Biology 265 Bevington
Cell Physiology Spring Term, 2016

COURSE SYLLABUS

Text: Alberts, B. et al. 2015. Molecular Biology of the Cell. Garland Publishing Co., New York. Sixth Edition. ISBN: 978-0-8153-4432-2

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 electronic 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.

Be sure to make use of the **Resources for Students** (see p. *xii*). You can find this on the publisher's website for students: www.garlandscience.com/MBOC6-students. It contains a wealth of information, so be sure to use it. There are 174 animations and movies you can access. These are distributed throughout the book and illustrate key concepts in cell biology discussed in the text. They are typically 2-3 minutes in length. As you read the chapters you will notice **media callouts** highlighted in color, usually in red (e.g. see Movie 6.2, p. 304; Movie 13.3; p. 733; Movie 20.4, p. 1116). You can use these callouts to access the videos and animations on

the publisher's website from your computer. There are also **slides** and **flashcards** on the website you can use to study and for review.

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. Be sure to read the laboratory experiments and familiarize yourself with the protocols before you come to laboratory.

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 the Academic Support Center, located in the lower level of Monocacy Hall, or by calling 610-861-1401. Accommodations cannot be provided until authorization is received from the Academic Support Center.

OUTLINE OF THE 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

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

---

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

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.	18 Jan.	Introduction, course objectives, begin review of cell structure
Wed.	20 Jan.	Review of cell structure
Fri.	22 Jan.	Complete review of cell structure; fractionation of cellular organelles; begin chemical bonds and molecular interactions
Mon.	25 Jan.	Properties of water, small molecules; begin nucleic acids
Wed.	27 Jan	Nucleic acids
Fri.	29 Jan.	Proteins
Mon.	1 Feb.	Proteins
Wed.	3 Feb.	**1st Quiz** (labs 1 & 2); proteins
Fri.	5 Feb.	Complete proteins, begin enzymes
Mon.	8 Feb.	Enzymes
Wed.	10 Feb.	Protein synthesis
Fri.	12 Feb.	Protein synthesis
Mon.	15 Feb.	**FIRST HOUR EXAM**
Wed.	17 Feb.	Protein synthesis
Fri.	19 Feb.	Control of gene expression
Mon.	22 Feb.	Control of gene expression
Wed.	24 Feb.	Control of gene expression
Fri.	26 Feb.	Cell cycle
Mon.	29 Feb.	Cell cycle
Wed.	2 Mar.	**2nd Quiz** (labs 3,4, 5 & 6); begin cancer cells
Fri.	4 Mar.	Cancer cells (MID TERM)
Sat.	5 Mar. - Sun. 13 Mar.	**SPRING RECESS**
Mon.	14 Mar.	Cancer cells; begin cell membranes
Wed.	16 Mar.	Cellular membranes
Fri.	18 Mar.	Cellular membranes
Mon.	21 Mar.	Targeting proteins to the nucleus, mitochondria, and chloroplasts
Wed.	23 Mar.	**SECOND HOUR EXAM**
Fri.	25 Mar. - Sun. 27 Mar.	**EASTER RECESS**
Mon.	28 Mar.	Endoplasmic reticulum
Wed.	30 Mar.	Endoplasmic reticulum
Fri.	1 Apr.	Complete ER; begin Golgi

Mon.	4 Apr.	Golgi
Wed.	6 Apr.	**3rd Quiz** (labs 7,8, & 9); Golgi
Fri.	8 Apr.	Lysosomes; receptor-mediated endocytosis
Mon.	11 Apr.	An overview of metabolism, glycolysis
Wed.	13 Apr.	Glycolysis
Fri.	15 Apr.	Glycolysis
Mon.	18 Apr.	TCA cycle
Wed.	20 Apr.	**THIRD HOUR EXAM**
Fri.	22 Apr.	TCA cycle and its control, cytochrome system, oxidative phosphorylation
Mon.	25 Apr.	Pentose phosphate pathway and the glyoxylate cycle
Wed.	27 Apr.	Review and comparisons: respiratory metabolism and photosynthesis
Fri.	29 Apr.	**Last Class**

Mon. 2 May. - Sat. 7 May Final Exams

Wed. 4 May. Final exam for this course, 2 hours (8:00 am)

LABORATORY SCHEDULE

Lab. No.	Dates	Topics
1.	19, 20 Jan.	Laboratory orientation: protocols, preparing solutions and making dilutions, pipeting, pipeting devices, and safety precautions
2.	26, 27 Jan.	Spectrophotometry: Beer's Law, use of the B&L Spectronic 20 spectrophotometers Constructing absorption curves for cytochrome c, DCPIP, and anthocyanin pigments from red cabbage at different pHs
3.	2, 3 Feb.	Spectrophotometric assays for protein (Bradford and bicinchoninic acid methods)
4.	9, 10 Feb.	Cell growth: growth kinetics in *Enterobacter aerogenes* 1. Determining generation time 2. Effects of temperature, chloramphenicol, peptone, and the amino acid analogue *p*-fluorophenylalanine
5.	16, 17 Feb.	Enzyme assay: acid phosphatase 1. Effect of substrate concentration 2. Effect of phosphate ion
6.	23, 24 Feb.	Estimation of specific activity of extracted acid phosphatase
7.	1, 2 Mar.	Isolating an organelle: 1. Mitochondria from cauliflower florets 2. Enzyme assay for succinic dehydrogenase and/or malate dehydrogenase
	Sat. 5 Mar. - Sun. 13 Mar.	**Spring Recess**
8.	15, 16 Mar.	Factors affecting membrane permeability
9.	22, 23 Mar.	Hill reaction and the Emerson enhancement effect in isolated chloroplasts
	Fri. 25 Mar. - Sun. 27 Mar.	**Easter Recess**
10.	29, 30 Mar.	Tyrosinase
11.	5, 6 Apr.	Effects of ultraviolet radiation on *Paramecium*, *Tetrahymena*, and *Euglena*

12.	12, 13 Apr.	Labeling patterns in glycolysis and the TCA
13.	19, 20 Apr.	When does carbon from hexose sugars flow into the pentose phosphate pathway instead of glycolysis and why?
14.	26, 27 Apr.	Open

SUMMARY OF DATES FOR QUIZZES AND EXAMS

Wed.	3 Feb.	First lab quiz (No's. 1 and 2)
Mon.	15 Feb.	FIRST HOUR EXAM
Wed.	2 Mar.	Second lab quiz (No's. 3, 4, 5 and 6)
Wed.	23 Mar.	SECOND HOUR EXAM
Wed.	6 Apr.	Third lab quiz (No's 7, 8, 9 and 10)
Wed.	20 Apr.	THIRD HOUR EXAM