

**Bio. Sci. 210**  
**Fall 2009**

**Cell Biology and Biochemistry**

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Text: Essential Cell Biology, 2<sup>nd</sup> edition, by Alberts, et al., 2004

<u>Dates</u>	<u>Topics</u>	<u>Readings</u>
Sept 2	Introduction to Cell Biology (JS)	Chap 1, Chap 2
Sept 4, 9	Structure of Biological Molecules (JS)	Chap 2
Sept 11, 14, 16	Concepts of Macromolecular Structure (HR)	Chap 4 (pp 119-143)
Sept 18, 21	Enzymes (HR)	Chap. 3, Chap 4 (143-158)
Sept 23	Color Vision, Blood type (JS)	
Sept 25-30, Oct 2	Structure & Function of Membranes (JS)	Chap 11, pp. 389-405, 164-5, 697-716
Oct 5	Specialized cells – Nerve (JS)	Chap 12 (403-423)
Oct 7	Cell Communication (JS) Specialized cells – Liver, Pancreas (JS)	Chap. 16 (533-552)
Oct 9, 12	Metabolic Pathways (HR)	Chap 13 and review Chap 3
Oct 14, 16	Mitochondria & Cell Respiration (JS)	Chap 14 (453-476)
Oct 19	Midsemester break!	
Oct 21, 23	Photosynthesis (JS)	Chap 14 (478-490)
Oct 26, 30	Structure & Replication of DNA (HR)	Chap 5, Chap 6 (169-208)
Oct 28	<b>Exam III</b>	
Nov 2, 4, 6	Expression of Genetic Information (HR)	Chap 7 (229-254), Chap 8 (273-278)
Nov 9, 11	Protein Sorting and Secretory Pathways (JS)	Chap 15 (497-523)
Nov 13, 16	Endocytic Pathways (JS)	Chap 15 (523-529)
Nov 18, 20, 23	Cytoskeleton and Skeletal Muscle (HR)	Chap 17, pp. 697-716
Nov 25-29	Thanksgiving Holiday	
Nov 30	Mitosis (HR)	Chap. 18 (611-614), Chap 19
Dec 2, 4	Cell Division and Cancer (HR)	Chap. 18 (614-634), Chap 21 (717-737)
Dec 7	Immune System (HR)	
Dec 9	Review in context—Gut, Liver, Pancreas	

Check on Blackboard for Monday Discussion Assignments

Sept. 14	<b>QUIZ</b> on molecules, polarity, bonding. Work on protein structure. Access <a href="http://jmol.sourceforge.net/">http://jmol.sourceforge.net/</a> and view beta-galactosidase. Select “List of many more” at the end of Jmol and find Hemoglobin, Dimeric DNA Polymerase III and Complete Antibody.	
Sept 21	Discussion Topic	Enzymes
Sept 28	<b>Exam I</b>	
Oct. 5	Discussion Topic	Membranes
Oct 12	<b>Exam II</b>	
Oct 19	On your own	Metabolism question sheet
Oct. 26	Discussion Topic	Mitochondria and Chloroplasts
Nov. 2	Discussion Topic	DNA replication and expression
Nov. 9	Discussion Topic	Protein synthesis on free or attached ribosomes
Nov 16	<b>Exam IV</b>	
Nov 23	No Class	
Nov 30	Discussion Topic	Cytoskeleton and muscle
Dec 7	Review	

**Note:** Students are responsible for checking Blackboard for postings of lecture notes and images, readings and homework assignments, and other important course announcements.

**Discussion Sections:**

Groups of students will meet in a tutorial format with an instructor. Questions will be provided before each session. Attendance at these sessions is required and participation is graded.

**Grading:**

Four one-hour examinations will be given during the semester. Your three highest exam grades will each count as 20% of your final grade. The lowest one of your four exam grades will count as 10% of your final grade. The final examination, which is required of all students, will be comprehensive and account for 20% of the final grade. The additional 10% of the final grade will come from the quiz and assignments for the discussion sessions.

Reminder: All students are bound by the standards of the Academic Honor Code, found at [www.goucher.edu/documents/General/AcademicHonorCode.pdf](http://www.goucher.edu/documents/General/AcademicHonorCode.pdf)

## **Overview of Biology 210**

Our goal for this semester is to help you understand the fundamental concepts of cell biology & biochemistry so that you might use them in subsequent learning and in your understanding of life. We hope that you will gain an appreciation for the cellular level of biology, how we determine new information about cells, and about practical applications of this knowledge. We realize that as you review your notes from this semester, it might be a bit overwhelming. This review sheet is an attempt to help you focus your studies so that you can see the big picture.

Please do not hesitate to make an appointment to ask questions – we would be happy to see you!

Best of luck!

Drs. Ratrie & Shambaugh

Every student of biology should know the following:

Similarities and differences between prokaryotic & eukaryotic cells

Similarities and differences between plant and animal cells

Be able to draw/recognize a rough diagram of each type of cell including organelles where necessary

The course is divided up into sections that are covered by each of the four exams. Although the course is divided into sections, you should now be able to use cell biological concepts to explain the functioning of certain systems, such as how a muscle functions or how carcinogenesis occurs. Below is a review of the fundamental concepts of each unit.

### **Molecular composition of cells**

What are the three classes of macromolecules that are regular repeating polymers? What is the fourth class? What are their functions? Where in the cell are you likely to find the different types of macromolecules? How are they synthesized & what enzymes are involved? What monomer unit acts as a building block for each type of macromolecule? Be able to draw a bond between monomer units. Is there an energy requirement for synthesis/degradation of macromolecules? What are the biochemical properties of the monomer units and how does this contribute to the structure of the macromolecules? You should be able to recognize diagrams of the monomer units and the macromolecules and identify portions that are polar and uncharged, polar and charged, or nonpolar. You should be able to draw glucose in the alpha or beta configuration and draw an amino acid. You should be able to name the components making up nucleotides in DNA and RNA and name the components of triglycerides and phospholipids. Be able to define the four levels of protein structure and explain how structure contributes to function.

### **Structure & properties of cell membrane and enzymes**

What are the building blocks of membranes/lipids? Why do membranes have a bilayer structure? What is the Fluid Mosaic Model? How do temperature, presence of cholesterol and nature of the fatty acids influence membrane fluidity? What types of proteins are found in the plasma membrane? What is the difference between integral membrane proteins and peripheral proteins? Name three ways that small molecules can be transported across the plasma membrane. What is the energy requirement for each type of transport? What are the different types of vesicle-mediated transport? How do the structural elements contribute to the function of membranes?

How do enzymes bind to substrate? How do enzymes achieve catalysis? You should be able to draw/interpret a reaction profile diagram. What determines whether a reaction is thermodynamically favorable? What determines the rate of a reaction? Do you know what is meant by the  $E_a$ ,  $\Delta G^\circ$ , transition state? What are the  $K_m$  and  $V_{max}$ ? What is an allosteric site? Can you explain what happens when an enzyme reaches saturation?

### **Cellular metabolism**

What is a catabolic/anabolic process? Which of these processes consumes ATP? What is the equation for the complete combustion of glucose (also known as respiration when it occurs inside of cell)? What are the three stages of glucose metabolism? What intermediates are formed during the first two stages of glucose metabolism? Which stages are aerobic/anaerobic? Where in the cell does each stage occur? What stages of glucose metabolism consume/produce ATP? What is the function of  $F_0/F_1$  ATP synthase? What are the roles of NADH,  $FADH_2$ ? ATP can be synthesized by either substrate level phosphorylation or oxidative phosphorylation – what is the distinction between the two? What is meant by chemiosmotic coupling and how does it lead to ATP production? What is the structure of a mitochondrion? What is its role in oxidative phosphorylation? What is the ETS? What are dual & pure electron carriers? Can you name a few key enzymes involved in glucose metabolism?

What is the complete equation for photosynthesis? Photosynthesis can be divided into light-dependent and light-independent reactions – what happens during each of these reactions? Which parts of photosynthesis produce/consume ATP, NADPH? What is the structure of a chloroplast? How is it similar to/different than mitochondrion? What are some of the key enzymes involved photosynthesis?

### **Maintenance and expression of genetic information; protein sorting & secretion**

What is the structure of a nucleus and what are the roles of its various components? What proteins are involved in DNA replication and what role do they play? What is the direction of synthesis of new DNA? Does DNA replication require energy? What is meant by semi-conservative? Why is there leading strand synthesis & lagging strand synthesis?

What is the central dogma of biology? Which step represents transcription and which represents translation? What are the differences & similarities between these processes in prokaryotic & eukaryotic cells? What components (proteins, nucleic acids, ribonucleoproteins) are involved in each process? Where in the cell does each process occur?

What signals are necessary for proteins to reach each subcellular location (see flow chart & tables you completed). Which modifications of proteins occur in ER? In Golgi? What signals are required for a protein to be secreted? What steps are involved in receptor mediated endocytosis?

### **Cytoskeleton and cell motility**

What are the three major types of cytoskeletal filaments, and in what cellular functions or processes do they play a role? Can you name the building blocks of each type of filament? What nucleotide derivative (if any) is associated with each type of filament? What motor proteins are associated with each type of filament? How are these filaments able to assemble/disassemble to allow movement of cell? Is there an energy requirement? What various types of junctions can exist between a cell and its neighbor(s) or substratum, and what are the roles of different types of junctions? What are the two major protein components of skeletal muscle filaments? Can you explain muscle contraction using the sliding filament model? What is the role of ATP in the contraction cycle? How is skeletal muscle contraction regulated?

### **Cell division and cell communication**

What are the four phases of the cell cycle? What occurs during each phase? What proteins regulate entry into different phases of cell cycle? What are histones and how do they function in packaging DNA in the nucleus? What roles do the p53 and Rb proteins have in control of cell cycle? What are the different phases of mitosis? What is happening on a molecular level during these phases?

In what ways can cells communicate with each other? Name three types of receptors and their transduction mechanisms (what events cause signaling?). What is a second messenger? How can defects in signaling pathways lead to carcinogenesis?