Biology 265 Bevington
Cell Physiology Spring Term, 2013

COURSE SYLLABUS

Text: Alberts, B. et al. 2008. Molecular Biology of the Cell. Garland Publishing Co., New York. Fifth Edition. ISBN: 0-8153-4105-9

Course Objectives:

The course will examine the structural elements of cells and their physiological functions. Both procaryotic and eucaryotic cells will be studied, but the emphasis will be on eucaryotic ones. Molecular interactions between complex molecules will be studied as a way to understand the cellular relationships between structure and function.

Considerable attention will be given to cell membranes, especially their roles in transport phenomena, cell-to-cell signaling, and protein targeting processes. Basic features of intermediate metabolism and metabolic control will be covered, particularly those pathways which cells use to derive energy. Genetic mechanisms to be studied include the basic elements of gene structure and control in procaryotes and eucaryotes. The cell cycle and its control will be examined, and some time will be devoted to cancer cells where control of the cell cycle has been lost.

The laboratory will emphasize techniques and methodology in cell biology. Since the accurate interpretation of data presupposes a firm understanding of how the data were acquired, it is hoped that you will develop an interest in the techniques and procedures we use in the laboratory. You should understand not only the theory behind the experiments but also principles underlying the protocols. In science, the methods one uses are as important as the results one observes.

Prerequisites: Chemistry 113 and 114; Biology 112 and/or 119.

About the text:

Reading assignments will cover about half of the textbook. In addition to its use in this course the text should be an good reference for other biology elective courses. From time to time the instructor will provide handouts and copies of recent journal articles to supplement some of the lecture topics. Handouts and especially the journal articles from the literature should be considered as important as reading assignments from the text. A complete list of the semester reading assignments will be distributed on the first day of classes. A CD-ROM comes with the text in a sleeve inside of the book; it is a powerful learning tool and you should use it liberally. Do **not** let it languish in the book (it will become very lonely – it needs companionship). Take it out, put it in your computer, and explore it. Its use will be illustrated in the first week of classes.

Laboratory experiments:

There is no laboratory manual for the course. Laboratory experiments come from handouts developed by the instructor. These will be distributed during the first class meeting.

Grading:

Item	Point Value	Percentage of Final Grade
Three hour exams (180 points each)	540	54%
Three lab quizzes (65 points each)	195	19.5%
One final exam (comprehensive)	265	26.5%
	1000	100%

Students who wish to request accommodations in this class for a disability should contact Elaine Mara, Assistant Director of Learning Services for Academic and Disability Support at 1307 Main Street, or by calling 610-861-1510. Accommodations cannot be provided until authorization is received from the Academic Support Center.

LECTURE SEQUENCE [1]

Introduction: scope and objectives of the course

A brief review of cell structure

Fractionation of cellular organelles – How to take a cell apart.

Molecules in cells
- Chemical bonds and molecular interactions
- Important characteristics of water
- The major classes of small molecules (sugars, amino acids, fatty acids, and nucleotides)
- Nucleic acids
- Proteins
  - Structure
  - Protein functions and factors which affect function
  - Assembly and turnover
- Enzymes: kinetics and factors affecting catalytic action
- Lipids: triglycerides and phospholipids

How cells synthesize proteins
- Basic mechanisms of the process
- RNA synthesis, RNA processing, RNA export from the nucleus
- Molecular chaperones and protein folding
- Ubiquitin, proteasomes, and protein destruction
- Transcriptional control of gene expression
- Posttranscriptional control

Cell growth and control of the cell cycle

The mechanics of cell division*

Cancer cells and loss of control of the cell cycle

Cellular membranes
- Architecture
- Transport phenomena

[1] The lecture topic marked with an asterisk (*) may be abbreviated or eliminated to allow more time for another topic.

Cellular compartmentalization and protein sorting:
- How are proteins targeted to and from the nucleus, mitochondria, chloroplasts, and peroxisomes?

Endoplasmic reticulum
- Signal hypothesis and the role of SRPs in directing proteins to the ER
- Vectorial transport of proteins into the ER lumen
- Protein glycosylation
- How the ER deals with improperly folded proteins
- Synthesis of membrane lipids

Vesicular traffic: How do vesicles arrive at the correct destinations within a eucaryotic cell?

The Golgi complex
- Structure and origin
- Posttranslational modification of secretory, membrane, and glycoproteins
- Sorting, packaging, and targeting of proteins from the Golgi

Lysosomes and cellular digestion

Receptor-mediated endocytosis. Exocytosis and secretion

Cell signaling
- General principles
- Signaling via G-protein linked cell surface receptors

Cell metabolism
- Overview and general concepts
- The major metabolic pathways of cells
- How cells regulate metabolism

Glyolysis in the cytoplasm

The mitochondrion
- Oxidation of pyruvate and fatty acids in the citric acid cycle
- Electron transport, proton-motive force, and oxidative phosphorylation

Metabolic regulation of glycolysis and the citric acid cycle

The Glyoxylate cycle and lipid metabolism

Pentose shunt (the pentose phosphate pathway)

The chloroplast and photosynthesis

Photochemical events and the light reactions
Photolysis, electron transport, and photophosphorylation
C_3 and C_4 metabolism

TARGET DATES FOR LECTURE TOPICS

Mon.	14 Jan.	Introduction, course objectives, begin review of cell structure
Wed.	16 Jan.	Review of cell structure
Fri.	18 Jan.	Complete review of cell structure; fractionation of cellular organelles; begin chemical bonds and molecular interactions
Mon.	21 Jan.	No class (MLK Day)
Wed.	23 Jan	Properties of water, small molecules; begin nucleic acids
Fri.	25 Jan.	Nucleic acids
Mon.	28 Jan.	Proteins
Wed.	30 Jan.	**1st Quiz** (labs 1 & 2); proteins
Fri.	1 Feb.	Proteins
Mon.	4 Feb.	Proteins, begin enzymes **E**nzymes
Wed.	6 Feb.	Enzymes
Fri.	8 Feb.	Protein synthesis
Mon.	11 Feb.	**FIRST HOUR EXAM**
Wed.	13 Feb.	Protein synthesis
Fri.	15 Feb.	Protein synthesis
Mon.	18 Feb.	Control of gene expression
Wed.	20 Feb.	Control of gene expression
Fri.	22 Feb.	Control of gene expression (MID TERM)
Mon.	25 Feb.	
Wed.	27 Feb.	**2nd Quiz** (labs 3,4, 5 & 6)
Fri.	29 Feb.	

Sat. 2 Mar. - Sun. 10 Mar. **SPRING RECESS**

Mon.	11 Mar.	Cell cycle
Wed.	13 Mar.	Cell cycle
Fri.	15 Mar.	Cancer cells
Mon.	18 Mar.	Cancer cells; begin cell membranes
Wed.	20 Mar.	**SECOND HOUR EXAM**
Fri.	22 Mar.	Cellular membranes

Mon.	25 Mar.	Cellular membranes
Wed.	27 Mar.	Targeting proteins to the nucleus, mitochondria, and chloroplasts

Fri. 29 Mar. - Mon. 1 Apr. **EASTER RECESS**

Wed.	3 Apr.	**3rd Quiz** (labs 7,8, & 9); Endoplasmic reticulum
Fri.	5 Apr.	Endoplasmic reticulum
Mon.	8 Apr.	ER and Golgi
Wed.	10 Apr.	Golgi
Fri.	12 Apr.	Golgi
Mon.	15 Apr.	Lysosomes; receptor-mediated endocytosis
Wed.	17 Apr.	**THIRD HOUR EXAM** Cell signaling
Fri.	19 Apr.	An overview of metabolism, glycolysis
Mon.	22 Apr.	Glycolysis
Wed.	24 Apr.	TCA cycle
Fri.	26 Apr.	**Last Class**

Mon. 29 Apr. - Fri. 3 May Final Exams

LABORATORY SCHEDULE

Lab. No.	Dates	Topics
1.	15, 16 Jan.	Laboratory orientation: protocols, preparing solutions and making dilutions, pipeting, pipeting devices, and safety precautions
2.	22, 23 Jan.	Spectrophotometry: Beer's Law, use of the B&L Spectronic 20 spectrophotometers Constructing an absorption curve for cytochrome c and DCPIP
3.	29, 30 Jan.	Spectrophotometric assays for protein (Bradford and bicinchoninic acid methods)
4.	5, 6 Feb.	Cell growth: growth kinetics in *Enterobacter aerogenes* 1. Determining generation time 2. Effects of temperature, chloramphenicol, peptone, and an amino acid analogue
5.	12, 13 Feb.	Manometric measurement of respiratory activity using the Gilson respirometer 1. Effects of temperature, substrates, and inhibitors on yeast Cell suspensions (*Saccharomyces cerevisiae*) 2. Effects of washing and aging in discs of storage tissue from potato tubers (*Solanum tuberosum*)
6.	19, 20 Feb.	Enzyme assay: acid phosphatase 1. Effect of substrate concentration 2. Effect of phosphate ion
	26, 27 Feb.	No laboratory
	Sat .2 Mar. - Sun. 10 Mar.	**Spring Recess**
7.	12, 13 Mar.	Estimation of specific activity of extracted acid phosphatase
8.	19, 20 Mar.	Isolating an organelle: 1. Mitochondria from cauliflower florets

2. Enzyme assay for succinic dehydrogenase and/or malate dehydrogenase

9. 26, 27 Mar. Factors affecting membrane permeability

Fri. 29 Mar. - Mon. 1 Apr. **Easter Recess**

10. 2, 3 Apr. Hill reaction and the Emerson enhancement effect in isolated chloroplasts

11. 9, 10 Apr. Effects of ultraviolet radiation on *Paramecium*, *Tetrahymena*, and *Euglena*

12. 16, 17 Apr. TCA cycle and its control, the cytochrome system, and oxidative phosphorylation

13. 23, 24 Apr. The glyoxylate cycle and pentose phosphate pathway
Review and comparisons: respiratory metabolism and photosynthesis

SUMMARY OF DEADLINES

Wed.	30 Jan.	First lab quiz (No's. 1 and 2)
Mon.	11 Feb.	FIRST HOUR EXAM
Wed.	27 Feb.	Second lab quiz (No's. 3, 4, 5 and 6)
Wed.	20 Mar.	SECOND HOUR EXAM
Wed.	10 Apr.	Third lab quiz (No's 7, 8, 9 and 10)
Wed.	17 Apr.	THIRD HOUR EXAM