Cell Biology 303- Spring 2020
Mon Wed 5:35-6:50 Room 510 Hunter North
Professors: Jill Bargonetti, Derrick Brazill, and Hualin Zhong

REQUIRED TEXTS and MATERIALS:

1) **Molecular Biology of The Cell: Bruce Alberts 6th edition (required).**
2) **Iclikers/Reef Polling required**

Course Description:

This Biology major capstone course builds upon what has been learned in molecular biology & genetics (BIOL 203) and biological chemistry (BIOL 300) providing an integrated look at the molecular biology of the cell. Separated into 3 units. The lecture and laboratory components are coordinated. The course includes integrated areas of eukaryotic cell biology through 3 integrated sections as listed below.

1. **Cell Imaging and Organelles, Membrane Structure, Transport, Protein Sorting and Vesicular Trafficking:** An in depth study of the components of a eukaryotic cell including transport and cellular channels will be discussed. An examination of cell morphology and commonly used techniques for examining the cell is included. Intracellular organelles are examined in detail for their structures and functions. This includes, but is not limited to, protein degradation pathways and intracellular trafficking.
2. **Regulation of Cell Growth and Cell Death, followed by a study of cancer as a cellular disease:** Regulation of cell proliferation, mitochondrial function and energy production, cell cycle and apoptosis are covered in depth. The molecular mechanisms of cell cycle regulation, cellular signal transduction, regulation of cell proliferation and cell growth, cell death mechanisms, and de-regulation of cell growth are covered and related to the process of tumorigenesis.
3. **The Cytoskeleton and Cell Communication:** An in depth study of cell motility, and cell communication (comparing prokaryotic and eukaryotic systems) will be conducted. Cytoskeleton, and signaling, including mechanisms for intercellular communication and their role in human biology and disease will be discussed. Cellular differentiation and an introduction to development and cell communities will also be covered.

prereq: BIOL 203 and 300 or Instructor Permission. Failure to meet these prerequisites will prevent enrollment in Biology 303. Documentation (unofficial transcripts) must be provided to demonstrate that the prerequisites are met. Credit transfer from another college must be confirmed by showing the instructor the student's transcript listing completion of the prerequisite with a grade of C- or better. 7 hrs (3 lec, 3 lab, 1 disc), 4.5 cr.

Learning Objectives:

A Working List of Student Learning objectives for Biol 303 Cell Biology.
Students will be able to:

• correctly use cell biology terms and know the prokaryotic and eukaryotic cellular differences.
• articulate the techniques used to study cells. These including microscopy and biochemical techniques for examining cellular compartments and localization of biological molecules in the cell.
• explain the biological consequences of defects in specific cellular processes.
• define the molecular regulation of the cell cycle and know the various components at different cellular levels that can regulate cell cycle checkpoints. Coordinate this understanding with an understanding of cancer.
• describe, and carry out the techniques used to examine cell cycle regulation.
• articulate the molecular regulation of membrane function and membrane transport.
• define the cellular organelles, their structures, and their functions; including recognition of disorders associated with dysfunction.
• describe cell-cell communication with a focus on differentiation and development.
• formulate experiments that address biological questions at the cellular level and select the appropriate techniques to use for these experiments.
• discuss the use of high-throughput technologies for discovering genes regulating cellular processes such as cell cycle, differentiation, and transformation. Understand and perform transcriptome/proteomics analysis (e.g., from microarray or RNA-Seq datasets).• communicate clearly: written communication and oral communication.
• collaborate with others (team-working).
• evaluate experiments critically (reading, interpreting, and evaluating research articles).

Exams: Three exams each worth 100pts based on the lecture material.

Laboratory component scoring:
The laboratory grade represents 33% of your total grade for this course and will be based on six quizzes and seven lab reports. The point breakdown is:
Quizzes (6 X 5 points) 30
Lab reports:
#1 10
#2 20
#3 10
#4 20
#5 20
#6 20
#7 20

Lab total 150

Course total: 450 pts for calculation of your average.
The final grades are based on the Hunter College Grading System.

Required Reading: This course requires the textbook and other readings that should be read before and after the lecture material is covered. Additional assigned readings will be posted on Blackboard.

Technology requirements
In order to participate fully in this course, students must have Internet and computer access, and a functional Hunter College E-mail address.
The chapters in each book assigned for each lecture will be listed in an excel syllabus format. In addition, required articles will be posted on blackboard. No hand out paper copies of these assigned articles will be given out. Students can download them from blackboard. Some PubMed searches will be required. The PubMed URL address can be obtained from Google.

" Hunter College regards acts of academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures."

No copying work from each other or from the web is allowed. Dishonesty in **lab or lecture** work will be reported, leading to uncomfortable situations.

Lecture	Date	Day	Lecturer	Subject	Chapter
1	27-Jan	Mon	Zhong	Introduction	Ch.1
2	29-Jan	Wed	Zhong	Cell biology methods	Ch.8 & 9
3	3-Feb	Mon	Zhong	Membrane Structure I	Ch.10
4	5-Feb	Wed	Zhong	Membrane Structure II	Ch.10 & papers
5	10-Feb	Mon	Zhong	Membrane Transport I	Ch.11
6	19-Feb	Wed	Zhong	Membrane Transport II	Ch.11 & papers
7	24-Feb	Mon	Zhong	Organelles and Protein Sorting I	Ch.12 & Ch.14
8	26-Feb	Wed	Zhong	Protein Sorting II	Ch.12 & Ch.14 & papers
9	2-Mar	Mon	Zhong	Intracellular vesicular traffic I	Ch.13
10	4-Mar	Wed	Zhong	Intracellular vesicular traffic II	Ch.13 & papers
11	9-Mar	Mon	Zhong	**Exam I**	
12	11-Mar	Wed	Bargonetti	The Nucleus as Command Central	Chap. 4
13	16-Mar	Mon	Bargonetti	DNA Replication and Gene Expression I (DNA-protein interactions)	Chaps. 5 & 7
14	18-Mar	Wed	Bargonetti	Regulation of Gene Expression II (Protein and RNA modification)	Chap. 7
15	23-Mar	Mon	Bargonetti	Cell Signaling	Chap. 15
16	25-Mar	Wed	Bargonetti	The Cell Cycle	Chap. 17
17	30-Mar	Mon	Bargonetti	The Cell Cycle and Cell Death	Chap. 17 & 18
18	1-Apr	Wed	Bargonetti	Cancer: A cellular disease of genetic origin	Chap. 18 & 20
19	6-Apr	Mon	Bargonetti	The tumor suppressor p53	Papers
20	7-Apr	Tue*	Bargonetti	Cancer: A cellular disease of genetic origin	Chap. 20
21	20-Apr	Mon	Bargonetti	**Exam II**	
22	22-Apr	Wed	Brazill	Cytoskeleton and Motility I	Chap. 16
23	27-Apr	Mon	Brazill	Cytoskeleton and Motility II	Chap. 16
24	29-Apr	Wed	Brazill	Cell Communication I	Chap. 15
25	4-May	Mon	Brazill	Cell Communication II	Chap. 15
26	6-May	Wed	Brazill	Differentiation	Chap. 21
27	11-May	Mon	Brazill	Development	Chap. 21
28	13-May	Wed	Brazill	Cell Communities	Chap. 19
29	20-May	Wed	Brazill	**Exam III**	

LABORATORY DESIGN

These components are instructed in an overlapping manner in a 15-week sequence.

Part 1. Introduction for Microscopy/Cell culture/fractionation/ protein electrophoresis: Microscopy, Immunofluorescence primer: tagging different organelles/cell compartments with fluorescent probes
Cell culture-sterile technique
Cell fractionation Protein estimation
Checking purity by SDS-PAGE/WB with specific markers (membrane, cytoplasm, nucleus, cytoskeleton).
Dictyostelium discoideum as a model for: Cytoskeleton/cell motility/Vesicular/nuclear transport/exocytosis/endocytosis
Endocytosis and exocytosis in Dictyostelium
Transfection with plasmids that encode GFP-fused proteins with different localization signals and determine protein locations.

Part 2. Eukaryotic Cell Cycle and Cyclin Dependent Kinases and p53
Signal Transduction I- cyclin dependent kinase inhibitor
Temperature sensitive p53 mutants for growth arrest.
Analysis of endogenous cyclin dependent kinase inhibitor during growth arrest.
Part I: Counting and Plating
Part II: Hemacytometer Readings
Part III: Whole Cell Lysates and Lowry Assay (other protein assays, BCA, Bradford, explain limitations)
Part IV: Western blot analysis for cyclin dependent kinase/inhibitor p21 expression at the p53 permissive and p53 restrictive temperatures
Possible exercise to assess different stages of cell cycle?
Eukaryotic Transcription Factor p53 Signal Transduction II- trans acting transcription factor activity
-Transient Transfection and Cis-Trans Analysis- Introduction
Part I: Transfection of DNA into Cells
Part II: Cell Lysates
Part III: Lowry Assay
Part IV: Luciferase Activity Assay
Data Analysis

Part 3. Dictyostelium discoideum mutants: analyzing micro array data

- Main analytical skills to teach include:
    - Understand and calculate fold change (logarithm with base 2)
    - Identify differentially expressed genes using statistical tests (e.g., t-test)
    - Understand and calculate correlated changes among genes
    - Understand and perform cluster analysis to groups genes and cells based on similarities in gene expression levels

Transcriptome/proteome analysis

(This could be a stand-alone lab, or, perhaps much more effectively, weaved into individual lab projects, so students get multiple exposures.)

Topics might be:

Yeast glucose-utilization microarray dataset (Derisi et al).

Cancer transcriptome/proteome: a microarray dataset comparing the transcriptomes of p53 mutant (or cancer cells) vs wildtype (or normal cells