

Instructor: Jeff Dahlseid, Ph.D.
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Course URL on Moodle site

Class: MTWF 12:30-11:20
Classroom: Nobel 222
Laboratory: Nobel 207

Texts: Chemistry 255 - Biochemistry Lab Manual

Office hours: M 3:30, F 1:30 or by apptmt

Lunch: TBA

Lehninger Principles of Biochemistry, Nelson & Cox, 5th Ed., 2008, Freeman, NY, NY

Feedback: I am very enthusiastic about being and becoming an outstanding educator, both for you and future students. I welcome constructive suggestions about how to improve class, my teaching, and the course at any time. I expect to learn from you this semester how I might teach better. I invite you to discuss your suggestions with me in my office, as you feel led.

Description and Course Outline:

Biochemists study the molecular basis for the functioning of living systems, including the structures, chemical properties, physical interactions, and biological functions of biochemicals. Yet **biochemistry** is more than that. Authors of our textbook write that biochemistry's "ultimate concern is with the wonder of life itself." (pp. 2) Biochemistry is surely an exciting and integrative field of study. The four types of macromolecules central to biochemistry are called proteins, nucleic acids, lipids, and carbohydrates. This semester you will discover these and a host of other biomolecules, be exposed to techniques and principles for biochemical investigation, and gain insight into the significance of biochemistry as part of our effort to understand the natural world.

In this course, we will study proteins, their building blocks, structure, and folding. We will learn about nucleic acids, their structure, building blocks, and how these molecules store genetic information. A case study of the proteins involved in oxygen binding and transport, including their physiological context, will serve to illustrate the relationship between protein structure and function. We will extend these ideas by considering enzymatic catalysis and kinetics of biochemical reactions. We will study lipids and the associations that give rise to membranes, the principal biological barrier. Consideration of biosignaling processes will help us appreciate the control of the metabolic processes we will study. An introduction to bioenergetics and carbohydrates will precede a study of energy metabolism including glycolysis, the citric acid cycle, and oxidative phosphorylation. Examples of the mechanisms of protein catalysis and of the mechanisms regulating protein function will be integrated into the material.

Course Objectives:

This course aims to integrate class and laboratory learning of biochemistry. Although a course in biochemistry necessarily involves learning new facts and laboratory techniques, my goal for this course is that you will come to appreciate the *breadth* of biochemistry and develop a solid background in its *fundamental* principles and practices. Specifically, my objectives are that you:

- develop a knowledge of biochemical building blocks and how their structures and assembly mediate their biological functions
- appreciate nucleic acid structure and its informational role in genetics
- understand and apply principles of enzyme kinetics to biochemical problems
- appreciate the structures of lipids and the interactions that contribute to the formation and maintenance of membranes
- develop a knowledge of the events and principles of signal transduction
- comprehend the principles of bioenergetics and how the reactions and events of catabolism, the citric acid cycle, and oxidative phosphorylation produce energy
- appreciate the relationship between the structure and function of biomolecules
- illustrate mechanisms of protein catalysis and regulation

Course Objectives (cont.)

Laboratory is an integral part of this course. Our hands-on learning about biochemical investigations will focus upon protein enzymes and their activities, properties, and kinetics. Laboratory will also emphasize scientific writing. For laboratory, my objectives are that you:

- understand and use many of the techniques and tools of biochemistry
- comprehend fundamental principles of biochemical experimentation and research
- communicate research results accurately and effectively in written and oral form

Academic honesty:

It is my expectation and policy that you will participate in this class in an honest and honorable way; I will not tolerate academic dishonesty. While I encourage you to work together to learn biochemistry, the work you submit on behalf of an assignment or exam must be your own. Dishonesty includes plagiarism, which is presenting someone else's ideas or words as your own. It is your responsibility in all written work to credit sources from which you draw ideas and language (quotes are rare here) with proper referencing. Dishonesty also includes cheating on exams. Gustavus has an Honor Code and, by virtue of being a student here (as well as your signed agreement from course registration), you have agreed to uphold the Honor Code. In this course, you are required to sign the following statement for papers and exams (though it applies to all of your work): "On my honor, I pledge that I have not given, received, nor tolerated others' use of unauthorized aid in completing this work." Central to the code is non-tolerance for violations. Though you are not expected to police others' actions, under the code (and in this class), failure to report a violation of which you are aware also constitutes an honor code violation. Documented violations will result in a zero for the assignment in question, will be reported to the Dean's office, and may result in failure of the course. If you have questions concerning particulars of academic honesty, please see me.

Attendance and Active Participation:

Attendance and active participation is important for your effective and enjoyable learning. I welcome and encourage your participation in classroom and laboratory learning. Attendance in the classroom will not be formally recorded, but I expect your attendance, both physically and mentally, at all classes. Attendance and active participation will account for 25 points (class) and 10 points (lab) toward your final grade. Active participation includes; answering questions in class, engaging in group work during class, asking questions in or out of class, and engaging in lecture. If you anticipate a valid excuse for being absent, please let me know. In the event that you miss a class, you are responsible for *understanding* the material from class, acquiring handouts, etc.

Attendance in laboratory every week, both physically and mentally, is **required** for passing the laboratory portion of the course. If you anticipate an absence from laboratory due to a significant extenuating circumstance, you must inform me *in advance* in order to make alternative arrangements, as you will be expected to make up the lab on your own time. If your attendance is challenged by a crisis or emergency, please contact me as soon as possible.

Cell phones/pages:

As a courtesy to the learning environment, your peers and myself, please turn off your cell phones, pagers or other devices that might disrupt the classroom or laboratory.

Teaching approach:

This section was intentionally left blank for first day introductory purposes.

Course Activities and Requirements:

- **Research Article Summaries:** Once this semester, you and a partner will use the search tools Medline or SciFinder Scholar and the Library (and ILL) to identify and obtain a copy of a research article on a biochemical topic (NOT a review) of interest to you. You will be required to read the article and write a two-page summary addressing a series of provided questions. See course Moodle site for due dates and details.
- **Protein Explorer (PE) Exercises:** This assignment will require you to do three things: 1) learn how to use a tool for the graphic display of molecular structures called Protein Explorer, 2) use Protein Explorer to explore the structures of biomacromolecules (proteins mostly) and capture a graphical image of your molecule, 3) record your observations from your exploration of molecular structure. See course Moodle site for due dates and details.
- **Class guests:** Twice we will be having guest visit our class as part of their visit to the campus. I hope to be having Curtis Marean visit the week of March 9 while he is here to give the Rydell Professor lecture 3/10 at 7 p.m. We may have Neal Hagberg while he is on campus for other things. Details around the associated assignments will be forthcoming.
- **Teaching approach "essay":** This will be a short writing assignment near the end of the semester to address the question about possibilities for teaching and learning that I raise on the first day. Details will be forthcoming.
- **Discretionary assignments:** I reserve 30 points to add assignments to the course that capture unexpected opportunities for learning.
- **Exams:** During the semester you will be required to take four mid-term exams and a final exam. The mid-term exams will cover new material and concepts covered in class, laboratory material, and assigned readings through the test date. The final exam will be comprehensive, so it will be important to integrate your learning of material from throughout the course. Exams will assess your cumulative learning of biochemical principles, problem solving and critical thinking skills. Thus, while very little or none of the earlier material may be tested directly, it will be assumed you are familiar with the all material covered to date. Exams will include short answer and recall questions (facts, structures, principles) and require some integration and synthesis, including application of principles to new situations or observations that have not been specifically discussed.

The mid-term exams and comprehensive final exam will be given at the times indicated on the schedule. **Exam attendance is mandatory**, and exams cannot be made up except for a *crisis* or *emergency*. For a crisis, you must talk with me personally in advance to arrange for a make-up exam. In an emergency, contact me by phone, voice-mail or e-mail, or, if you are unable to reach me, Judy Helmeke (x7320) in the Chemistry office or the Dean of Student's office (x7526). IF I am properly notified AND your emergency is valid, a make-up exam will be arranged. All students must take the final exam as scheduled.
- **Laboratory reports:** For laboratory, you will write two short reports and a initial and final draft of a full report as part of an integrated series of activities intended to promote good scientific writing. Both report types will be formal. The short format allows an early focus on the writing of methods and results. The full report is designed to provide significant feedback on a complete report. See the lab manual for scheduled due dates and assignment details. Note that the Writing Center (x6027 for appointments) is available to you for help with your writing.
- **Peer evaluations of laboratory reports:** You will evaluate the initial draft formal report of two of your peers. The evaluation guide is available in the laboratory manual.

- **Experimental investigation:** This multi-week experience will involve proposing, planning, executing and presenting an original biochemical investigation. See lab manual for details.
- **Data analysis and questions (DAQs):** You will complete and hand in your data analysis and answers to provided questions for two laboratory exercises. These assignments are aimed at assessing your ability to perform technically in laboratory, to acquire good data, and to meaningfully analyze and present it. See lab manual for details.
- **Laboratory notebooks:** Keeping a careful record of your work is a *most important* component of laboratory investigations. You **must** keep a laboratory notebook for biochemistry laboratory. The notebooks will be collected twice during the semester for evaluation (see schedule). Note – a penalty may be applied for laboratory reports that are inadequately supported by a laboratory notebook record.
- **Lab participation/group work component:** Laboratory experiments in CHE-255 are performed as lab groups of two or three persons. Although the experimental work performed is a group effort, each group member is responsible for ALL aspects of the lab (*i.e.* even if it was not your ‘job’ to do the stock dilutions). During each laboratory meeting, your instructor will monitor your participation in the laboratory experiment/activity and award a maximum of 10 points for the semester based on your contributions. Cleaning up the lab bench/solutions prep area/cold box is part of good team-work and will be included within this grade.

Grading breakdown:	Article summary	30
	PE exercises (2 @ 20 pts)	40
	Class guests (2 @ 20 pts)	40
	Teaching approach “essay”	10
	Discretionary assignments	30
	Midterm Exams (4 @ 100 pts)	400
	Comprehensive final exam	100
	Laboratory reports	
	Short reports (2 @ 20 pts)	40
	Final full report	100
	Peer evaluation (2 @ 20 pts)	40
	Experimental investigation	75
	DAQs (2 @ 10 pts)	20
	Laboratory Notebooks (2 @ 20 pts)	40
	<u>Attendance and active participation</u>	<u>35</u>
	Total	1000

Final grades will be assigned according to a straight percentage scale. The following percentage scale will serve as a **guideline** for letter grade assignment:

90-100% = A
80 - 89% = B
70 - 79% = C
60 - 69% = D

Electronic tools policy:

For many of the course assignments, you may use the option to submit electronically on Moodle or via a paper copy. If you prefer feedback on paper, you should submit a paper copy, but I will try to provide feedback electronically as much as possible in order to save costs and lessen our impact upon the environment. Assignments required in paper form will be announced.

I use e-mail and the Moodle site to help manage the course and field questions about the material, so I require that you use your **Gustavus** e-mail and Moodle account. Here's the **e-mail** protocol. **When you have questions, e-mail them to me.** If your question is very specific, I will reply directly. If the question seems potentially interesting to the entire class, I will forward the question (anonymously) and my reply to the class. I will assume you do not object to sharing your question unless you specifically state so. I also encourage you to use the **s-che-255** class alias to ask each other questions. As I may refer to e-mail questions in class and I use e-mail and the Moodle site for general class announcements and assignment postings, **I encourage you to check your e-mail before class and the Moodle site regularly.** Campus rules for alias use apply and abuse will not be tolerated.

Late assignment/ exam date change policies

All assignments (unless otherwise noted) are due on the given date by 5:20 pm. If you are unable to hand the assignment directly to me/your lab instructor or upload the assignment on Moodle, you may place the assignment under my/your lab instructor's office door by the due date/time. I expect you to turn in your assignments and take your exams on the scheduled day. However, I am aware that you all have many academic and personal commitments that go beyond this course. For this reason, you may choose to delay ONE assignment due date or scheduled exam date (not both) by up to **48 hours** without penalty. In order to take advantage of this option, you must inform me (for lecture assignments) or your lab instructor AND me (for lab assignments) at least 24 hours in advance of the scheduled 'date', unless there is a serious extenuating circumstance that prevents you from doing so. Email is a perfectly acceptable means of communicating that you need to extend a deadline. As an example, if an exam is on April 28th, you must inform me by 12:30 am on April 29th and you must take the exam by 12:30 am on April 30th. Each student will only receive ONE opportunity to take advantage of this option unless there is a serious extenuating circumstance associated with your situation. For unannounced late assignments that may follow, your final score on the assignment will be deducted by **10% for each 24 hour period** after the due date/time (*i.e.* a 30 point assignment turned in from 5:21 pm on the due date to 5:20 pm on the day after will be docked 3 points). NOTE: The final exam is NOT included in this policy.

Tips for Success in Biochemistry

CHE-255 is a challenging course and it is not unusual to experience difficulty with the material and some of the grading requirements. Nevertheless, I am confident that you can do well, especially if you follow the suggestions below.

I. Keep Current

It is very important that you keep up with the course material as it progresses. Keeping current will make the class much more understandable and enjoyable. You will be able to ask questions and make the class work for you. Keeping up with the course means reading the appropriate textbook chapter section, attending class, being prepared for class, reviewing notes immediately following class, checking email and/or Moodle regularly, and seeking clarification of the material as soon as possible.

Regular attendance and active participation in class is helpful to you, to me, and to your fellow students. It helps you clarify any difficulties you encounter. At times, the course lecture and questions asked by your peers will point out and solve a weakness of which you were not aware. Your questions in class help me to know where you are encountering difficulties. If no one says anything in class, how am I to know if I am lecturing too quickly or incorrectly assuming that you recall some facts from your 'core' coursework in the biology and chemistry departments? Your attendance and questions will help your fellow students in much the same way they help you. Your insights may be precisely what they need to help them understand.

You may also find it helpful to review and perhaps recopy your notes from each lecture before you attend the next one, and to reread text sections. As we move fairly quickly through material in this course, this may help you detect difficulties early enough to prevent any snowballing. More importantly, it will help make the lectures more useful and understandable. The 15-30 minutes you spend reviewing or recopying your notes may save you hours at exam time. As you review/recopy the notes, think about the material, do not just copy blindly. Ask yourself if the material makes sense.

For most of my course lectures, I will post a series of power point slides on the course Moodle page prior to the lecture. For some students, taking notes on the slides is very beneficial to help him/her learn the material. If this will help you, please feel free to access and print off these pages prior to or following lecture. NOTE: These slides may not be available until noon on the day of a lecture.

II. Prepare for the prelab lecture

Because laboratory is an integral part of the course, we will have a prelab discussion during the Tuesday lecture period prior to each laboratory experiment. It would be to your benefit to prepare for the lecture by reading and thinking about the experiment that is to be discussed. This preparation will allow you to more thoroughly understand experimental details that are being discussed or demonstrated. For example, when I do a demonstration of the pump and fraction collector, you will already have some idea about when and why you will be using these machines during the protein purification, thus facilitating specific questions about the instruments, laboratory or data analysis (i.e. how to set the flow rate). Biochemistry laboratory is a challenging and sometimes frustrating experience. If you can take advantage of the prelab lecture by asking specific questions about the procedure and tasks that are to be completed during the actual lab, you will likely have a more positive and successful laboratory experience.

III. Discuss material with your peers

Science is a collaborative endeavor. I encourage you to work with others as you study the material. You understand a concept only to the extent that you can explain it to another, or apply it to a situation/problem different than that presented in class. It is not enough to have read or heard about a concept, or 'followed' an example presented in class. You must be able to do it, explain it, or apply it to another problem or situation. If you do not understand a concept, ask a peer, or consult your textbook, your notes, or me as soon as possible.

Students with disabilities: Appropriate accommodations will be made for students with specific, documented disabilities of a physical, psychiatric or learning nature. Related information will be kept strictly confidential. Please contact either me or Laurie Bickett (x7027) in Academic Advising if this applies to you.

2/9	Wecome & introductions; course structure & approach	Syllabus
2/10	Zin Obelisk exercise – collaboration & leadership	
2/11	Overview of introduction; cell structure & function exercise	Ch. 1 (pp. 1-29)
2/13	Physical & genetic foundations	Ch. 1 (same), H ₂ O log
	Personal water use inventory due	
2/16	Properties of water	Ch. 2 (all)
2/17	<i>Prelaboratory Expt. 1</i>	Lab manual
2/18	Protein Structure - amino acids	Ch. 3 (pp. 71-94, box 3-2)
2/20	Protein Structure - peptides	Ch. 3 (same)
2/23	Protein Structure - methods	Ch. 3 (same)
2/24	<i>Prelaboratory Expt. 2</i> , protein methods cont.	Lab manual
2/25	Protein Structure - 3-D structure	Ch. 4 (pp. 113-38)
2/27	Protein Structure - 3-D structure	Ch. 4 (same)
	ProteinExplorer exercise due	
3/2	Protein Structure - folding	Ch. 4 (pp. 140-48)
3/3	Protein Structure - folding	Ch. 4 (same)
3/4	Protein Function - oxygen transport	Ch. 5 (pp. 153-69, box 5-1)
3/6	Midterm Exam 1 - Ch. 1-4	
3/9	Protein Function - oxygen transport	Ch. 5 (same)
3/10	<i>Prelaboratory Expt. 3</i>	Lab manual
3/11	Protein Function - oxygen transport	Ch. 5 (same)
3/13	Rydell Professor Curtis Marean ??	
	Article summary due	
3/16	Protein Function - oxygen transport	Ch. 5 (same)
3/17	<i>Prelaboratory Expt. 3 continued</i> , oxygen transport cont.	Lab manual
3/18	Protein Function - introduction to enzymes	Ch. 6 (pp. 183-200)
3/20	Protein Function - enzyme kinetics	Ch. 6 (same)
	ProteinExplorer exercise due	
3/21-29	Spring Break	
3/30	Protein Function - enzyme kinetics	Ch. 6 (same)
3/31	Protein Function - enzyme kinetics	Ch. 6 (pp. 201-5, box 1 & 2)
4/1	Nucleotides	Ch. 8 (pp. 271-81)
4/3	Midterm Exam 2 - Ch. 5-6	
4/6	Nucleic Acids	Ch. 8 (pp. 280-3, 292-6)
4/7	<i>Prelaboratory Expt. 4 & peer evaluation</i>	
4/8	Nucleic Acids	Ch. 8 (pp. 282-9), Ch. 9 (pp. 325-8)
4/10-13	Easter Recess	
4/14	Lipids	Ch. 10 (pp. 343-9)
4/15	<i>Prelaboratory on Experimental Design</i>	
4/17	Lipids	Ch. 10 (pp. 349-66)
4/20	Membranes	Ch. 11 (pp. 371-86)
4/21	Transport	Ch. 11 (same)
4/22	Biosignaling	Ch. 12 (TBD)
4/24	Biosignaling	Ch. 12 (TBD)
4/27	Carbohydrates	Ch. 7 (all, esp. 235-49)
4/28	Midterm Exam 3 - Ch. 8, 10-12	
4/29	Bioenergetics	Ch. 13 (pp. 495-521)
5/1	Bioenergetics	Ch. 13 (same)
5/4	Glycolysis	Ch. 14 (pp. 527-51)
5/5	Glycolysis	Ch. 14 (same)

5/6	Glycolysis	Ch. 14 (same)
5/8	Citric Acid Cycle	Ch. 16 (pp. 615-35)
5/11	Citric Acid Cycle	Ch. 16 (same)
5/12	Citric Acid Cycle	Ch. 16 (pp. 635-38)
5/13	Oxidative Phosphorylation	Ch. 19 (pp. 707-722)
5/15	Midterm Exam 4 - Ch. 7, 13, 14, & 16	
5/18	Oxidative Phosphorylation	Ch. 19 (723-32)
5/19	Oxidative Phosphorylation	Ch. 19 (732-35)
5/20	Review; course evaluations	
	Teaching approach paragraph due	
5/22	Comprehensive Final Exam 1:00-3:00 p.m.	

Biochemistry Laboratory Schedule

Week of:	Topic
2/16	Expt 1: Introduction to Basic Techniques
2/23	Expt 2: pH-Dependence of Tyrosinase Short report due for Expt 1
3/2	Writing discussion and workshop; Buffer preparation Literature reading, questions for discussion, buffer problems due
3/9	Expt 3: Purification of Mushroom Tyrosinase Short report due for Expt 2
3/16	Expt 3: (cont'd) Anion exchange separation data analysis & questions (DAQ) due Midterm laboratory notebooks due
3/23	No lab – spring break
3/30	Expt 3: (cont'd)
4/6	Expt 4: Kinetic Analysis of Tyrosinase Expt 3 formal report initial draft due on 4/9 by noon Expt 4 DAQ due same day
4/13	Tyrosinase Experimental Design 1st draft Tyrosinase experimental design proposal due Peer response on formal report due on 4/20 by 9:00 am
4/20	Tyrosinase Experimental Design & Preparation Final draft Tyrosinase experimental design proposal due
4/27	Tyrosinase Experimental Preparation & Execution
5/4	Tyrosinase Experimental Execution & Interpretation Final draft of Expt 3 formal report due on 5/4 by 5:00 pm
5/11	Tyrosinase Experimental Presentations Final lab notebooks due after presentations
