

BioC 3022
Biochemistry for the Life Sciences
Fall 2017

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Class Schedule: 11:15 AM - 12:30 PM Tuesday and Thursday in Bruininks Hall 330

Office Hours: Mondays, 2:00 PM in 6-110 MCB. You can also make individual appointments, please contact me by email.

Text: "Essential Biochemistry", Pratt and Cornely, J Wiley and Sons, Publishers. You can use either the first edition, second, third, or fourth edition. Alternatively, most other college-level biochemistry texts can be used, contact the instructor to check a particular book.

Prerequisites: A college-level biology course, and Chem 2081 or 2301 are required. Biol 3020 is not required.

Course Content: This course is intended for students in the College of Biological Sciences who need a comprehensive introduction to biochemistry. If you plan on declaring an undergraduate major in biochemistry, you must register for the alternative pair of biochemistry courses (BioC 4331 and BioC 4332), which provide a more extensive coverage of the subject.

This course will introduce you to the discipline of biochemistry and provide a foundation for understanding the chemistry of biological systems. We will discuss the structure and function of proteins, nucleic acids, lipids, and carbohydrates; the principles of chemical equilibria, enzyme catalysis and bioenergetics; and the essential metabolic pathways. In this course, you will become familiar with the structure and function of biological molecules that are important to living things, and with some of the fundamental metabolic pathways that describe how nutrients can be utilized for production of energy and for synthesis of new biological materials.

Important note about molecular biology: This course is intended for CBS students who have completed Biol 3020, and does not include any discussion of molecular biology. Students in other Colleges, or who have not taken Biol 3020, should take BioC 3021, which does cover molecular biology.

Student Learning Outcomes: Following successful completion of this course, each student should be capable of scholarly discussions of the following topics:

- the general principles of the biochemistry
- the chemical structures and function of the various classes of biomolecules
- energy flow in biological systems
- the central pathways of metabolism
- chemical processes that occur in the human body in health and disease
- Students should also be familiar with examples of the relevance of biochemistry in today's society, and
- be able to effectively communicate biochemical information in oral and written form.

In addition, students should develop a *sophisticated, portable biochemistry knowledge* that they can use long after to course ends to:

- explain to their grandparents why their doctor recommends low dose aspirin
- decide whether or not to pay more for shampoo that contains vitamins
- evaluate information on a new artificial sweetener
- understand a new therapy for cystic fibrosis
- ace the MCAT, DAT, or Bio 4003

Student Development Outcomes: In addition to setting goals for student learning, the University expects students to develop critical thinking and analytic skills. These skills are enumerated in the Student Development Outcomes (<http://www.sdo.umn.edu/Students/Outcomes/index.html>), and are as important to your success as the specific knowledge you gain. This course provides a chance to develop several of these skills, particularly “tolerance of ambiguity”. In biochemistry, as in life, you will need to solve problems for which there is not one perfect answer. You will have many opportunities to practice this important skill.

Active Learning: I will ask many questions during each class meeting: I want you to try to answer every one. For some questions, we will stop and discuss them in pairs or as tables; for other questions we will only pause a few seconds. It’s OK if you get a question wrong, or can’t find an answer: the important point is that you think about every one.

Student Expectations: As a student in this course, you are expected to take an active role in your learning.

- You are expected to arrive on time and not leave early.
- You should be prepared for each lecture by reading the assigned material. You should take good lecture notes and use the course packet to make sure you understand all of the concepts covered in class.
- You should use the text to clarify concepts that are unclear to you.
- You should ask questions in lecture to help clarify concepts.
- You should adhere to the University of Minnesota Student Conduct Code found at https://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf

Course Web Site: A Moodle site will be set up that contains course information and a bulletin board.

email Course Notices: Course information will regularly be sent out by email. University of Minnesota regulations require that this correspondence go to your assigned “___@umn.edu” address. Please be sure to check your umn.edu mailbox frequently, and do not forward your umn.edu mail to any other account. These accounts can fill up or reject important messages.

TA Help Sessions: Teaching assistants working with this course are undergraduates who have excelled in one or more courses in biochemistry. A schedule of times and locations of TA sessions will be distributed after the semester begins.

Homework: At the start of each class period, one (and sometimes two) assignments will be due. These include:
3 assignments in which you research a compound of your own interest
4 problem sets
20 daily homework to prepare you for class. You should come to class with these sheets completed and hand them to the TA for grading. You’ll get them back right away to use during class. Each is worth 2 points, and only your top 15 homework scores will be counted.

Examinations: There will be three midterm examinations and one final examination. Each exam will cover approximately one fourth of the course. Although the final exam will focus mainly on topics covered in the last quarter of the course, it also will include questions based on material from the entire course. Dates of the midterm examinations are listed in the lecture schedule below. All examinations will be closed book. While examinations are in progress, students may not consult the textbook, reference books, class notes, any other written summary of information, or another student's examination paper!

Electronic Devices: No electronic devices of any kind, including calculators, iPods, Blackberrys, and cell phones, may be used during any examinations. Use of a prohibited device during an examination is considered Scholastic Dishonesty and falls under the University Student Conduct Code.

Make up Exams: Students are to make every effort to take exams at the times listed in the syllabus. Make up exams will be given only to students who are sick on the day of the exam or who experience a significant unanticipated difficulty such as an illness or a death in the family. Being sick before an exam is not a valid reason

for missing an exam. Interviews, vacations, family trips, etc. are to be scheduled around your coursework, not vice versa. If you absolutely must miss an exam for an interview, you must take the make up exam before you leave for the interview.

Requests for make up exams must be accompanied by documentation (e.g., letters from university offices, doctors, police reports, bail bond receipts, towing or repair receipts, etc.). You must contact the instructor either before the exam or in a timeframe after the exam that is consistent with the reason for missing the exam.

Workload Expectations: For each credit of coursework, the University suggests that you spend two to three hours per week studying course material outside of class. That means six to nine hours per week for this course. To earn an A, you might need to spend more time than this!

The University defines each letter grade as follows:

A : achievement that is outstanding relative to the level necessary to meet course requirements.

B : achievement that is significantly above the level necessary to meet course requirements.

C : achievement that meets the course requirements in every respect.

D : achievement that is worthy of credit even though it fails to meet fully the course requirements.

F : Represents failure (or no credit) and signifies that the work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I .

Grading: The course has 430 total points distributed as follows:

Assignment 1	2 points
Problem Set 1	10 points
Exam 1	88 points
Assignment 2	2 points
Problem Set 2	10 points
Exam 2	88 points
Assignment 3	2 points
Problem Set 3	8 points
Problem Set 4	5 points
Exam 3	85 points
Exam 4	100 points
Homework (2 points each, top 15 count)	30 points

At the end of the course, letter grades will be assigned according to the point distribution curve. However, anyone who obtains a total score of 90% or more of the total points (387 or more points out of 430 possible) is guaranteed a course grade of at least A-, 80% or above at least a B-, 70% or above at least a C- and 60% or above at least a D. Plus and minus grades will be assigned on either side of the grade cutoff lines. The instructor may lower the grade cutoffs scores if necessary.

Late work policy: One point per day for assignments, or 20% of the total points for problem sets, will be deducted for each day late. Once the key is posted on the moodle site, no late work will be accepted. Assignments and problem sets must be turned in at the start of class on the due date. Homework can not be submitted by email without prior permission from the instructor.

Regrades: Any errors or problems with grading should be brought to the instructor's attention within one week of return of the graded item. No adjustments to the grade on that item will be made after one week. Only exams originally written in pen will be considered for regrades. If you want the option of submitting your exam for regarding, you must write the original exam in pen.

Incompletes: Grades of incomplete will be granted only to students who are receiving a passing grade and experience illness or other calamities that prevent them from finishing the course. The following conditions must be met:

1. the student's achievement to date has been significant and satisfactory (i.e. much of the coursework is finished with a passing grade),
2. the instructor has a reasonable expectation that the student can successfully complete the unfinished work by the end of the next semester, and
3. the student and instructor have signed a contract (available in CBS Student Services, 223 Snyder) agreeing to the work yet to be completed and the timeframe for this completion.

You are not eligible for an incomplete if you are failing and want to try the course again another semester. You must be passing the course and have a compelling reason why you can not finish the work. Note that the I grade will automatically turn to an F grade if the conditions specified in the contract are not met within one year. See the CBS grading policy at: <http://www.cbs.umn.edu/students/grades-and-grading-options>.

Appropriate Use of Course Material

All material presented in this course is the intellectual property of the instructor or copyright assignee and is provided solely for use by the enrolled student. Students must not distribute by any means lecture slides, figures, images, movies, audio recordings, exams, homework, text, or any other instructor-provided materials without the permission of the instructor. This means you are not allowed to post anything from this course on social media or to any web site whatsoever.

Academic Misconduct: Examples of inappropriate conduct include, but are not limited to: copying from another student, permitting another student to copy, the use of written or electronic crib sheets, collaborating with other students to answer a question, receiving information from another student about an examination when taking an examination late. In cases of misconduct, the instructor will take appropriate actions, which could include filing a report with the Office for Student Academic Integrity. Violations will elicit penalties such as a failing grade for the examination or a failing grade for the entire course, depending upon the nature and severity of the infraction. To review the Regent's policy on academic conduct, please refer to https://regents.umn.edu/sites/regents.umn.edu/files/policies/Academic_Misconduct.pdf.

Mental Health Services: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: <http://www.mentalhealth.umn.edu>.

Accommodations: Students with disabilities that might hinder their ability to participate in the full range of class activities should contact the instructor as soon as possible. Additional information on accommodation is also available from Disability Services in 230 Gateway (V/TTY) 624-4037.

Problems in the course? For any concerns, contact the instructor.

My Philosophy for the Course: My approach to this course is based on two observations:

1. Biochemistry is a foundational science. Whatever you do in the life sciences, a solid background in biochemistry will help you.
2. You are paying a lot of money to take this course: you deserve to get a lot of instruction.

Therefore, I will deliver a rigorous, content-rich course, and will have high expectations of you. To get the most out of this course, you should set high expectations for me, and most importantly, for yourself.

What does it take to do well in this course?

How to Fail Biochemistry

1. Don't study as you go. You can cram all the important information in the night before the test, just like you did for that "Paths to German Heroic Poetry" final.
2. Don't worry about details, focus on the big picture. Who cares if that -OH group points up or down?
3. Skip class. It's all in the book, there's no decent jokes, and you have the lecture notes. So why go?
4. Don't learn the assigned structures. Memorization is just make-work, not a learning tool. You won't retain them anyway. If the instructor were really interested in helping you learn, he would *teach* you instead of making you memorize things.
5. Sit way in the back. You've got the notes so you don't need to see the screen and there's more room to stretch out back there. Besides, sometimes that one guy watches some pretty good DVDs on his laptop during lecture and you can look over this shoulder.
6. Never ask questions in class. Every single person in the entire class always understands all the material perfectly and you will look like a complete and utter fool if you ever ask even one single question.
7. Don't bother reading the book before class, and forget about doing practice problems. You can get by fine without them.
8. Don't get help. The TAs are overworked and underpaid, and the Professor certainly doesn't want to talk to you.
9. Don't form a study group. Unless you prefer to study alone, in which case you should definitely join a study group so that you work less efficiently.
10. Adopt and maintain a negative attitude. Remember, learning SHOULD hurt, and by being miserable during this course, you can join the legions of miserable Biochemistry students around the world and throughout time.

How to Pass Biochemistry

1. Study as we go. Many students have done this experiment and the results are conclusive: you cannot learn this material by studying just a few days before the test. The U recommends two hours of outside studying for each hour of class time. Sometimes you won't need that much, but sometimes you will. Generally, you should study biochemistry for at least an hour, at least three times each week. If your background in chemistry is not strong, increase this to four times a week. We will cover lots of material and it comes at an ever-increasing pace, so you may have to spend time every day studying Biochemistry. Much of the material builds onto prior material; if you don't study as we go, you'll have a difficult time.
2. Biochemistry is a science of details. To the cell, details ARE the big picture. If the OH group points up instead of down, the properties of the molecule can change drastically. At times, we will pay enormous attention to detail, even following individual electrons around in order to understand how cells work.
3. Come to class every time. I am here to explain and highlight the most important material. The book generally has a lot more information than we will cover (feel free to learn it though!). Also, I frequently diverge from my lesson plan, so even the course packet won't have the information we actually discuss. Remember that *exams are based on the material actually covered in class*, not on what's in the book or course packet. In addition, in-class exercises and active learning will cement your knowledge. If you already know all the material cold, come to class anyway. Take your understanding to a deeper level, make connections

with the other material we have covered, look to see how the topic is relevant to your life beyond this class, or figure out questions to stump your instructor!

4. Learning biochemistry is like learning a language: structures are the vocabulary and you can't speak the language without them. In fact, it is much easier to understand the reactions we will talk about if you know the structures. This is because the structures make the chemical logic of the reactions obvious. For example, by knowing the structures of the amino acids, you will easily understand how a single mutation causes sickle cell anemia; without knowing the structures, you would not be able to understand the disease. Yes, you will forget the structures over time, but having memorized them once, you will learn them much more quickly the next time you see them, on the MCAT or in Dental School Biochemistry courses, for example. Finally, students in past years have done extremely well on the parts of exams where they are asked to draw structures: think of the structures as easy points!

5. Don't sit way in the back. If I can see you, I can tell if you don't understand something and I will go back over it until you do. If the screen looks like a postage stamp, it will be very hard to follow the lecture. Studies show that students sitting in the front get higher grades.

6. If you don't understand something, you can be certain that others in the class don't understand either. Don't let it go by: raise your hand and ask for clarification. I promise I will never make your question sound dumb. More importantly, science is a process of asking questions about things you don't understand. The process is identical whether you are conducting research in the lab, or learning in classroom. Formulating questions to ask in class is good practice for anyone interested in science.

7. Reading the book before class really helps. Even if you don't understand the chapter, you will at least be introduced to new vocabulary and major topics on the subject. The lecture will then clear up your questions. If you do understand the chapter, you will get more out of lecture. By being familiar with the topic before lecture, the material will make more sense to you, taking notes will be easier and you will be better able to ask clarifying questions. Even if you are already familiar with the material, you will achieve a better understanding by reading the text before lecture.

8. Draw when you study. Instead of just reading your notes and book, use your hand and eyes to draw an illustration of the material. It could be a biochemical pathway, an altered protein structure, or a map of the worldwide incidence of diabetes. Also try to recreate important figures from lecture. **If you can draw them, you generally have a deep understanding of the material.**

9. Journey to Understanding. You will have to memorize structures and pathways. Don't stop there. After memorizing the material, move to understanding it. I will use detailed examples to show you how to do this.

8. Get help when you need it. The TAs are really excellent. They have taken this and other biochemistry courses and done very well. They can offer the material from a different perspective (they are underpaid, though). As for the Professor, it is my job to help you learn, and I am happy to do so. You can contact me by phone or email, or in person before or after class or during office hours.

9. Study groups are a matter of individual preference. If you work well with others, by all means study together. If you work more efficiently alone, you could still contact other students when you have questions.

10. Believe it or not, most students really enjoy this course. It ties together a lot of material you have learned in Biology, Chemistry, and Organic Chemistry. This section has a focus on human disease, which many students find very interesting. My college Biochemistry course was miserable and was taught by instructors who were miserable: I am determined that yours will be better than mine was.

**BioC 3022 Lecture Schedule
Fall Semester, 2017**

Lecture	Date	Topic	Text: Fourth Edition	
1	T	9/5	Overview, Water, pH, and Ionic Equilibria	Chapter 2
2	Th	9/7	Organic Chemistry Review	1-9
3	T	9/12	Assignment 1 Due Amino Acids	85-92
4	Th	9/14	Proteins: Primary and Secondary Structure	93-106
5	T	9/19	Problem Set 1 Due Purification and Function	
6	Th	9/21	Blood Proteins	119-129
	T	9/26	FIRST HOUR EXAM	
7	Th	9/28	Thermodynamics and Introduction to Enzymes	10-14, 154-160, 183-192
8	T	10/3	Enzyme Kinetics	164-171, 194-200
9	Th	10/5	Enzyme Mechanisms	160-164
10	T	10/10	Assignment 2 Due Carbohydrates	Chapter 11
11	Th	10/12	Lipids and Membranes	215-219, 222-229
12	T	10/17	Problem Set 2 Due Nucleotides	52-59
13	Th	10/19	Introduction to Metabolism	308-321
14	T	10/24	Catch up / Review	
	Th	10/26	SECOND HOUR EXAM	
15	T	10/31	Glycolysis	329-344
16	Th	11/2	Glycolysis II	
17	T	11/7	Assignment 3 Due Citric Acid Cycle	362-374
18	Th	11/9	Problem Set 3 Due Electron Transport	385-405
19	T	11/14	Gluconeogenesis and Glycogen Metabolism	344-352, 501-505
20	Th	11/16	Catch up / Review	
21	T	11/21	THIRD HOUR EXAM	
	Th	11/23	Thanksgiving Day	
22	T	11/28	Lipid Metabolism	435-9, 443-7, 450-2, 454-5
23	Th	11/30	Amino Acid Metabolism, Metabolic Integration	467-9, 476-9, 480-484
24	T	12/5	Problem Set 4 Due Pentose Phosphate Pathway, Cancer Metabolism	350-352, 511-513
25	Th	12/7	Photosynthesis, Sports Cheating	Chapter 16
26	T	12/12	Biochemistry of HIV	
FINAL EXAM:		8:00-10:00 AM Saturday, December 16, 2017		