Biochemistry II CHEM 3812
Membranes and Metabolism

[Winter 2017]

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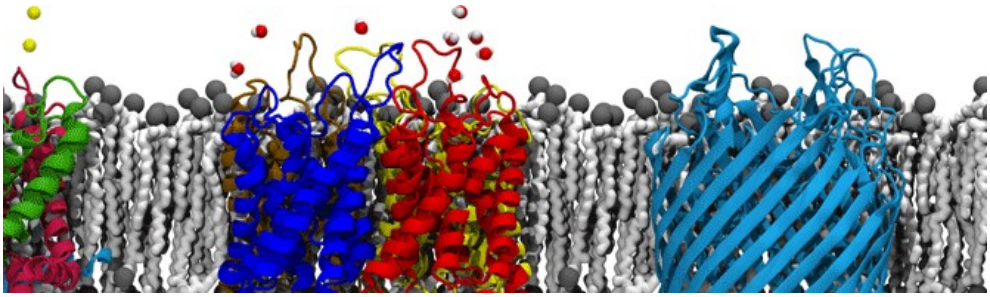
Class Lectures: MWF 11:00 – 11:50; Strum 186
Office Hours: Before or after class by appointment (MWF: 10:30 – 11a, 12 – 12:30p)



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 mixtures of 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 phosphoryaltion. 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 (5^{th} or 4^{th}) 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.

IN-CLASS ACTIVITIES. There will be 5 in-class activities throughout the quarter. Class periods on these days will consist of a short introductory lecture followed by small group work to complete the activity. These activities will be worth 10 points each and be largely participation based. **MATERIAL COVERED IN THESE ACTIVITIES MAY BE ON THE EXAMS.**

GRADUATE STUDENT ACIVITY LEADERS. *Each in-class activity will be led by a pair of graduate students. The pair will give a brief lecture/introduction regarding the activity. During the activity, the pair of graduate students and the instructor will be interacting with the small groups to ensure everything is going smoothly. Graduate students will receive a score (out of 50) based on their overall effectiveness as activity leader.*

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**.** The 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 one week in advance 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 (150 points each)		300
Final Exam		200
In-Class Activities (10 points each)		50
Activity Lead (Grad Students Only)		*50*
Total Points	**Undergraduate**	**550**
	Graduate	**600**

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.

LECTURE SCHEDULE (EXAMS, SPECIAL TOPICS, IN-CLASS ACTIVITIES)

DATE	TOPIC	READING
WEEK 1 – LIPIDS, FATTY ACIDS AND MEMBRANES		
Jan 4	Class Introduction / Lipids	10.1
6	Fatty Acids and Biological Membranes	10.2, 10.3, 11.1
WEEK 2 – Protein-Membrane Interactions		
9	Membrane Proteins and Transport	11.2, 11.3
11	**Hydropathy Plots, Membrane Protein Prediction**	
13	**Model Membranes, Nanodiscs and AMPs**	Handout
WEEK 3 – Biosignaling		
16	**Martin Luther King Holiday**	
18	Signal Transduction, G Protein Receptors, Sight	12.1, 12.2, 12.10
20	**Mitochondrial Protein Transport**	
WEEK 4 - Carbohydrates		
23	Gated Ion Channels and Receptor Tyrosine Kinases	12.6, 12.3, 12.11
25	**EXAM 1**	
27	Mono and Disaccharides	7.1
WEEK 5 – Intro to Bioenergetics/Glycolysis		
30	Polysaccharides and Glycoconjugates	7.2, 7.3
Feb 1	General Bioenergetics	13
3	Glycolysis	14.1
WEEK 6 – Glycolysis Continued		
6	Glycolysis continued and Feeder Pathways	14.2
8	Fermentation and **Biofuels**	14.3, Handout
10	**African Sleeping Sickness and 3rd World Drugs**	

WEEK 7 – Metabolic Regulation

13	Gluconeogenesis and the Pentosephosphate Pathway	14.4, 14.5
15	Metabolic Regulation	15.1, 15.2
17	Regulation of Glycolysis	15.3

WEEK 8 – The Citric Acid Cycle

20	**EXAM 2**	
22	Acetyl-CoA, PDH and the Citric Acid Cycle	16.1
24	Reactions of the Citric Acid Cycle continued	16.2

WEEK 9 – Oxidative Phosphorylation

27	Regulation of the Citric Acid Cycle	16.3
Mar 1	Electron-Transfer (Complex I, II, III and IV)	19.1
3	ATP Synthesis (Complex V) and Regulation of the ETC	19.2, 19.3

WEEK 10 – Metabolism of Glycine, Lipoate, Iron-Sulfur Clusters and Fatty Acids

6	P-450, Apoptosis and Mitochondrial Genes	19.4, 19.5
8	**Mitochondrial Ancestor Prediction**	
10	**Glycine, Lipoate, Fe-S and Fatty acid Metabolism**	Handout

WEEK 11 – Overflow, Final Exam

13	Last day of classes. Overflow. Extra office hours?
Mar 16	**FINAL EXAM**: **10AM to 11:50AM** (Cumulative)

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.