University of Denver • Fall 2020 • Chemistry & Biochemistry 3811

**Biochemistry- Proteins**

**CLASS MEETINGS**

MWF XXXXX

Final Exam: Takehome on Dec. 1

Online: via Zoom on Canvas

**INSTRUCTOR**

Prof. Scott Horowitz

scott.horowitz@du.edu

Instructor Office Hours: By appointment- please send me an email. I’m flexible.

Online: https://udenver.zoom.us/my/scotthorowitz

**TEXTBOOK**

Lehninger Principles of Biochemistry, 7th edition, by David L. Nelson and Michael M. Cox. Full and partial versions are available at the bookstore. MacMillan Sapling course is required.

**COURSE DESCRIPTION**

This course is meant to be an introduction to protein structure and function. It will be primarily active learning. Classroom time will be used primarily for activities, questions, and problem-solving. Reading is required.

**COURSE LEARNING OUTCOMES**

1. Recognize, describe, and compare protein primary structure, integrating concepts of chemical properties learned in general chemistry.
2. Integrate primary structure with concepts of non-covalent interactions from general chemistry to create interaction principles for building higher order protein structure.
3. Recognize, describe, compare, and build secondary structures using primary structure and non-covalent interactions.
4. Recognize, describe, compare, and build tertiary/quaternary structures using secondary and primary structure, as well as non-covalent interactions.
5. Draw basic chemical mechanisms of enzymes integrating principles from organic chemistry.
6. Describe and draw enzymatic strategies, inhibitors, and kinetics integrating principles from general chemistry and organic chemistry.

**COURSE REQUIREMENTS**

1. In-class participation and attendance (10%)
2. Custom Contest Foldit Puzzles and Assignments (60%)
   * Hydrogen Bonding (3%)
   * Primary structure (16%)
   * Secondary Structure (8%)
   * Tertiary Structure (7%)
   * Folding Pathway (3%)
   * Immunoglobulin G (8%)
   * Chymotrypsin (10%)
   * Zymogen (5%)
3. Reading homework (totaling 15%)
4. Cumulative final (with extra Ch. 6) (15%)

**LATE WORK/EXAM AND ATTENDANCE POLICY**

Late are penalized 10% for each day past the deadline, **EXCEPT** Sapling quizzes, which are 2% per day specifically so you can turn it in late after class if you try it and don’t get it right and want to wait until after class to finish it. Except under extraordinary circumstances (e.g. a doctor’s note is required for illness), class presentations cannot be made up.

If you are unable to attend class due to a legitimate emergency, please contact me via e-mail. If you are not in class for any other reason, you will be marked absent and earn a zero for the day. Students who arrive more than five minutes late will earn 50% attendance for the day.

**A NOTE ON HOMEWORK**. Sapling homework and discussion questions will be due by 4 PM the day **BEFORE** class. If you see something in the syllabus, Canvas due dates, or Sapling due dates that is inconsistent with this, please let me know so I can check if there was a mistake.

A note on questions: if you ask me a question in writing on course material that is not specific to you, I will answer it in full, remove your name and email and other identifiers, and then email the question and answer to the full class. That way, everyone will benefit from it. If you don’t want that done, please make sure to specify that in your question.

**DETAILED SCHEDULE**

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| **Date** | **Subject** | **Reading** | **Due Dates (before class)** |
| 14-Sep | What is biochemistry and this class? |  |  |
| 16-Sep | Non-Covalent Interactions | 2.1 through “Weak Interactions Are Crucial to Macromolecular Structure and Function” (Skip Colligative Properties) |  |
| 18-Sep | Other things water | 2.2-2.4 (can skip “Untreated Diabetes Produces Life-Threatening Acidosis and Box 2-1) |  |
| 21-Sep | Amino acids | 3.0-3.1 (skip box 3-1) |  |
| 23-Sep | Peptides and Proteins | 3.2 | Hydrogen bonding puzzle |
| 25-Sep | Continue primary structure puzzle |  |  |
| 28-Sep | Foldit day |  |  |
| 30-Sep | Working with Proteins | 3.3 (and box 3-1 from 3.1) |  |
| 2-Oct | Primary Structure | 3.4, skip Figs 3-27 and 3-29, only skim last section on chemical synthesis |  |
| 5-Oct | Primary Structure Solutions Presentations |  | Primary structure puzzle |
| 7-Oct | Overview of Protein Structure | 4.0-4.1 |  |
| 9-Oct | Secondary Structure | 4.2 (skip Common Secondary Structures Can Be Assesed by Circular Dichroism) |  |
| 12-Oct | Continue Secondary Structure Puzzle |  |  |
| 14-Oct | Tertiary and Quaternary Structure | 4.3 (In box 4-3, just read paragraph introducing 4-Hyp, skip box 4-5) | Secondary struture puzzle |
| 16-Oct | Continue tertiary and Foldit pathway puzzles |  |  |
| 19-Oct | Folding and Denaturation | 4.4 (just skim Box 4-6) |  |
| 21-Oct | No class |  |  |
| 23-Oct | Reversible Binding and Hemoglobin | 5.0-5.1 (through “Hemoglobin Subunits are Structurally Similar to Myoglobin, p. 163) | Tertiary structure puzzle, Pathway puzzle |
| 26-Oct | Cooperativity and Hemoglobin | Rest of 5.1 (skip Box 5-1) |  |
| 28-Oct | Antibody function & Molecular Motors | 5.2 (through Antibodies Bind Tightly and Specifically to Antigen) & 5.3 (skip Additional Proteins Organize the Thin and Thick Filaments into Ordered Structures) |  |
| 30-Oct | Continue IgG puzzle |  |  |
| 2-Nov | Introduction to Enzymes and starting How they Work | 6.1-6.2, starting at “Most Enzymes Are Proteins”, through “Enzymes affect Reaction Rates, Not Equilibria”, p. 192). If you have trouble understanding this, try: <https://www.ncbi.nlm.nih.gov/books/NBK9921/> |  |
| 4-Nov | How Enzymes Work | Remainder of 6.2 | IgG puzzle |
| 6-Nov | Enzyme Mechanism- Chymotrypsin | Start of 6.4 through Figure 6-20, and Figure 6-23 |  |
| 9-Nov | Other Enzyme Mechanisms | 6.4 “The Enolase Reaction Mechanism Requires Metal Ions” and “Lysozyme Uses Two Successive Nucleophilic Displacement Reactions”. In Fig 6-29, only bother with right (SN2) side of the figure. |  |
| 11-Nov | Enzyme Kinetics and Mechanism | 6.3 (through the beginning of “Many Enzymes Catalyze Reactions with Two or More Substrates”, stopping before Figure 6-13, and also skipping the derivation in “The Relationship between Substrate Concentration and Reaction Rate Can Be Expressed Quantitatively”, just get to the Michaelis-Menten Equation at the end.) |  |
| 13-Nov | Enzyme Inhibition | 6.3 (inhibition, starting at “Enzymes Are Subject to Reversible or Irreversible Inhibition”, skipping Box 6-3) | Chymotrypsin puzzle |
| 16-Nov | Allosteric and Phosphorylation Regulation, and Zymogens | All of 6.5 (Don’t worry about the details within Fig 6-41, skip Fig 6-42) |  |
| 18-Nov | Remainder of 6.5 |  |  |
| 20-Nov | COVID-19 puzzle design |  | Zymogen puzzle |
| 1-Dec | Take home final due |  |  |