CHE 170: Molecular and Cell Biology for Engineers

UCSB Department of Chemical Engineering

meeting times:	TuTh 11:00am-12:15pm, Engineering II 1519
enrollment code:	04945
web page:	www.engr.ucsb.edu/~shell/che170/
course announcements:	thermopia.blogspot.com (You can subscribe to updates via email.)

Course description and objective

Credits: 3

Prerequisites: Chemistry 109C.

This course aims to familiarize engineering students with basic molecular and cellular biology principles and concepts, and to apply chemical and engineering principles to further the understanding of biological systems. Topics include protein structure and function, transcription, translation, post-translational processing, cellular organization, molecular transport and trafficking, and cellular models.

Instructor

Professor Scott Shell
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Office hours: M 11am-12pm, W 10-11am
(or by appointment)

Teaching assistant

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Office hours location: Engineering II 3201

Course text

Essential Cell Biology, 3rd Edition. Alberts et al., Garland Science (2009).

Course policies

1. The basis of grading will be 35% homework and other assignments / 25% quizzes / 40% final.
2. ***There will be absolutely no make-up quizzes***. However, the lowest quiz grade will be dropped, which should accommodate absences due to illness, job interviews, etc.
3. Homework will be assigned and collected on Thursdays ***in class***. Late homework will not be accepted unless there is an excellent reason, ***which should be arranged in advance***.
4. For questions on homework grading, please see the TA within one week of receiving the graded homework back. For exams, see the instructor within one week after exams are returned.
5. Your integrity is of upmost importance. ***Cheating of any form will not be tolerated*** and may lead to university expulsion. Copying other students' work or searching the internet for answers is considered cheating, as it is a significant disservice to your learning.

Important dates

Thursday, Nov 11: university holiday; no class
Thursday, Nov 25: university holiday; no class
Thursday, Dec 9, 12-3pm: final exam

How to succeed in this course

1. **Read, read, read the book.** You will not be able to pass the quizzes or understand the lectures without having read the book thoroughly. It is essential to build a robust working knowledge of the processes and components in the cell in order to apply chemical engineering principles.
2. **Take note of concepts and statements that you do not understand.** Write them down, jot things in the margins, constantly keep tabs sources of difficulty and confusion for you. Then, seek answers. Work through problems a second time. Consult a different book. Ask a peer. Use office hours.
3. **Be independent.** Work on problems by yourself first. Try to resolve difficulties by taking different approaches, working on related examples, or consulting other texts. *Then*, consult your peers for discussion of the best approach. Working in groups on homeworks from the outset tends to let things you don't understand slip by unnoticed.
4. **Think carefully and deeply.** It is important to know the concepts and assumptions on which the equations are based. Do not try to find or memorize formulas and apply them blindly to problems. Pose yourself questions. After working through a problem, ask yourself, "What would happen in that problem if X were changed to Y?" Challenge yourself to think of possible variations beyond the examples in the lectures and homeworks.
5. **Attend all classes. Utilize the office hours.** Use all of the resources available to you to help you understand and master the course material.

How to work homework sets and exams

To obtain maximum credit and avoid mistakes, follow the strategies below. These are simple steps that you should internalize and apply to every assignment.

1. **Work neatly and professionally.** Use clean paper, not torn from a notebook. Staple your work together before coming to class. Use legible handwriting and clearly indicate the progression of ideas in your solution. It is better to use more pages and have a clearly presented solution than to cram all of your work onto a single page. ***Homework sets not prepared according to these guidelines will automatically incur a 25% deduction.***
2. **Add explanations and commentary where appropriate.** For lengthy problems, outline your strategy, draw diagrams, and comment to explain your approach. If you run out of time and your approach is correct, you will receive partial credit even if you did not get the correct final answer.
3. **Start with fundamental equations.** Be careful not to take special-case equations "off the shelf" when working problems, unless you are fully sure they apply. It is always better to start working each problem from the fundamental equations.
4. **Wherever possible, maintain your solutions in analytic form until the final answer.** Avoid plugging in numbers before reaching a final solution.
5. **Watch your units and scales.** Always check to make sure that units in equations combine appropriately. Check that the order of magnitude of your answer is reasonable.

Tentative schedule (subject to change)

date		lec	topic	reading	due
9/23	Th	1	**Course organization** **Molecular and cell biology in engineering** **What's in a cell?** • kinds of cells	Ch. 1-2	
9/28	Tu	2	• interactions • molecular building blocks • components, compartments, organelles	Ch. 1-2	
9/30	Th	3	**Energy, thermodynamics, and molecular processes** • energy, entropy, and free energy	Ch. 3	Q1
10/5	Tu	4	• microscopic interpretation • energy sources, carriers, and storage	Ch. 3	
10/7	Th	5	**Proteins: the biomolecular workhorses** • protein composition • protein folding thermodynamics and kinetics	Ch. 4	HW1
10/12	Tu	6	• protein structure • recognition and ligand binding	Ch. 4	
10/14	Th	7	• allostery and cooperative binding	Ch. 4	Q2
10/19	Tu	8	• enzyme catalysis	Ch. 4	
10/21	Th	9	**Information management** • overall information flow • DNA structure and packaging • DNA replication and repair • transcription and RNA	Ch. 5-7	HW2
10/26	Tu	10	• translation, genetic code • manipulating DNA, proteins, cells	Ch. 7, 10	
10/28	Th	11	**Compartmentalization** • lipids and membranes; self-assembly • osmotic driving forces • transmembrane proteins and solute transport	Ch. 11-12	Q3
11/2	Tu	12	• ion channels, membrane potential • neurons	Ch. 11-12	
11/4	Th	13	**Transport (protein sorting & processing)** • diffusion at the molecular scale • protein movement through the cell	Ch. 15	(HW3)

11/9	Tu	14	• post-translational modification • vesicular transport	Ch. 15	Q4,HW3
11/11	Th		**NO CLASS – holiday**		
11/16	Tu	15	**Process control (regulation & signaling)** • signaling and signal transduction • control of gene expression	Ch. 15	(HW4)
11/18	Th	16	• drug delivery examples	Ch. 8, 16	HW4
11/23	Tu	17	• systems biology [guest lecture F. Doyle]	Ch. 8, 16	Q5
11/25	Th		**NO CLASS – holiday**		
11/30	Tu	18	**Mechanics (cell structure & motility, tissues)** • protein self-assembly • actin filaments; myosin • microtubules	Ch. 17, 20	
12/2	Th	19	• tissues • cell proliferation, tumor growth	Ch. 17, 20	HW5
12/9	Th		**FINAL, 12-3pm**		