Principles of Biochemistry
Chemistry 5700, Fall 2015

M W F, 10:30-11:20 AM, ESLC-046

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Office Hours: Dr. Dickenson: Mon 2-3, Wed 3-4, and Thursday 3-4pm and other times by appointment.
Jordan Wilkes: Mon and Wed 1:30-2:30pm.
Jamie Kingsford: Tues and Thurs 10:30-11:30

Text: The listed course text is "Lehninger Principles of Biochemistry", Nelson and Cox, 6th ed. The previous (5^{th}) edition will work just fine if you can get a copy. You may have to cross reference the recommended problem sets if you use the 5^{th} edition.

Undergraduate Teaching Fellows: Jamie Kingsford and Jordan Wilkes are the designated undergraduate teaching fellows (UTFs) for this course. They have both taken Chem 5700 recently and performed exceptionally well. They will each have designated duties including attendance of lectures, help with course organization and grading, and they will hold office hours (location/times to be posted on Canvas). Jamie and Jordan are valuable resources for this course that I encourage you to take advantage of and I expect that they be treated with the same respect that you extend to me.

Lecture Overheads Canvas: I will be using Canvas for the management of Chem 5700. Copies of my lecture overheads will be posted on Canvas (https://online.usu.edu/). I strongly recommend that you print the lecture notes BEFORE coming to class and this will be very useful to take notes during the lectures as well.

Prerequisites: A full year of organic chemistry (Chem 2310-2320, or equivalent)

Course Withdrawal: Refer to the current academic year registration calendar for details and deadlines concerning withdrawal conditions and deadlines.

Provisions: The administration of Chem 5700 will adhere strictly to the academic policies outlined in the most recent USU General Catalog, which can be found here: http://catalog.usu.edu/index.php
Per instructions from the Dean's office, no assignments will be accepted or graded from students not formally enrolled in the course. Students not enrolled in the course may sit in only with instructor approval.

Learning goals and Objectives:

Students successfully completing Chem5700 should be able to:

- explain and apply the core concepts underlying the theory of evolution, including the process of natural selection and its molecular basis, and evidence supporting the theory of evolution.

- explain and apply core concepts of matter and energy transformation, including thermodynamics, catalysis, the coupling of exergonic and endergonic processes, and the nature of biological energy.

- explain and apply core concepts of underlying homeostasis, including the need for biological balance, linked steady state processes, quantification of homeostasis, the organization of chemical processes, and control mechanisms.

- explain and apply core concepts of biological information, including the genome, the manner in which the information it contains is encoded and translated, and the mechanisms by which it is transmitted and maintained across generations.

- explain and apply core concepts of macromolecular structure and function, including the nature of biological macromolecules, their interaction with water, the relationship between structure and function, and frequently-encountered mechanisms for regulating their function.

- understand the process of science, including hypothesis generation, experimental design, quantitative analysis, and data interpretation.

Critical Thinking Problem sets:

Critical thinking and creative problem solving are invaluable skills for scientists of all fields, including Biochemistry. Chem 5700 is an upper division course designed to arm you with the knowledge necessary to address technically challenging problems. Over the course of the semester we will work several in class critical thinking problem sets as practice and you will have 2 take home problem sets each worth 25 points. The goal of these assignments is to promote problem solving that requires you to put together what you have learned in order to effectively address a problem that you have not been directly exposed to previously. Much of what you need to answer them will come from lecture and the provided materials, however, it is most likely that you will also have to search online databases and read primary literature, etc. to complete the projects. The time/date that the assignments will be due will vary based on the difficulty of the assignment, but will be communicated prior to assigning the problem set. Late assignments will be deducted 10 points per day.

Canvas critical thinking short problem sets:

These will be much like the problem sets described above but will be administered via Canvas and will be a single question requiring a short answer to complete. Five will be administered over the course of the semester and each will be worth 5 points.

In-class work:

To help guide and evaluate in-class discussion and participation, I will on occasion provide worksheets or other materials to be completed during class. The main goal of these assignments is to engage the students in critically

thinking about the topics being discussed. These assignments will be collected during class and cannot be made up or turned in late. So, while attendance is not mandatory, you must be present to have access to these worksheets. In the event of an "excused absence" you must notify the instructor prior to the absence and arrangements will be made. The total points for all of these in-class assignments will be 25 points and will not be tallied until the end of the semester.

Quizzes: Quizzes will cover material presented in the previous week's lecture **OR** in the reading material. The quizzes are to be taken on-line using Canvas. The quizzes are open book/open note but MUST be worked individually. The intent of the quizzes is to keep you on top of the course material- i.e. not waiting until exam time to cram. You will have 30 minutes to complete the quiz once it is initiated. A total of 11 quizzes worth 10 points each will be given during the semester. Each student will be allowed to drop the lowest one graded quiz. Quizzes will be due by 8AM MST the Monday after they are administered. You are allowed to drop your lowest quiz grade and for this reason, I will not re-open a quiz after the cutoff time under any circumstance.

Exams: Three hourly exams (100 points each) will be given during class on the dates indicated on the course schedule. The comprehensive final exam will be worth 150 points. The first three exams will consist primarily of short answer, essay, and problem solving similar to the exams given in previous years. The comprehensive final exam will be primarily multiple choice and matching format, similar to the online quizzes. I strongly encourage you to work the past years exams as part of your exam preparation. Make-up exams will **only** be

allowed for students that can demonstrate a documented birth or death in the family or a documented illness or presence at a scientific conference or interview. Family vacations do **NOT** qualify as a reasonable excuse**.**

Recommended Problem sets: Recommended problem sets from the text book will be provided periodically for the students. Participation is 100% voluntary and the problems will not be graded.

Course Assessment: Students in this class are expected to develop proficiency in the principles listed on the class schedule and the attached "Learning Objectives" list. Questions provided on midterms, quizzes, and your analysis of the problem sets will be used to assess your understanding of these principles. The formats to be used for assessment will include instructor-designed questions (essay, short answer, problem solving, multiple choice) and will cover material that is expected to be mastered by students taking the first semester of a two semester upper division biochemistry class. Please note that assessment is a tool used by the Department of Chemistry and Biochemistry to improve the quality of instruction and proficiency of our students. Your grade will be based on your performance on the assignments indicated above, some of which will be used for course assessment.

Grading:

Canvas critical thinking short problem sets	25 points
Critical Thinking Problem Sets	50 points
In-class critical thinking worksheets	25 points
On-line quizzes (1, drop lowest)	100 points
Three hourly exams	300 points
Comprehensive Final exam	150 points
Total	**650 points**

In terms of final assignment of grades, you are guaranteed the following grades if your final class percentage lies within the indicated ranges.

100-90% A through A-	89.9-78% B+ though B-
77.9-68% C+ through C-	67.9-59% D+ through D-

Based on the overall class average at the END of the semester, the percentage cutoffs may be adjusted to be lower than those above at the instructor's discretion. They will never, however, shift higher.

Students with ADA-documented physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations. Veterans may also be eligible for services. All accommodations are coordinated through the Disability Resource Center (DRC) in Room 101 of the University Inn, (435)797-2444. Please contact the DRC as early in the semester as possible. Alternate format materials (Braille, large print, digital, or audio) are available with advance notice.

Tentative Class schedule (Subject to change)

Day	Date	Lecture	Topic	Chapter, Lehninger (6th ED)	Quiz
M	8/31	1	Introduction to the course	1	**#1** Due 9/9
W	9/2	2	Water: properties, ionization, hydrophobic effects	2	
F	9/4	3	Amino acids, peptides, and proteins	3	
M	9/7		Labor Day (No Class)		
W	9/9	4	Protein Structure	3	**#2** Due 9/21
F	9/11	5	Protein Structural Tools	3	
M	9/14	6	Protein 2˚ Structure	4	
W	9/16	7	Protein 3˚ and 4˚ Structure	4	
F	9/18	8	Protein Structure Determination, Folding and Prion Diseases	4	**#3** Due 9/28
M	9/21	9	Protein function: ligand binding; allostery; regulation	5	
W	**9/23**		**In Class Critical Thinking Set #1**		
F	9/25	10	Protein function: molecular motors	5	
M	**9/28**		**Exam 1 in class: covers Lectures 1-10**		
W	9/30	11	Enzyme Function	6	**#4** Due 10/5
F	10/2	12	Enzyme Kinetics - I	6	
M	10/5	13	Enzyme Kinetics - II	6	**#5** Due 10/12
W	10/7	14	Regulatory Enzymes	6	
F	10/9	15	Carbohydrates	7	
M	10/12	16	Polysaccharides	7	**#6** Due 10/19
W	10/14	17	Nucleic Acids: DNA	8	
R	10/15	18	Nucleic Acids: RNA *Note Thursday Class	8	
F	10/16		No Class Fall Break (Meet Thursday)		

M	**10/19**		**Critical Thinking Problem Set #2**		
W	10/21	19	Lipids	10	**#7** Due 10/26
F	10/23	20	Lipids and Metabolism	10	
M	**10/26**		**Exam 2 in class: covers Lectures 11-20**		
W	10/28	21	Biological Membranes	11	**#8** Due 11/9
F	10/30	22	Membrane Transport – Ion Channels	11	
M	11/2	23	Bioenergetics - I	13	
W	11/4	24	Bioenergetics - II	13	
F	11/6	25	Glycolysis	14	**#9** Due 11/16
M	11/9	26	Metabolic Disorders	14	
W	11/11	27	Metabolic Regulation - I	15	
F	11/13	28	Metabolic Regulation - II	15	**#10** Due 11/23
M	**11/16**		**Critical Thinking Problem Set #3**		
W	11/18	29	Citric Acid Cycle	16	
F	11/20	30	Citric Acid Cycle and Physiology	16	
M	11/23		**Exam 3 in class: covers lectures 21-30**		
W	11/25		Thanksgiving Break No Class		
F	11/27		Thanksgiving Break No Class		
M	11/30	31	Fatty Acids	17	**#11** Due 12/7
W	12/2	32	Nitrogen Excretion	18	
F	12/4	33	Urea Cycle	18	
M	12/7	34	Amino Acid Oxidation	18	
W	12/9	35	Mitochondrial electron transfer and oxidative phosphorylation	19	
F	12/11	36	Mitochondrial electron transfer and oxidative phosphorylation (Cont)	19	
F	12/18		**Final Exam(All Lectures) 9:30-11:20AM ESLC 046**		

EXPECTATIONS

This is a 5000 level class and I thoroughly expect you not just to memorize the information, but be able to interpret and apply it to specific tasks that will be presented to you throughout the course (research problem sets). At the end of the course, my expectation is that you are aware of the connection between the subject material to your everyday lives.

YOUR RESPONSIBILITIES

Come to Class Prepared

a) Download notes and look them over BEFORE class
b) Be punctual, attend all classes, and finish the quizzes/problem sets on time.
c) Read all the assigned material in the book and any additional information/papers handed to you.
d) Think about the material learnt and apply it to real-life scenarios. This would be a perfect way to study for your exams.

MY JOBS

Come to Class Prepared

a) Be precise and systematic with presentation of the lecture material.
b) Be clear and fair about expectations.
c) Provide you with ample material to best understand the concept being taught.
d) Enable you to critically think and apply the concepts.

OBJECTIVES

In planning this course, I have identified three main course objectives:
1. Gaining factual knowledge (terminology, classifications, methods, trends)
2. Learning fundamental principles, generalizations, or theories
3. Learning to apply course materials (to improve rational thinking, problem solving and decisions)

Below is a list of examples of how these objectives apply to material throughout the semester:

A. Teach the fundamentals of biochemistry including the connection between chemistry, math, and biology and how it pertains to a quantitative description of life. Present the information about the building blocks of life - protein, DNA, RNA. Teach the students how these molecules are synthesized, regulated, and specifically highlight how these processes are interconnected **(1,2,3).**

B. Describe the concept of enzymes; including how they are made, how they function and the biological and biophysical processes that define their activity and function. Help the students connect the dots between how mutations in the DNA lead to defective enzymes and their disease phenotypes **(1,2,3).**

C. Describe to students the connection between how the findings were uncovered, what is their historical context and where they encounter such information in their lives (diagnostic tests, etc.). **(1,2,3).**

D. Teach how humans makes and use energy. What are the by-products of energy metabolism and how does the body secrete the waste. **(1,2,3).**