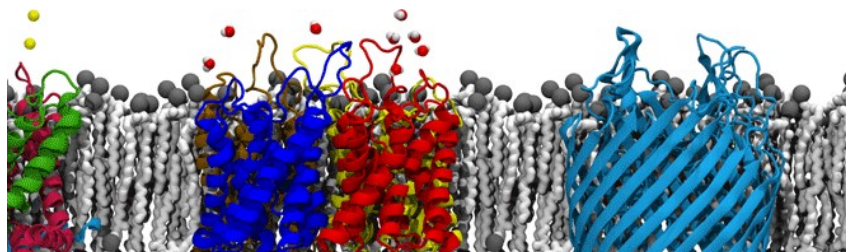# Biochemistry II   CHEM 3812
Membranes and Metabolism

[Winter 2021]

Instructor   Dr. Michael Swanson
Contact info: email: mike.swanson@du.edu
Class Lectures: Online:https://www.youtube.com/channel/UCIpa3lmMNlCBp5ULDckuHtQ/videos
Class Meetings: T,Th 8-9:30a; Zoom: https://udenver.zoom.us/j/4915625194

At some point in the history of Earth, molecules which were water-soluble on one side and insoluble on the opposite side were formed. Due to very weak hydrophobic interactions, these types of molecules self assemble into spherical bilayers. Simple bilayers were adopted early in the evolution of life and have evolved to the cellular membranes present in every cell today. Membranes are an integral part of living organisms which keep complex molecules from dispersing into the outside environment. An essential property of biological membranes is that they are selectively permeable, allowing certain molecules in/out of the cell while restricting the movement of others. Complex organisms have membrane-bound organelles inside the cell which segregate important chemical reactions, such as oxidative phosphorylation. How does composition affect membrane properties? How are membranes selectively permeable? How do cells of multi-cellular organisms communicate with each other? How is metabolism regulated?   These questions, and many others can be answered by investigating the interactions between proteins and membranes which is the major theme for this class.

COURSE OBJECTIVES
Some of the important concepts we will be covering in this class:

- The constituents of biological membranes and model membranes
- How proteins interact with membranes
- How molecules are transported across membranes
- Signal transduction via membrane receptor proteins
- Glycolysis, gluconeogenesis and regulation
- The reactions of the Krebs cycle (citric acid cycle)
- Mitochondrial electron transport and ATP synthesis (Chemiosmotic Theory)

REQUIRED COURSE ITEMS

Textbook: Lehninger Principles of Biochemistry, 6th (5th or 4th) Edition, Nelson and Cox, Freeman and Company, 2008

Calculator: An inexpensive calculator that has the capabilities for square roots, logarithms, and (exponential) scientific notation operations. The calculator will be used for homework, quizzes, and exams.

READING.   Assigned reading is listed in the tentative lecture schedule below. Reading should be completed prior to class. Important concepts from readings will be highlighted during lectures. Several special topics that are not in the text book will be covered during the quarter. Supplemental resources will be provided before these special topics are covered.

LECTURES. Recorded lectures are available through the class YouTube channel (Link below and also on class Canvas page):
https://www.youtube.com/channel/UClpa3lmMNlCBp5ULDckuHtQ/videos
There will be a lecture that corresponds to each assigned reading detailed below in the class schedule. There are many sources of biochemistry lectures online which you may also use (I really like Kevin Ahern from Oregon State on YouTube). You can choose to watch lectures from another source instead, however, keep in mind that they might cover slightly different material from our class. Also be aware that our class lectures contain practice problems which might be similar to exam questions.

CLASS MEETINGS. This class follows a hybridized learning model. Instead of a traditional lecture, class meetings will be used as group office hours. Questions concerning material from the reading or lectures can be asked during this time. Students can also spend this time working through homework problems and can ask questions if they run into problems. I might briefly highlight some material from the reading/lecture that I feel is important at the beginning of these meetings but, in general, I will not have any formal presentation planed. What we discuss during this time will be driven by the students. For maximum benefit, reading and/or lectures should be completed before class meeting times. *Attendance at these meetings is not required (except for the days when we have an in-class activity planned, see schedule below).* **The class meeting Zoom address can be found on Canvas under the "Zoom" tab on the left side of the page (my personal meeting link).**

IN-CLASS ACTIVITIES. There will be 3 in-class activities throughout the quarter. Class periods on these days will consist of a short introductory lecture followed by work to complete the activity. You will be assigned to breakout rooms to complete these in groups. These activities will be worth 20 points each and be largely participation based. **MATERIAL COVERED IN THESE ACTIVITIES MAY BE ON THE EXAMS.**

HOMEWORK. Practicing problems is very helpful in the mastery of chemical/biochemical concepts. Therefore, homework problems will be assigned throughout the quarter. Problems will be assigned primarily from the end of chapter questions in the text. These homework problems are voluntary and will not be graded**.** An initial list of homework problems is given below.

EXAMS. There will be two (2) one-hour exams given during the quarter and a two-hour, cumulative final exam. Dates for these exams are posted below on the lecture schedule. **NO MAKE-UP EXAMS WILL BE ACCEPTED**. There is one exception to this policy. If you will be out of town for a University sanctioned function (e.g., athletic team or music group), you are responsible for making arrangements with Dr. Swanson at least <u>one week in advance</u> to complete the exam prior to the scheduled date.

GRADES. Final grades will be determined according to relative positions and overall class performance. There will be a maximum of 550 points (600 for graduate students) for the course:

Component	Points
Hour Exams (100 points each)	200
Final Exam	200
In-Class Activities (20 points each)	60
Total Points	**460**

LECTURE AND TESTING ACCOMODATIONS. Every effort will be made, in complete confidence, to accommodate students diagnosed with a learning disability. Any student requiring these accommodations should inform Dr. Swanson the first week of class. For further information, please see DU's Disability Services' website at http://www.du.edu/disability/dsp/index.html.

ACADEMIC DISHONESTY. Collaborative learning and teamwork are very important parts of science but cheating of any kind will not be tolerated. **Copying on exams (as *well as any behavior that could be interpreted as copying*) will result in no credit being given on the exam.** Repeated offences will result in failure of the course and possible expulsion from the University. Please refer to the University's honor code: http://www.du.edu/ccs/honorcode.html.

CLASS SCHEDULE (RECORDED LECTURES, EXAMS, IN-CLASS ACTIVITIES, AMINO ACID QUIZ)

Date	Topic	Reading
Week 1: LIPIDS		
1/12/2021	Course Introduction	Syllabus
1/14/2021	**1** – Lipid Structure and Function	Chapter 10
Week 2: MEMBRANES AND TRANSPORT		
1/19/2021	**2** – Membranes	Chapter 11
1/21/2021	**IN-CLASS ACTIVITY 1: HYDROPATHY PLOTS**	Worksheet
Week 3: SIGNALING		
1/26/2021	**3** – Signal Transduction, G Protein Receptors, Sight	12.1, 12.2, 12.10
1/28/2021	**4** – Gated Ion Channels and Receptor Tyrosine Kinases	12.6, 12.3, 12.11
Week 4: EXAM 1 AND SUGARS		
2/2/2021	**EXAM 1**	12.6, 12.3, 12.11
2/4/2021	**5** – Mono and Disaccharides	7.1
Week 5: CARBOHYDRATES AND ENERGETICS		
2/9/2021	**6** – Polysaccharides and Glycoconjugates	7.2, 7.3
2/11/2021	**7** – General Bioenergetics	Chapter 13
Week 6: GLYCOLYSIS		
2/16/2021	**8** – Glycolysis	14.1-14.2
2/18/2021	**9** – Fermentation and Gluconeogenesis	14.3-14.5
Week 7: METABOLIC REGULATION		
2/23/2021	**IN-CLASS ACTIVITY 2: AFRICAN SLEEPING SICKNESS**	Worksheet
2/25/2021	**10** – Regulation of Glycolysis	15.1-15.3
Week 8: EXAM 2 AND THE CITRIC ACID CYCLE		
3/2/2021	**EXAM 2**	
3/4/2021	**11** – PDH and the Citric Acid Cycle	16.1-16.3
Week 9: OXIDATIVE PHOSPHORYLATION		
3/9/2021	**IN-CLASS ACTIVITY 3: MITOCHONDRIAL ANSCESTOR**	19.1-19.3
3/11/2021	**12** – Electron Transport Chain and ATP Synthesis	19.4, 19.5
Week 10: FINAL EXAM (Date TBD)		
3/16/2021		
3/18/2021		

HOMEWORK

CHAPTER	PROBLEM NUMBERS*
10	1, 2, 3, 7, 8, 9, 10, 11, 12, 17, 19
11	3, 4, 6, 8, 10, 11, 12, 13, 14, 15, 19, 22, 23 (Bonus: 5, 7, 16, 25)
12	2, 3, 4, 5, 9, 10, 11, 13, 15 (a. use only K^+), 16, 20, 25 (Bonus: 18, 22, 23)
7	1, 2, 4, 6, 8, 9, 10, 13, 14, 16, 17, 23, 26 (Bonus: 19, 20, 22, 24)
13	2, 3, 4, 9, 14, 15, 19, 20, 23a, 26
14	1, 2, 5, 6, 9, 10, 11, 12, 13, 15a, 19, 20, 21, 22, 25, 26, 30
15	1, 3, 4, 5, 16b, c, d, f (might be interested in 11, 12, 13)
16	1-12, 14, 18, 25, 26, 28, 30, 31, 34
19	1-5, 8, 9, 11-15, 16a, b, d, e, 19-21, 23

*Problem numbers are from 6th edition of the text.