MCB493. Advanced Cell Biology

This course is directed towards graduate students in Molecular Cell Biology, graduate students in the physical sciences with an interest in cell biology, and advanced undergraduates who might be interested in pursuing future graduate level training in cell biology.

Time and Place:

Lecture: 11:00 – Noon Monday, Wednesday, Friday

Text:

Primary Text:
Molecular Biology of the Cell, Alberts, et al, 5th Edition. Garland Science.
This is the all time classic text in cell biology. We will assign reading from this textbook that must be read prior to attending class. The textbook serves simply as a review to refresh key points about cells that were taught in MCB250 and MCB252.

Other relevant texts:
Molecular Cell Biology, Lodish, et al, 6th Edition. Scientific American Books
Cell Biology, Earnshaw and Pollard, 2nd Edition, Saunders Press.
Physical Biology of the Cell, Phillips, Kondev, and Theriot. Garland Science

Instructors:

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Office Hours:
Monday 3-4 PM
Thursday 10-11 AM.

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TBA

Prerequisites:
Undergraduates must complete MCB250 and MCB252 with an average grade of B or higher in the two courses. Undergraduates might find concurrent enrollment in MCB354 helpful, but it is not required.

Course Overview, Objectives, and Philosophy:

This is an exciting time in cell biology. We are moving beyond generating parts lists of which molecules are required for what cellular processes. Cell biologists are now trying to understand how ensembles of molecules perform complex functions. Old mysteries in cell biology are now within our reach of experimental dissection. Cherished cell biological dogma and textbook models of the recent past are increasingly challenged by new experiments. This course is for seriously interested students of cell biology wishing to understand contemporary views of the molecular mechanisms controlling cell function. Upon completion of this course, students should understand current views as to how cells organize time and space, be able to critically analyze and interpret experimental data taken from the primary literature, develop testable hypotheses regarding cellular function, and be able to design experiments to test those hypotheses. To achieve these goals, lecture material will extend beyond the textbook to include highlights from the current, primary literature. Whenever possible, attention will be given to major controversies in the field to foster critical thinking. Concepts will be emphasized over memorization of molecules. The names of certain, key molecules and organelles, however, are part of the vocabulary of cell biology and thus necessary for scholarly discussion of the material. Therefore, it is important that students read the assigned reading before class. In addition to the lectures and reading assignments, I will assign weekly problem sets. Problem sets are an integral part of learning the material and will be indicative of the types of questions asked on the exams. The purposes of the problem sets are to teach students how to interpret experimental data, formulate hypotheses, and design experiments to test such hypotheses.

Course Outline:

Protein targeting and membrane trafficking. (Brieher) 6 lectures. How can cells secrete and internalize massive amounts of material yet retain organelle identity?

- Historical roots of the secretory pathway
- Maintaining organelle identity
- How cells select cargo for the secretory pathway
- How cells build vesicles
- How cells fuse membranes

Cytoskeletal organization and dynamics. (Brieher) 6 lectures. How do cells shape the cytoskeleton and harness its dynamics to perform work?

- Polymerization dynamics
- Coupling polymerization to nucleotide hydrolysis
- Molecular motors
- Signaling to the cytoskeleton
- Morphogenesis of complex cytoskeletal arrays

Cell adhesion and extracellular matrix. (Brieher) 6 lectures. How do cells specifically adhere and respond to different surfaces?

- Specificity of cell adhesion
- Regulating adhesion
- Linking adhesion molecules to the cytoskeleton
- Signaling through adhesion molecules

Cell division cycle. (Brieher) 6 lectures. How do cells faithfully duplicate their contents and segregate them to make two daughter cells?

- Ordering the events of the cell cycle
- Duplicating the genome
- Preparing chromosomes for mitosis
- Segregating the genome
- Checkpoints that monitor cell cycle progression
- Segregating the cytoplasm
- Rebuilding an interphase cell and preparing for the next cell cycle

Organization and dynamics of a complex tissue. (Brieher) 2 lectures

Genome Organization. (Belmont) 4 lectures

Chromosome Structure and Function. (Belmont) 6 lectures

Nuclear compartments. 4 lectures (Belmont)

Cell Biology of Cancer. 2 lectures (Belmont)