

**University of Nevada, Las Vegas**  
**CHEM 474: Biochemistry I**

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- Course Web Page:** <http://webcampus.nevada.edu> (choose UNLV, log in, and choose CHEM 474)
- Textbook Web Page:** <http://bcs.whfreeman.com/berg7e> (This companion site for our textbook contains some free and open resources, including “conceptual insights,” “living figures,” animations, and sample quizzes for each chapter.)
- Required Text:** *Biochemistry* by Berg, Tymoczko & Stryer, 7<sup>th</sup> Edition
- Online HW:** During the semester, you will complete a number of online homework assignments. The dates on which these assignments are due are listed in this syllabus. You will access these homework assignments through the Sapling Learning website. You will need to create a Sapling Learning Account and purchase access to their homework site (\$34 for 1 semester). Instructions for creating a Sapling Learning Account can be found in the “Online Homework” section of this syllabus.
- Top Hat:** Top Hat, an interactive lecture experience, will be used throughout the semester to administer online quizzes and for tracking your attendance. Quizzes will be graded and will count as extra-credit towards your final grade. You will need to create a Top Hat Account and purchase access to their site (\$24 for 1 semester). Instructions for creating a Top Hat Account can be found in the “Top Hat” section of this syllabus.
- Special Notes:** Information about UNLV’s official policies about Academic Misconduct, Copyright, the Disabilities Resource Center, Religious Holidays, tutoring, the UNLV Writing Center, and Rebelmail are located on the last page of this syllabus.
- Acknowledgement:** I would like to thank Dr. MaryKay Orgill for supplying a syllabus template used to create this one, the learning objectives, and lecture notes that were used in the preparation of this course. I am deeply grateful to her for her excellent guidance and mentorship!

**CATALOG DESCRIPTION**

Fundamentals of biochemistry with emphasis on the structure-function relationships of proteins, enzymes, carbohydrates, lipids and nucleic acids; bioenergetics; and intermediary metabolism and the mechanisms of its regulation. Credits: 3.  
Prerequisites: CHEM 242.

## **COURSE OBJECTIVES**

Upon completion of this course, you will be able to:

1. apply concepts from general and organic chemistry to the understanding of the structures and functions of biomolecules;
2. draw the structures of 20 common amino acids and determine how they are ionized at different pHs;
3. describe the primary, secondary, tertiary, and quaternary structures of proteins and the effect of specific amino acid side chains on protein structure;
4. explain techniques used to analyze proteins and interpret the results of tests using such techniques;
5. describe the cooperative binding of oxygen to hemoglobin and determine the effects of changing pH on oxygen binding;
6. draw the monomers of DNA and RNA and describe the different structural variations of these molecules;
7. describe the basic process by which genetic information in DNA is transcribed and translated into expressed protein and use the genetic code to determine the protein sequence resulting from the transcription and translation of a particular segment of DNA;
8. describe the processes by which enzymes increase biochemical reaction rates;
9. use the Michaelis-Menten Model to describe the kinetics of enzyme-catalyzed biochemical reactions;
10. construct double-reciprocal plots to determine mechanisms of enzyme inhibition;
11. characterize the chemical catalytic strategies utilized by enzymes;
12. understand the major allosteric control systems utilized by enzymes;
13. analyze and reproduce the reactions by which the cell extracts energy and reducing power from glucose (glycolysis and the citric acid cycle);
14. describe the regulation and inhibition of glycolysis, gluconeogenesis, the citric acid cycle and oxidative phosphorylation;
15. explain the coupling of electron transport to oxidative phosphorylation; and
16. describe the mechanism of ATP formation by ATP synthase.

\*\*\*\*\*Tentative Schedule\*\*\*\*\*

<i>Dates</i>	<i>Textbook</i>	<i>Lecture Topic</i>	<i>Online Homework</i>
Jan. 18	*****	Martin Luther King Day: No class	
Jan. 20	Chapter 1	Biochemistry: An Evolving Science	
Jan. 25	Chapter 2	Protein Composition and Structure	
Jan. 27	Chapter 2	Protein Composition and Structure	
Feb. 1	Chapter 2	Protein Composition and Structure	
Feb. 3	Chapter 3	Exploring Proteins and Proteomes (Protein Techniques)	Online Homework Assignment 1 due before 11:55 p.m. on Thursday, February 4
Feb. 8	Chapter 7	Hemoglobin: Portrait of a Protein in Action	
Feb. 10	Chapter 7	Hemoglobin: Portrait of a Protein in Action	Online Homework Assignment 2 due before 11:55 p.m. on Thursday, February 11
Feb. 15	*****	President's Day: No class	
Feb. 17	Chapter 4	DNA, RNA, and the Flow of Information	Online Homework Assignment 3 due before 11:55 p.m. on Thursday, February 18
<b>Feb. 22</b>	<b>Exam I</b>	<b>Chapters 1-3, 7</b>	
Feb. 24	Chapter 4	DNA, RNA, and the Flow of Information	
Feb. 29	Chapter 8	Enzymes: Basic Concepts and Kinetics	
Mar. 2	Chapter 8	Enzymes: Basic Concepts and Kinetics	Online Homework Assignment 4 due before 11:55 p.m. on Thursday, March 3
Mar. 7	Chapter 8	Enzymes: Basic Concepts and Kinetics	
Mar. 9	Chapter 8	Enzymes: Basic Concepts and Kinetics	Online Homework Assignment 5 due before 11:55 p.m. on Thursday, March 10
Mar. 14	Chapter 9	Catalytic Strategies	
<b>Mar. 16</b>	<b>Exam II</b>	<b>Chapters 4 &amp; 8</b>	
Mar. 21-25	*****	Spring Break	
Mar. 28	Chapter 9	Catalytic Strategies	
Mar. 30	Chapter 9	Catalytic Strategies	
Apr. 4	Chapter 9	Catalytic Strategies	Online Homework Assignment 6 due before 11:55 p.m. on Thursday, April 7
Apr. 6	Chapter 10	Regulatory Strategies	
Apr. 11	Chapter 15	Metabolism: Basic concepts and design	Online Homework Assignment 7 due before 11:55 p.m. on Thursday, April 14
Apr. 13	Chapter 16	Glycolysis	
Apr. 18	Chapter 16	Glycolysis	Online Homework Assignment 8 due before 11:55 p.m. on Thursday, April 21
<b>Apr. 20</b>	<b>Exam III</b>	<b>Chapters 9-10, 15-16</b>	
Apr. 25	Chapter 17	The Citric Acid Cycle	
Apr. 27	Chapter 17	The Citric Acid Cycle	Online Homework Assignment 9 due before 11:55 p.m. on Thursday, April 28
May 2	Chapter 18	Oxidative Phosphorylation	
May 4	Chapter 18	Oxidative Phosphorylation	Online Homework Assignment 10 due before 11:55 p.m. on Thursday, May 5
<b>May 11</b>	<b>Exam IV</b>	<b>Chapters 17 &amp; 18 (WEDNESDAY, 3:10 p.m.)</b>	

\*With the exception of the exam dates, this schedule is subject to change. Students should verify the content covered by each exam.

## LECTURE

Attendance at lectures is essential and expected. You are responsible for all announcements and concepts covered in lecture. The lecture schedule above, with the exception of exam dates, is subject to change.

## RECOMMENDED PRACTICE PROBLEMS

On the last page of the syllabus, I have included recommended practice problems for each chapter. The purpose of these practice problems is to allow you to practice the kinds of questions that will help you gauge your understanding of the material. The suggested problems are the *minimum* number of problems that you should work in order to master the course material.

## LEARNING OBJECTIVES

At the beginning of each chapter, I will provide a list of learning objectives for the chapter on the WebCampus site under "Course Content." This list will give you an idea of the concepts and skills that I believe are important for you to understand or have. You can think of these lists as study guides for the chapters. **I often model exam questions after the questions in the Learning Objectives documents.** I suggest that you print out the lists before we cover the topics in lecture so you can mark your notes in accord with the learning objectives.

## COURSE GRADES

Exam 1	100 points
Exam 2	100
Exam 3	100
Exam 4 (given during final exam week)	100
Online Homework	100
<u>Top Hat (extra credit; see below)</u>	<u>25</u>
Total	500 points possible

- **Exams:** You will complete a total of four exams over the course of the semester. Four 100-point exams will be given during the semester. There will not be a cumulative "final" exam. **There are no make-up exams.**
- **Special Circumstances:** An alternate exam may be administered prior to the scheduled time *only* in cases where travel for a university sanctioned business or function, which cannot be rescheduled, interferes with an exam date. *If such plans do interfere with an exam date, then it is your responsibility to schedule an alternate exam date prior to the scheduled date. This alternate date must be finalized at least two weeks prior to the scheduled exam date.* You must show proper documentation from the appropriate university official for an early exam to be administered. Extraordinary health issues with proper documentation will also be allowed. It is solely the right of the instructor to determine whether the documentation and/or reason for rescheduling an exam is appropriate.
- **Online Homework:** During the semester, you will complete 10 online homework assignments (due in most non-exam weeks). The dates on which these assignments are due are listed in this syllabus **but may be subject to change.** You will have access to each homework assignment the Friday before it is due.
  - **Accessing your online homework assignments:** You will access these homework assignments through the Sapling Learning website. You will need to create a Sapling Learning Account and purchase access to their homework site (\$34 for 1 semester). Instructions for creating a Sapling Learning Account are included below:
    - 1. Go to <http://saplinglearning.com> and click US Higher Ed.
    - 2a. If you already have a Sapling Learning account, log in, click "View Available Courses", then skip to step 3.
    - 2b. If you have Facebook account, you can use it to quickly create a Sapling Learning 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 timezone, accept the site policy agreement, and click "Create my new account". You can then skip to step 3.
    - 2c. 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.

- Once you have registered and enrolled, you can log in at any time to complete or review your homework assignments.
- 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.
- *Top Hat*: During the semester, you will complete several online quizzes and your attendance will also be recorded. The results from these quizzes will count as extra-credit. Up to 25 points are possible and will count towards your 500 point course total. The fraction of correct answers from these quizzes will determine the final amount of extra-credit. For instance, if you are present for every quiz and answer every question correctly, you will receive 25 additional points. If you answer 50 % of the questions correctly, you will receive 12.5 additional points.
- *How to enroll in a course using Top Hat*: Before you can enroll in a course (\$24 for 1 semester), you'll need to create a Top Hat account. During the account creation process, you'll be able to search for your course by my name, the Top Hat join code (**333208**), or course description. You can select and enroll in a course at any time by searching for it in the Course Lobby. First, go the Top Hat Login page. Select UNLV as your school, and then enter your username and password to Login. Click on the Top Hat icon in the top-left corner to exit to the Course Lobby. To enroll in a course, start by clicking the "Add a Course" button. You can now search courses using the search bar.

The course grade will be based on the following scale:

%	100-93	92-91	90-89	88-81	80-79	78-77	76-69	68-67	66-65	64-57	56-0
Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	F

\*Although I will never raise the grading scale, I reserve the right to lower it at the end of the semester. After each exam, I will explain how I will determine grades and post a grade breakdown to show you where you stand in class.

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### RECOMMENDED PRACTICE PROBLEMS FROM THE BERG, TYMOCZKO & STRYER TEXTBOOK

Chapter 1	1, 3, 6, 7, 12, 14, 16, 24 (These problems should mostly be review from general chemistry. If you don't remember how to solve them, please come in for help!)
Chapter 2	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 14, 15, 17, 18, 19, 21, 22, 25, 28 <b>Comments:</b> <i>About problem 2.2a:</i> The answer to part (a) should be A and C. <i>About problem 9:</i> The structure shown in the back of the book is missing a negative charge on the side chain carboxyl group.
Chapter 3	1, 3, 5, 6, 9, 10, 11, 13, 17, 21, 22, 26, 27
Chapter 7	7, 8, 9, 10, 11, 13, 14a, 15, 16
Chapter 4	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 20, 24, 25, 26, 29, 32, 33, 34, 35, 36, 38, 39, 43, 44, 45
Chapter 8	1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 20 (parts a and b only), 23, 24, 26, 28, 31 <b>Comments:</b> <i>About problem 7:</i> The answer given in the back of the book is correct; however, you should also realize that $\Delta G$ depends only on the initial and final states of the reaction ( $G_{\text{products}}$ and $G_{\text{reactants}}$ ) and not on the reaction mechanism/pathway ( $\Delta G^\ddagger$ ). <i>About problem 8:</i> "Thermodynamically unstable" means that a reaction has a positive $\Delta G$ . <i>About problem 13:</i> I calculate $\Delta G^\circ$ to be -7.30 kJ/mol (which is slightly different than the answer in the back of the book). I agree with the book's value of $K'_{\text{eq}}$ . <i>About problem 16:</i> The answer shown in the back of the book is not entirely correct. When $[S] = 10K_M$ , $V_0 = 0.91V_{\text{max}}$ . When $[S] = 20K_M$ , $V_0 = 0.95V_{\text{max}}$ . According to the Michaelis-Menten equation, $V_{\text{max}}$ is never reached (just "approached"). "So any Michaelis-Menten curves showing that the enzyme actually attains $V_{\text{max}}$ are pernicious lies." <i>About problem 20:</i> The answers to part (a) shown in the back of the book are incorrect. $K_M = 9.9 \mu\text{M}$ and $V_{\text{max}} = 8.9 \mu\text{mol/min}$ . <i>General comment:</i> Pay close attention to units when determining kinetic parameters from double-reciprocal plots!
Chapter 9	3, 4, 6, 7, 9, 11, 13, 15, 16 <b>Comments:</b> <i>About problem 3:</i> To answer this question, you should consider the fact that subtilisin is an enzyme that has a

	catalytic triad in its active site.
Chapter 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 16
Chapter 15	1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 19, 21, 22, 23, 25, 26, 27, 28, 29 <b>Comments:</b> <i>About problem 4:</i> There is a typo in part 4. Please remove the word “reaction” from the phrase. The phrase should say “Catabolic electron carrier.” <i>About problem 8:</i> Remember that, in reactions that involve the hydrolysis of ATP, the true substrate is the ATP-Mg <sup>2+</sup> complex (even though the magnesium isn’t shown as part of the reaction in problem 8). So, by increasing the [Mg <sup>2+</sup> ], the reaction can be made more spontaneous. <i>About problem 11:</i> Remember, the change in free energy tells you if the reaction is spontaneous (whether it will happen), but it does not tell you anything about the speed of the reaction. <i>About problem 19:</i> There is a typo in this problem. The problem says that you should calculate the “ratio of reactants to products.” You should calculate the ratio of “products to reactants” in this problem. <i>About problem 21:</i> You will need to calculate the value of Q in order to solve each part of this problem. Remember that Q is the ratio of the MOLAR concentrations of products to reactants (not the ratio of millimolar concentrations). You will need to change the concentrations that are given in the problem to molar concentrations before you solve the problem. <i>About problem 22:</i> Several of the structures shown in this problem are incorrect. Some electrons in double bonds are shown as being delocalized when they are not. In part b, in the structure of pyruvate, the carbonyl on the right should be a double bond. In part d, in the structure of oxalosuccinate, the carbonyl at the top of the structure should be a double bond. In part e, in the structure of oxaloacetate, the carbonyl at the top of the structure should be a double bond. In part f, in the structure of pyruvate, the carbonyl on the right should be a double bond. <i>About problem 29:</i> “Exergonic” refers to the fact that ΔG is negative for this reaction. ΔG determines if a reaction is spontaneous (if it will happen), but it is not related to the speed of the reaction, which is affected by the activation energy.
Chapter 16	1, 2, 3 (only parts a-c), 6, 7, 8, 9, 10, 11, 12, 14, 16, 17, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 38, 40 <b>Comments:</b> <i>About problem 6:</i> Hint: This reaction requires NAD <sup>+</sup> . <i>About problems 11 and 27:</i> Lactic acid is a <i>relatively</i> strong acid, not a strong acid. <i>About problem 17:</i> The balanced equation in part (a) should be: Glucose + 2P <sub>i</sub> + 2ADP → 2lactate + 2ATP + 2H <sub>2</sub> O. For the calculations in part (b), you can assume that the reaction occurs at 298K. The value of ΔG° is -123.1 kJ/mol. The value of ΔG under the conditions listed in the problem is -113.5 kJ/mol. <i>About problem 29:</i> Remember that glucose 6-phosphate is not a substrate for the transport proteins that shuttle glucose across cell membranes. Therefore, if the glucose 6-phosphate cannot be dephosphorylated, it cannot be transported across cell membranes.
Chapter 17	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 15, 16, 18, 19, 20, 21, 22, 23, 25 <b>Comments:</b> <i>About problem 8:</i> The answer for this problem in the back of the book doesn’t correspond with the question! The answer should be that the enzymes of the citric acid cycle are physically associated with each other. They are organized into a multienzyme complex called a “metabolon.” <i>About problem 16:</i> For the calculation in part (b), assume that the reaction occurs at 298K. Also, as long as a biochemical reaction occurs at pH 7, the hydrogen ion concentration is not included in the calculation of Q, the reaction quotient.
Chapter 18	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 16, 17 (only parts a, c, d, and f), 19, 20, 32, 33, 34, 38, 41

## UNLV POLICIES

**Academic Misconduct** — Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution. An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the Student Academic Misconduct Policy (approved December 9, 2005) located at: <https://www.unlv.edu/studentconduct/student-conduct>.

**Copyright** — The University requires all members of the University Community to familiarize themselves **with** and to follow copyright and fair use requirements. **You are individually and solely responsible for violations of copyright and fair use laws. The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws.** Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at: <http://www.unlv.edu/provost/copyright>.

**Disability Resource Center (DRC)** — The UNLV Disability Resource Center (SSC-A 143, <http://drc.unlv.edu/>, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

**Religious Holidays Policy** — Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor within the first 14 calendar days of the course for fall and spring courses (excepting modular courses), or within the first 7 calendar days of the course for summer and modular courses, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit: <http://catalog.unlv.edu/content.php?catoid=6&navoid=531>.

**Transparency in Learning and Teaching** — The University encourages application of the transparency method of constructing assignments for student success. Please see these two links for further information: <https://www.unlv.edu/provost/teachingandlearning>  
<https://www.unlv.edu/provost/transparency>

**Incomplete Grades** — The grade of I—Incomplete—can be granted when a student has satisfactorily completed three-fourths of course work for that semester/session but for reason(s) beyond the student's control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving "I" grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

**Tutoring and Coaching** — The Academic Success Center (ASC) provides tutoring, academic success coaching and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, visit <http://www.unlv.edu/asc> or call 702-895- 3177. The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of the SSC (ASC Coaching Spot). Drop-in tutoring is located on the second floor of the Lied Library and College of Engineering TEB second floor.

**UNLV Writing Center** — One-on- one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 702-895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>.

**Rebelmail** — By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always **@unlv.nevada.edu**. **Emailing within WebCampus is acceptable.**

**Library Resources** — Students may consult with a librarian on research needs. For this class, the subject librarian is [https://www.library.unlv.edu/contact/librarians\\_by\\_subject](https://www.library.unlv.edu/contact/librarians_by_subject). UNLV Libraries provides resources to support students' access to information. Discovery, access, and use of information are vital skills for academic work and for successful post-college life. Access library resources and ask questions at <https://www.library.unlv.edu/>.

**Final Examinations** — The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: <http://www.unlv.edu/registrar/calendars>.