Bi 251: Biochemistry and Cell Physiology Course Information Fall 2010

Professor: Karen Sprague ksprague@molbio.uoregon.edu

Office Hours: Wednesday 11:00 AM – 12:30 PM, 15E Klamath; special Office Hours, by appointment

Course web site: Log into Blackboard and go to Bi 251. The Office Hours of all Bi 251 faculty, Graduate Teaching Fellows and Peer Tutors are listed on Bb

Overview of the Foundations sequence: This sequence will introduce you to the full range of biology – and will emphasize cellular, molecular and genetic mechanisms. Throughout the sequence, we want you to understand the fundamental principles that explain much of the biology we see every day, and we also want you to appreciate how those principles were arrived at. All three courses emphasize scientific reasoning, and will give you practice in this kind of thinking. The labs associated with each course are especially useful for this because we have deliberately linked the main ideas in the lectures and labs so that you can apply the same concepts in different settings. The Foundations sequence is ideal for pre-medical students and for students planning post-graduate work in any biological science.

Foundations I (Bi 251) begins the sequence by asking how cells work. To answer this question, you will first learn about the properties of proteins that make them effective as the principal structural elements and catalysts within cells. You will learn the distinctive physical characteristics of the 20 different amino acids that make up proteins -- things like size and shape, relative hydrophobicity, and positive or negative electrical charge. The purpose is to understand how these simple characteristics account for the complex structures and remarkable activities of proteins. You will then investigate the central challenge to cells: the need to convert food energy into a form that is capable of driving the energy-requiring reactions that life depends on. Finally, you will learn now cells co-ordinate their repertoire of chemical reactions so as to be both energetically efficient and able to respond effectively to changes in their surroundings – for example, the supply of food.

Foundations II (Bi 252) asks where proteins come from and how their production is regulated. You will examine the role of DNA and RNA as informational molecules that direct the synthesis of proteins, and transmit genetic information to subsequent generations. You will also dissect the mechanisms by which cells respond to changing conditions by altering the pattern of proteins they produce. You will learn about current research, particularly the elegant experiments that underlie our present understanding of gene regulation and embryonic development.

Foundations III (Bi 253) synthesizes ideas from the first two courses to explain the remarkable biological diversity that characterizes our planet. You will build on your understanding of embryonic development from Bi 252 to consider developmental variations that generate different body plans – the bilateral symmetry of humans compared with the radial symmetry of starfish, for example. You will then learn how genetic variation and natural selection generate biological diversity, and you will examine the interactions of organisms with each other, and with their environments, that create complex ecosystems.

Hints for Success in Bi 251

Problems and old exams: All of the Foundations courses emphasize reasoning, not just memorization. Although you will need to commit some facts and new terminology to memory, what's most important is to understand what the facts mean and how they fit together. In Bi 251, we'll give you practice in this kind of thinking in the form of problems and old exams. The problems may strike you as unusual – different from the ones you're accustomed to in Chemistry courses. Many are "story problems" that won't have been worked out in class. When you first read a problem like this, you may not immediately see how to solve it, but that's OK. Keep at it. Try to re-formulate the question in your own words, ask questions in office hours, discuss the problem with other students. You'll find that trying to solve problems of this kind may take a while, but the process will help you identify the fuzzy areas in your thinking. **Working lots of problems is the best possible way to study for this course**. Simply reading the textbook, even several times over, won't do the trick. If you want to understand the material at the level required for success, you need to work problems. Several years ago, a student took Bi 251 twice – first, working few problems and doing poorly, and then again, working lots of them and doing well. Here's the email I received after the second round: "I must say, this class was just as challenging the second time around. The key to success, which you state pretty clearly in the syllabus, is doing the problem sets. That helped with the final and midterms." Nuf ced.

Labs: Bi 251 includes both lectures and a weekly 3-hour lab period. The main ideas in the lectures and the lab exercises are tightly linked so as to allow you to grapple with the same concepts in different ways. The lab work is not meant to teach techniques. Rather, the exercises are designed to minimize technical manipulations, and allow you to concentrate on what the lab is really about. Both faculty and student teaching assistants are available in the labs throughout the 3 hours. **Talk to them about what you're doing – even (or especially) if you're confused.** One of my colleagues in Math tells his students that Math isn't meant to be understood instantly. I think the same is true of Biochemistry. On the other hand, if you're mentally engaged during the lab period and take advantage of it, you'll emerge with insight.

Textbook: Biochemistry textbooks typically contain more detail than is useful for an introduction to the subject. Pratt and Cornely does a better job than most in presenting key principles clearly, but I've still suggested a path through the book *via* the specific weekly reading assignments on the Lecture/Lab Outline. You'll find that these assignments do not simply go through the book, chapter by chapter, as is typical in high school courses and in some college freshman courses. That's because Bi 251, as a true university-level course, is organized around a set of concepts rather than a series of facts. To help you understand these concepts, I've made the text fit the lectures as closely as possible by identifying the specific sections of chapters that are closest to the material in each of my lectures. Initially, it may be disconcerting to find that you are reading parts of widely separated chapters in the same week (*e.g.* Chapters 1,2 and 4 in Week 1), but I think you'll see that this approach makes the text and lectures reinforce each other. You may find it helpful to read quickly through an entire chapter and then focus on the section that's particularly relevant to the lecture. That way, you'll get an initial overview before focusing on the particular concepts of the week.

Biochemical Charades: Each Friday, we'll play charades – not the competitive kind involving words and phrases, but a representation of a biochemical process or concept. Each Friday, a different group of students will perform a charade and the rest of the class will try to guess what's being represented. This may strike you as just playing around, and I do hope you'll enjoy it, but it's also a great way to get a grip on abstract ideas.

Organization and Grading

Format: 3 lectures (10 AM Mon. Wed. Fri.) each week in 240A McKenzie
1 three-hour lab session each week in Klamath

Course Material (available in UO Bookstore): Text: Pratt and Cornely, Essential Biochemistry, 2004
Lab Manual
Problems and Old Exams
Lecture Diagrams (also available on the course BlackBoard site)

Exams and Grading:

There will be two hour-exams plus a comprehensive final exam. The exams are not open book, but some factual information will be provided. Look at the back of the Old Exams packet to see exactly what factual information you'll be given.

Your grade for the course will depend on the combination of your performance in these exams (400 points possible) plus your work in the labs (270 points possible). **Total possible course points (exams + lab) = 670**

Scores will be determined by 2 methods for each student:

			Points	% total course pts
Method 1				
2 Hour-exams	100 + 100	=	200	30
Final exam			200	30
Lab			270	40
	Total		**670**	**100**
Method 2				
1 Hour-exam (highest score)	100 x 1.33	=	133	20
Final exam	200 x 1.33	=	267	40
Lab		=	270	40
	Total		**670**	**100**

Points for lab work will be calculated as follows:

Self-help Quiz (pts for taking)		=	10
Quizzes (8 x 15 pts/quiz)	120 x 1.3	=	156

Lab reports (8 x 8 pts/report)			
+ pre-labs (8 x 2 pts/pre-lab)	80 x 1.3	=	104
	Total		**270**

2 letter grades will be assigned on the basis of the Method 1 and Method 2 scores. If the two grades differ for an individual student, the higher letter grade will be awarded. Letter grades are determined only after the **total** course points have been calculated, not after individual hour exams. The percentages of total course points that correspond to particular letter grades vary somewhat from year to year, but are approximately: 85% = low A, 75% = low B, 60% = low C, 50% = D. Since grades are not assigned strictly on the basis of a statistical distribution about a mean, the opportunities to earn good grades in this course are not restricted and you are not in competition with other students for a fixed number of top grades.

Re-grading: Exams will be returned to you during your lab period. If you wish to have an exam answer re-graded, you must WRITE a logical explanation for why your answer merits a higher score, attach it to the exam, and submit both the explanation and the exam to the course instructors. Well thought-out arguments will be carefully considered, but other questions on the exam may be re-graded as well, and requests that we simply "look again" at an answer will not be honored. **To be considered for re-grading, your exam and explanation must be submitted by the announced deadline – which is typically, though not always, at the beginning of your lab period, within one week of your receipt of the graded exam. Be sure to check the actual re-submission deadline for each exam.**

Missed exams: No make-up exams will be given. If you miss an exam for a valid (usually medical) reason, you should provide written documentation of that reason, and your grade will be based on the other exams you have taken. In the event of a major flu outbreak, the kind of documentation required may change and we will communicate this to you.

Disabilities: If you have a documented disability and anticipate needing accommodation in this course, please make arrangements to meet with me. When you come to that meeting, please bring a letter in which a Disabilities Services counselor has verified your disability.

Bi 251: Biochemistry and Cell Physiology Lecture & Lab Outline Fall 2010

Course Overview: This course focuses on the structures and the regulated chemical reactions that allow cells to grow, to transform energy, and to communicate.

Date			Lect #	Topic	Reading in P & C 2004	Lab Topic
				Structure and Action of proteins		
Mon.	Sept	27	1	The inner life of a cell: Can this be man-made ?? Why amino acids are important.	Ch 1 (pp 2-10), `	Self-help Quiz
	Sept.	29	2	Ionizable groups and amino acid charge	Ch 2 (pp34-41); Ch 4 (pp 90-99)	
	Oct.	1	3	Charge on peptides; isoelectric point	"	
Mon.	Oct.	4	4	3-D protein structure: why do proteins fold?	Ch 1 (pp 11-12); Ch 2 (pp 25-31)	Structure & Properties of Amino Acids
	Oct.	6	5	Universal and variable structural features	Ch 4 (pp 103-115).	
	Oct.	8	6	Proteins that bind DNA: p53 and cancer	Ch 18 (pp. 556-560)	
Mon.	Oct.	11	7	Enzymes: What happens in active sites?	Ch 6 (pp 166-174)	Protein Structure
	Oct.	13	8	An example: chymotrypsin	Ch 6 (pp 174-184)	
	Oct.	15	9	"	"	
Mon.	**Oct.**	**18***	10	What kinetic analysis reveals about enzymes	Ch 7 (pp 198-210); LD I (pp 77-79)	Quantitation of Enzyme Activity
	Oct.	20	11	"	Ch 7 (pp 213-219)	
	Oct.	22	12	Cooperativity: How does hemoglobin bind & release O_2 "intelligently" ?	Ch 4 (pp 116-126)	

*** First Hour Exam:**	**Monday, October 18**	**7-9 PM**	**189 PLC**
Review for Exam:	Thursday, October 14	7-9 PM	129 McKenzie

Date		Lect #	Topic	Reading in P&C 2004	Lab Topic
Mon.	Oct. 25	13	Allostery: Why hemoglobin works best inside cells	Ch 4 (pp 116-126)	Enzyme Kinetics
			Key Cellular Structures and Strategies		
	Oct. 27	14	Structure & function of biological membranes: Why lipids **and** proteins?	Ch 2 (pp 32-34) Ch 8 (pp. 232-246)	
	Oct. 29	15	Intracellular organization: Why are internal compartments needed? How are small molecules transported in, out, and through cells?	Ch 1 (pp. 14-21) Ch 8 (pp. 248-258)	
Mon.	Nov. 1	16	Intracellular organization: How do proteins get to the right places? What determines cell shape and mobility?	Ch 5 (pp. 136-152) Ch 6 (pp. 186-191)	Cooperativity & Allostery
			Metabolic Strategies Common to All Cells		
	Nov. 3	17	Why do cells need high energy electrons? Glycolysis + fermentation: One fate of high energy electrons	Ch 1 (pp.13-14) Ch 9 (pp. 276-290) Ch 10 (pp. 302-324)	
	Nov. 5	18	Glycolysis *vs*. gluconeogenesis: Why are the 2 pathways different?	Ch 10 (pp. 324-328)	
Mon.	**Nov. 8***	19	Respiration: Another fate of high energy electrons The 2 roles of the Krebs Cycle	LD II (pp 50a,b,c) Ch 11 (pp 342-348) Ch 11 (pp 360-362)	Osmosis & Transport
			How Mitochondria and Chloroplasts Work		
	Nov. 10	20	Energy changes in oxidation/reduction rxns	Ch 12 (pp. 370-375)	
	Nov. 12	21	Energy changes during electron transport by mitochondria	Ch 12 (pp 375-385)	

*** Second Hour Exam:**	**Monday, November 8**	**7-9 PM**	**180 PLC**
Review for Exam:	Thursday, November 4	7-9 PM	129 McKenzie

Date		Lect #	Topic	Reading in P&C 2004	Lab Topic
Mon.	Nov. 15	22	How does electron transport drive ATP synthesis? Mitchell's idea	Ch 12 (pp 385-387)	Intermediary Metabolism
	Nov. 17	23	Mitochondrial structure and proton motive force are linked.	"	
	Nov. 19	24	ATP synthesis requires a regulated pore & allostery	Ch 12 (pp 388-392)	
Mon.	Nov. 22	25	Photosynthesis is the sum of 2 redox reactions	Ch 13 (pp 398-413)	**No Lab**
	Nov. 24	26	Chloroplast structure: why both thylakoid and stroma?		
	Nov. 26	-	**Thanksgiving Holiday**		
Mon.	Nov. 29	27	Alternative life styles: How to thrive by eating iron or breathing CO_2		Respiration in yeast
			Communication Within and Between Cells		
	Dec. 1	28	Metabolic communication within cells How cells decide whether to synthesize <u>or</u> degrade glucose (not both) Why bumble bees sometimes do both!	Ch 10 (pp 327-328)	
	Dec. 3	29	Metabolic communication between cells Regulation by hormones: glucagon & insulin De-regulation & diabetes	Ch 16 (pp 500-510; 517-519) LD II (pp 112a,b)	

Final Exam (Cumulative):	**Wednesday, December 8, 2010**	**10:15 AM - 12:15 PM**	**129 McKenzie + other rooms**
Review for Exam:	Monday, December 6	7-9 PM	TBA