions

Name	Scheme A (%)
In-Class Quiz 1	20
In-Class Quiz 2	20
In-Class Quiz 3	25
Final Examination (Cumulative)	35
Total	100

### 6.2 Assessment Details

#### In-Class Quiz 1 (20%)

**Date:** Fri, Jan 26, In class

**Content from lectures 1-8**

#### In-Class Quiz 2 (20%)

**Date:** Wed, Feb 28, In class

**Content from lectures 10-17**

#### In-Class Quiz 3 (25%)

**Date:** Fri, Mar 15, In class

**Content from lectures 19-25**

#### Final Examination (Cumulative) (35%)

**Date:** Mon, Apr 22, 8:30 AM - 10:30 AM

**Content from all classes and readings.**

### 6.3 Quizzes 1, 2, and 3

- A set of questions on material covered in a designated block of lectures. These will be written during a class period, and will be of 45 minutes duration and are **closed-book**. Students who foresee potential problems with any of the scheduled dates must contact the instructor as soon as possible.
- If quizzes are missed because of **illness or other valid reasons such as compassionate**



**considerations**, you must contact the instructor within 3 (three) business days to arrange an alternate quiz.

- Since this is a face-to-face class and quizzes are scheduled for classtime, students are expected to be present for class and assessments. Please note that travel plans scheduled for before or after Reading Week are NOT considered valid reasons to miss class or quizzes.
- **Quizzes missed for no valid reason will result in a grade of zero.**

## 6.4 Final Examination

Short answer questions, essay questions, multiple-choice questions, and problems dealing with the entire semester's material. **The College of Biological Science policy stipulates that all students must write the final exam at this time.** Students who are unable to write the final exam at the scheduled time because of conflicts, or for other valid reasons, should contact their Academic Counsellor, and request a deferred final examination.

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# 7 Course Statements

## 7.1 Recording of Classes

Recordings of classes are solely for the use of the authorized student, and may not be **reproduced, edited** in whole or part, or **transmitted** to others, without the express written consent of the instructor.

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.

## 7.2 Academic Integrity

Academic misconduct limits learning and disadvantages honest students.

- For University policy on academic misconduct and penalties see: <https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>
- For a better understanding of academic integrity see tutorials at: <https://academicintegrity.uoguelph.ca/> and <https://academicintegrity.uoguelph.ca/plagiarism>

### 7.3 Faculty Evaluation

As part of the faculty evaluation process, written comments on the teaching performance of the lecturer may be sent at any time to Dr. Cezar Khursigara, Chair, Department of Molecular and Cellular Biology. Such letters must be signed; a copy is made available to the instructor after submission of final grades.

### 7.4 Viewing Final Examinations

The University regulations for viewing a final examination within the appropriate timeframe are listed in the Undergraduate

Calendar: <https://www.uoguelph.ca/registrar/calendars/undergraduate/current/>

Permission must be requested from the Department Chair at [mcbchair@uoguelph.ca](mailto:mcbchair@uoguelph.ca).

## 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).

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