2014

440-01/02 Biochemistry

Stephen Mills

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Biochemistry
Course Syllabus

Instructor: Dr. Stephen Mills
Logan 104B, 745-3307, millss4@xavier.edu

Class Meeting: Section 01: MWF 11:00 – 11:50 am, Linder 103
Section 02: MWF 12:00 – 12:50 pm, Linder 103

Office Hours: MW 2-3:30pm, TTh 1-2pm, and by appointment


Prerequisite: Completion of Chem 242 – Organic Chemistry II, with a grade of D or better.

Overview: This course is an introduction to the chemistry of biological systems. Success requires proficiency in General Chemistry, Organic Chemistry and some skills in Mathematics. It is a good idea to review some general principles of equilibria, buffers and non-covalent forces. You will also need to be proficient at drawing the flow of electrons in reactions (arrow pushing). This course also expects basic understanding of algebra and logarithms.

Expected Learning Outcomes: The course lectures, exams, quizzes, and protein portfolio assignments will allow you to master the following learning outcomes.

1. Identify the 4 main classes of biomolecules, (proteins, nucleic acids, lipids & carbohydrates), and describe their covalent nature.
2. For all 4 main classes of biomolecules, summarize the non-covalent forces that stabilize their 3D structure and illustrate a connection between 3D structure and function.
3. Predict the protonation states of biological molecules & the pH of buffered solutions.
4. Describe the origins of protein stability.
5. Examine an enzyme reaction mechanism and determine the features that selectively stabilize the transition state leading to chemical catalysis.
6. Perform graphical analysis of enzyme kinetics and enzyme inhibition.
7. Relate the equilibrium constant for a reaction \( K_{eq} \) to free energy changes \( \Delta G \) under standard state and physiological conditions.
8. Recognize metabolic pathways (e.g. glycolysis) and identify the energetic strategies of metabolism.
Grading: There will be 3 Exams and 9 Quizzes during the semester. The 8 highest quiz grades count toward your total. You will be put into groups to work on a Protein Portfolio, described below. You will also complete three tutorials online.

Grading will be as follows:

- 3 Exams (50 min each) 45%
- 8 Quizzes (15 min each) 15%
- Final Exam 30%
- Protein Portfolio and Tutorials 10%

Exams: The material for this course is both descriptive and quantitative. Therefore, some of the test questions require calculations while others require answers in essay form. While it is not my intent to assign grades according to one’s written ability, I cannot assign credit to answers where it is unclear that core concepts are understood. Additionally, it is possible to answer a question correctly, but to a level that is below the response of other students in the course. The best answer will get full credit, whereas, lesser answers will receive partial credit. This does not mean you should add irrelevant information to your answer. Be clear and concise and include as much detail as possible in your response. Use point allocations on the questions to guide the amount of time you spend on it.

Exam Schedule: The three exams are scheduled for the following dates:

- Sept. 26
- Oct. 31
- Dec. 3

These exam dates are set in stone and will not be changed (except possibly for a natural disaster or other catastrophic event). An unexcused absence from an exam will result in a score of zero, with no opportunity for make-up. An excused absence will only be granted in cases of extreme illness (e.g. hospitalization) or a death in the family. In either case, I need at least 12 hours notice and written documentation, such as a doctor’s note.

Final exam: The final exam will be on:

- Section 01: Fri., Dec 19, 10 am
- Section 02: Wed., Dec 17, Noon

These dates cannot be changed. The final will not be offered early.

The final exam is comprehensive.

Quizzes: Quizzes will be given most Fridays at the beginning of class, except as indicated on the lecture schedule or if there is an exam. The quizzes will be ~15 min long and are intended to test your understanding of the current material in the class. Don’t fall behind!

There will be no make-up exams or make-up quizzes.
Tutorials: These will be two short exercises to help you visualize amino acids, peptides and secondary structure. To get credit for these exercises, you must do each of the exercises and turn in the answers to the questions through Canvas by the assigned dates.

Protein Portfolios: These will be a collection of short exercises to be done in groups. The exercises will introduce you to some current methods used to find and analyze proteins, including sequence searching and alignments, finding 3-D structures and viewing those structures, and finding information about what is known about the function of a protein and its metabolic pathway. The exercises will be assigned throughout the semester, culminating with presentations of the collected information during the last week of class.

Grading Scheme: The following grading scheme will be used:

- 90 & above = A- to A
- 80 – 89 = B- to B+
- 70 – 79 = C- to C+
- 60 – 69 = D- to D+
- 59 & below = F

I reserve the right to adjust these guidelines to your advantage depending on overall class performance. Plus (+) and minus (-) grades will be given to the upper and lower third of a grade level, respectively. Xavier does not have an A+ grade designation.

NOTE: According to the Xavier University Catalog, a grade of A is earned for Exceptional performance. This is also the agreed grading policy of the faculty in the Chemistry Department. The Chemistry Department Grading Policies should be viewed by all students and can be found on the Department Web site at: http://www.xavier.edu/chemistry/Department-grading-policy.cfm

Canvas: The Canvas page can be found at https://canvas.xavier.edu/. Please log in and make sure you have access. Let me know if you cannot log in. Canvas will be used for several things in this course:

1) All lecture materials will be posted on Canvas. This includes lecture presentations, the syllabus, the lecture schedule and problem sets.
2) I will post the Protein Portfolio exercises on Canvas.
3) I will have a page of web links that will help with the Portfolios as well as some links to interesting and fun chemistry sites.
4) I have included a discussion forum on Canvas. This is a place for you to post questions to each other and to me.
5) You can check your grades.
**Academic Honesty:** Cheating on any test will result in a grade of F being given for the course. Students may appeal according to normal procedures stated in the University Catalog.

**Lectures and Readings:** Read the book. Work the problems in the book. I will focus my lectures on important topics from the book, but the book will provide a slightly different perspective and broader focus. Exams will focus on important concepts rather than fine details. Lectures will generally involve a mix of Powerpoint presentations and material written on the white board. I will make the lectures available on Canvas. You are encouraged to print these and bring them to lecture to take notes on them.

**Attendance:** Regular attendance is strongly recommended but not required

**Illness/Flu:** Let me know if you are sick and I’ll do my best to make accommodations. Especially for quizzes and exams, I need to know as far in advance as possible to make accommodations.

The procedures in this course syllabus are subject to change in the event of extenuating circumstances. These changes, if necessary, will be announced to the class in as timely a manner as possible.
<table>
<thead>
<tr>
<th>Week of</th>
<th>Monday</th>
<th>Wednesday</th>
<th>Friday</th>
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<tr>
<td>Aug. 25</td>
<td>8/25 First class Introduction/Biomolecules</td>
<td>8/27 Ch 4 Amino Acids</td>
<td>8/29 Quiz 1: Amino Acids Ch 4 Amino Acid reactions Unusual Amino Acids</td>
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<td>Sept. 1</td>
<td>9/1 Labor Day Holiday No class</td>
<td>9/3 Spirit Celebration No class</td>
<td>9/5 Ch 2 Water, pKas, &amp; Buffers</td>
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<td>Sept. 8</td>
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<td>9/10 Ch 5 Protein Structure</td>
<td>9/12 Quiz 2: Buffers, pKa Ch 5 1° Structure</td>
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<td>Sept. 15</td>
<td>9/15 Ch 5 Sequence Alignments Tutorial 1 Due</td>
<td>9/17 Ch 6, 31 Protein Folding Prot Port 1 due</td>
<td>9/19 Quiz 3: 1° Structure Ch 6 2° Structure</td>
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<td>Sept. 22</td>
<td>9/22 Ch 6 2° Structure Tutorial 2 Due</td>
<td>9/24 Ch 6 Protein Folding, Motion</td>
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<td>Sept. 29</td>
<td>9/29 Ch 8 Lipids/Fatty Acids</td>
<td>10/1 Ch 9 Membranes</td>
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<td>Oct. 6</td>
<td>10/6 Ch 13 Enzymes Prot Port 2 due</td>
<td>10/8 Ch 13 Enzymes</td>
<td>10/10 Fall Holiday No Class</td>
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<td>Oct. 13</td>
<td>10/13 Ch 13 Kinetics</td>
<td>10/15 Ch 13 Kinetics</td>
<td>10/17 Quiz 5 Kinetics Ch 13 Kinetics</td>
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<td>Oct. 20</td>
<td>10/20 (Midterm grades due) Ch 14 Mechanism</td>
<td>10/22 Ch 14 Mechanism</td>
<td>10/24 Quiz 6 Mechanism Ch 14 Mechanism Prot Port 3 Due</td>
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<td>Oct. 27</td>
<td>10/27 Ch 7 Carbohydrates</td>
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<td>Nov. 3</td>
<td>11/3 Ch 10,11 Nucleic Acids</td>
<td>11/5 Ch 10,11 DNA Sequencing</td>
<td>11/7 Quiz 7 Nucleic Acids Ch 6, 15 4° Structure Allostery</td>
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<td>Nov. 10</td>
<td>11/10 Ch 3 Energetics Prot Port 4 Due</td>
<td>11/12 Ch 18 Metabolism overview</td>
<td>11/14 Quiz 8 Energetics Ch 18 Glycolysis</td>
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<td>Nov. 17</td>
<td>11/17 Ch 18 Glycolysis</td>
<td>11/19 Ch 22 Gluconeogenesis</td>
<td>11/21 Ch 19 Citric Acid Cycle</td>
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<td>Nov. 24</td>
<td>11/24 Quiz 9 Metabolism Ch 19 Citric Acid Cycle Prot Port 5 due</td>
<td>11/26 Thanksgiving No class</td>
<td>11/28 Thanksgiving No class</td>
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<tr>
<td>Dec. 1</td>
<td>12/1 Ch 20 Electron Transport/ Oxidative Phosphorylation</td>
<td>12/3</td>
<td>12/5 Protein Portfolios</td>
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<tr>
<td>Dec. 8</td>
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<td>12/10 Protein Portfolios</td>
<td>12/12 Last Day of Class Metabolism Wrap-up</td>
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<td>Dec. 15</td>
<td>12/15 Reading Day</td>
<td>12/17 Section 02 Final Exam: 12-2</td>
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