



# CHEM 855 –Biochemistry for HS Teachers

## SYLLABUS

- Instructor:** Frank A. Kovacs
- Email:** kovacsfa@unk.edu - Email checked each morning 8-9 am (M-F)
- Phone:** 308-865-8384
- Class Dates:** May 7 - June 29, 2012
- Text:** *Lehninger Principles of Biochemistry*, 4<sup>th</sup> or 5<sup>th</sup> ed. (Nelson and Cox, *4th Ed ISBN-13: 9780716743392, 5th Ed ISBN-13: 9780716771081*)
- Online homework:** [www.saplinglearning.com](http://www.saplinglearning.com)
- Lectures:** Lecture videos highlighting important topics for each chapter will be posted for each week.
- Problem videos:** I will post a few short videos of how to work certain kinds of problems that may be found on the quizzes and exams. I am willing to post additional problem examples upon request but keep in mind there could be at least a 2 day period before the requested extra problems will get posted.
- Chapter objectives:** I will post a list of objectives for each of the chapters covered in this course.

### Course Description

Biochemistry is the study of the chemistry of living organisms. This chemistry is water based and involves biopolymers like proteins and nucleic acids (DNA and RNA) and other biologically relevant molecules like lipids, carbohydrates, hormones, and vitamins. This course begins with a review of the foundations of biochemistry and the chemistry of water. It then moves on to address various aspects of the structure, function and metabolism of the range of biomolecules mentioned above. The course closes with a discussion of the basics of metabolism and metabolic pathways.

### Course objectives summary

- Upon completion of this course, students should have a basic understanding of:
1. Structure and function of basic biomolecules like proteins, nucleic acids, carbohydrates, etc. and their locations in cells.
  2. How biological information is stored and transmitted.
  3. Acid/base chemistry of water its effect on biomolecular structure and function.
  4. Enzyme function and mechanisms.
  5. Structure and function of lipids.

6. Structure and function of biological membranes.
7. The breakdown of glucose metabolism to produce ATP as an example of how metabolism works.

## Grading Policy

Your grade will be based on the number of accumulated points as a percentage of the total possible number of points according to the distribution given below:

Quizzes	5 at 12 pts ea.	60
Biochemistry in the News	8 at 5 pts ea.	40
Discussion board assignments		
Online Homework	8 at 10 pts ea	80
Lesson Plan		100
Exams	3 exams - 150 points ea.	450
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Total		730

**Grading** - Grades will be assigned using the following grading scale: A (93-100%), A- (90-92%), B+ (88-89%), B (83-87%), B- (80-82%), C+ (78-79%), C (73-77%), C- (70-72%), D+ (68-69%), D (63-67%), D- (60-62%), and F (below 60%).

**Exams** - The exams will be given in 2 parts.

- **Part 1 (100 pts)** will be given on Blackboard and will be true/false, multiple-choice, and matching (40 questions). These will be timed exams and you will have exactly 60 minutes to complete it (exam will be set to auto-submit).
- **Part 2 (50 points)** will be a “Take Home” Word document for you to download, complete and email back to me by the end of the day on the due date (points will be taken off at a rate of 25% for each day (24 hour period) late)

A **Quiz** will be posted for each week covering the chapters for that week via Blackboard. There will be no quiz for the week of the exam. They will be available at the beginning of the week and closed by the end of the day on Friday of that week.

**Biochemistry in the News Discussion Board assignments** will be to post a “Biochemistry in the News” item each week for discussion by the class. Additionally, you will be required to post comments on at least two other “News” posts by fellow students.

**Original Lesson Plan Assignment** (100 points)- At the graduate level, one must develop the ability to create original instructional material from existing knowledge. As a term project, you are required to write an “original” 3-5 day lesson plan that introduces and/or reinforces one or more concepts from the covered material. Your write-up should include a lesson plan summary in the format that you would turn in to your principal or department head, detailed outlines (with full explanations of any example problems) of any lectures, full descriptions and “teacher notes” for any demonstrations, and complete handouts for any lab experiments (include a background section, procedural instructions for students, additional notes for teachers, and information on chemical hazards, safety, and storage considerations), homework assignments, and quizzes. A one-page topic proposal and plan outline must be submitted by

Friday, June 1<sup>st</sup>. Within a week, the instructor will evaluate the outline and return it with suggestions for the full assignment.

**Online Homework** will be administered through Sapling Learning. As a part of this class, you will need to buy a one-semester subscription to this service for \$29.99. To sign up use the following instructions:

1. Go to <http://saplinglearning.com>
2.
  - a. If you already have a Sapling Learning account, log in, click "View Available Courses", then skip to **step 3**.
  - b. If you have Facebook account, you can use it to quickly create a SaplingLearning account. Click "create account" located under the username box, then click "Login with Facebook". The form will auto-fill with information from your Facebook account (you may need to log into Facebook in the popup window first). Choose a password and time zone, accept the site policy agreement, and click "Create my new account". You can then skip to step 3.
  - c. Otherwise, click "create account" located under the username box. Supply the requested information and click "Create my new account". Check your email (and spam filter) for a message from Sapling Learning and click on the link provided in that email.
3. Find your course in the list (listed by school, course, and instructor) and click the link.
4. Select your payment options and follow the remaining instructions.
5. Once you have registered and enrolled, you can log in at any time to complete or review your homework assignments.
6. During sign up - and throughout the term - if you have any technical problems or grading issues, send an email to [support@saplinglearning.com](mailto:support@saplinglearning.com) explaining the issue. The Sapling support team is almost always more able (and faster) to resolve issues than your instructor.

## Course Policies

**Policy on plagiarism:** Anyone caught plagiarizing any exercise will receive a 0 for that exercise; subsequent violations will result in referral to the Vice Chancellor for Academic Affairs for dismissal from the university.

**Policy on incomplete:** To be considered for an incomplete in Chemistry 855:

1. You must submit the reasons you cannot complete the scheduled work. This must include a copy of your class schedule and description of your responsibilities outside the classroom. This should be done in writing and include confirmation from your employer or doctor when appropriate.
2. You must specify the assignments you have missed and a schedule of plans to complete them.
3. You must submit a copy of the above information to the Chair of the Department of Chemistry and the Dean of Natural and Social Sciences.
4. Upon completion of items 1-3, your request for an incomplete will be considered.

I expect all students to progress through the requirements for CHEM 855 in a timely fashion. Unless your circumstance is quite remarkable, do not consider an incomplete.

**Tests and quizzes** will not be rescheduled without valid reason.

## Students with Disabilities

The university is committed to providing support for students with disabilities. If you are a student with physical, learning, emotional, or psychological disabilities you are encouraged to stop by room 163 in the Memorial Student Affairs Building, the Academic Success Office and make an appointment at 308-865-8214. If you have an accommodation plan please see me as soon as possible, so we can make any arrangements necessary for your learning. No accommodations can be provided until a Reasonable Accommodation Plan is in place. Please remember, plans are not retroactive and cannot be used for assignments prior to the date of my signature. To the greatest extent possible, University Representatives, shall observe confidentiality with respect to any request for accommodation.

## Course Schedule

Week Starting on:	Week #	Exams and Due Dates	Chapters to be Covered
May 7	1	<ul style="list-style-type: none"> <li>• <i>Biochemistry in the News</i> Posting</li> <li>• Quiz 1 - due by Friday</li> </ul>	Chap 1 - Foundations Chap 2 – Water
14	2	<ul style="list-style-type: none"> <li>• <i>Biochemistry in the News</i> Posting</li> <li>• Quiz 2</li> </ul>	Chap 3 - Amino Acids Chap 4 –3D Structure Proteins
21	3	<ul style="list-style-type: none"> <li>• <i>Biochemistry in the News</i> Posting</li> <li>• Exam 1 (covers Ch 1-6)</li> </ul>	Chap 5 –Protein Function: O <sub>2</sub> Binding Proteins Chap 6 – Enzymes
28	4	<ul style="list-style-type: none"> <li>• <i>Biochemistry in the News</i> Posting</li> <li>• Quiz 3</li> <li>• Lesson Plan Topic Proposal due Friday</li> </ul>	Chap 7 - Carbohydrates
June 4	5	<ul style="list-style-type: none"> <li>• <i>Biochemistry in the News</i> Posting</li> <li>• Quiz 4</li> </ul>	Chap 8 – Nucleotides and Nucleic Acids
11	6	<ul style="list-style-type: none"> <li>• <i>Biochemistry in the News</i> Posting</li> <li>• Quiz 11 and 12</li> <li>• Exam 2 (covers Ch 7, 8, 10 and 11)</li> </ul>	Chap 10 – Lipids Chap 11 – Biological Membranes
18	7	<ul style="list-style-type: none"> <li>• <i>Biochemistry in the News</i> Posting</li> <li>• Quiz 5</li> </ul>	Chap 13 – Bioenergetics Chap 14 – Glycolysis
25	8	<ul style="list-style-type: none"> <li>• <i>Biochemistry in the News</i> Posting</li> <li>• Lesson Plan Project Due</li> <li>• Exam 3 (13, 14, 16 and 19)</li> </ul>	Chap 16 – Citric Acid Cycle Chap 19 – Oxidative Phosphorylation

# Week One Topics

*For week one of this course you should know or understand the following:*

## **Chapter 1 – Foundations**

1. General definition of biochemistry
2. Distinguishing features of living organisms
3. Basic differences between prokaryotes and eukaryotes.
4. Cellular organelles and their function.
5. How differential and isopycnic centrifugation are used to isolate organelles
6. The 3 main types of biopolymers and their general functions.
7. Four levels of molecular organization of a cell.
8. The 6 main elements in living organisms.
9. Be able to identify functional groups involved in biochemistry
10. Difference between configuration and conformation in molecular structure.
11. The relationship between free energy and spontaneity of a reaction.
12. General chemical reactions describing energy capture and release.
13. Concept of energetic coupling of chemical reactions.
14. Enzyme influence on chemical reaction.
15. Difference between kinetic stability and thermodynamic stability
16. Basic flow of biological information.
17. Why knowing an organism's genome does not tell us how the organism will look.
18. Be able to solve problems with unit conversions.
19. Biochemical terms:
  - Central Dogma
  - dalton
  - lipids
  - amphipathic
  - *in vivo*
  - *in vitro*
  - photosynthesis
  - metabolism
  - bioenergetics
  - thermodynamics
  - free energy, enthalpy and entropy
  - endothermic and exothermic
  - endergonic and exergonic
  - DNA, RNA
  - chirality, stereoisomers, enantiomers and diastereomers
  - genome, proteome

## **Chapter 2 – Water**

1. Why water is polar.
2. Characteristics of hydrogen bonds.
3. Significance of specific heat and heat of vaporization of water.

4. How hydrogen bonding takes place with polar molecules.
5. How ionic and polar substances interact with water.
6. Phenomenon of osmosis and the strategies cells have for balancing and using osmotic pressure.
7. Understand hydrophobic effect
8. Noncovalent interactions
9. Bronsted-Lowry definition of acids and bases.
10. Henderson-Hasselbalch equation and how to use it
11. Difference between strong and weak acids/bases
12. Why pH is important to biological molecules
13. Concept of acid neutralization
14. How to do calculations involving acid/base titrations
15. Bicarbonate buffering system of the blood
16. How water functions as a reactant in biochemical reactions
17. Biochemical terms:
  - Hydrophilic - polar
  - Hydrophobic - nonpolar
  - Osmotic pressure
  - pH
  - $pK_a$
  - $K_a$
  - buffer
  - buffering range
  - hydrolysis
  - condensation