Syllabus

Membrane Biology

Fall 2020
CBCH-3316
CRN: 12424

Virtually by Blackboard Collaborate

https://us.bbcollab.com/collab/ui/session/join/1706c145cd6a4a46b90a4069b750b53b

Lecture: **M, W (10.30 am-11.50 am)**

Professor: **Siddhartha Das**
Office: **Biosciences Building 5.128 (747-6896)**
E-mail: **sdas@utep.edu.**

Office Hours: **M, W: 11.50-12.10 (or by prior appointment)**

Guidelines:

Blackboard will be used as the primary platforms for online instructional activities.

Non-synchronous alternative such as recordings of lectures will be provided.

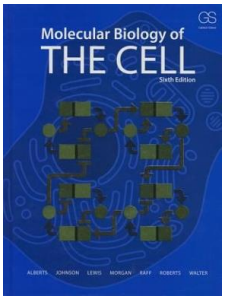
No webcams are required by students.

The schedule assigned by the Goldmine will be followed.

Inform the instructor beforehand if you have to miss the class, facing technical difficulties during the lecture or need some additional assistance.

Text Book:

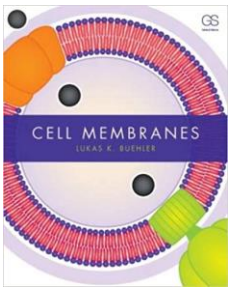
Molecular Biology of the Cell by Alberts and others, 6th edition

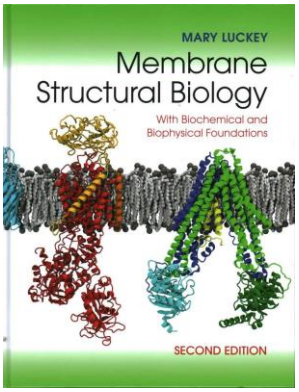


(UTEP Bookstore).

Reference Books:

Cell Membranes by Lukas K. Buehler (Garland Science, 2016)





Membrane Structural Biology: With Biochemical and Biophysical Foundations by Mary Luckey (1st Edition, Cambridge University Press)

Course description and objective

This course is aimed at students, who would like to learn the recent advances in membrane biology. We will discuss the experimental evidence, which leads us to understand the current models of the structure and function of biological membranes.

Strategies:

1. Rather than delivering boring lectures by this instructor, we will brainstorm topics, and discuss classic papers in membrane biology in addition to the text and reference books.

2. Participants will be asked to describe their ideas of selected topics before class and compare that with other students.

3. The instructor will provide data and figures from primary literatures, and students will discuss the concept in an effort to gain an understanding of the topic.

4. The class will work on problems, presentations and writing short reports on the various aspects of Membrane Biology

5. It is expected that students will have a good understanding about the membrane model, plasma membrane biogenesis,

Examination Procedure

There will be quizzes on each chapter, three exams and a final exam. Your grade will be distributed as follows:

Grades (100%) will be the average of three class exams, presentations, attendance (2%) and the final exam. The lowest class exam grade (not the final) will be dropped.

Notes:

1) Try not to miss any exam or class without proper notification.

Grading Policy

A = 90-100
B = 80-89
C = 70-79
D = 60-69
F = Below 60

Important dates

Class starts: Monday, August 24, 2020
Drop date: Friday, October 30, 2020
Final exam: Friday, December 11, 2020 (10 AM-12.45 PM)

Course Materials
The Role of Membranes in Cells and Organisms
(Ch-1, Cell Membranes by Lukas Buehler)
Membranes establish the outer limits of life
Lipids and proteins have different roles in the cell membranes
Membranes provide four basic cellular functions
Membranes are self-renewing structures
Membrane display a unique combination of mechanical and electrical properties
Membranes are linked to disease and serve as therapeutic targets
Fluid-mosaic model
(Practice quiz)
The Molecular Organization of Cell Membranes
(Ch-2, Cell Membranes by Lukas Buehler)
The structure of Cell Membranes is described by the Fluid-Mosaic Model
Phospholipid bilayers from the structural foundation of cell membranes
The lipid bilayer serves as a scaffold for the attachment and integration of proteins
The width of phospholipid bilayers is universal and matches the size of small proteins
Cell membranes are complex modular structures
The bilayer configuration allows for an adjustable surface area without affecting width.
Fluidity is a defining characteristic of cell membranes
Membranes are two-dimensional liquids
Diffusion is an efficient method but not the only means of redistributing membrane components
Lipid and proteins organize into local domains
Membranes form closed structures called vesicles
Cell shape can be characterized by membrane curvature
Lipid packing influences membrane curvature
The fluid-mosaic model of cell membranes was built on thermodynamic principles
Bringing an old paradigm up to date

(Practice quiz)

Tools for Studying Membrane Components: Detergents and Model Systems

(Membrane Structural Biology by Mary Luckey)

Detergents
Model Membranes
Liposomes
Nanodiscs

Exam-1

Membrane Proteins

(Molecular Biology of the Cell by Alberts, Ch-10)

Membrane proteins can be associated with the lipid bilayer in various ways
Lipid anchors control the membrane localization of some signaling proteins
In most transmembrane proteins the polypeptide chain crosses the lipid bilayer in an α-helical conformation
Transmembrane alpha helices often interact with one another
Some β-barrels from large transmembrane channels
Many membrane proteins are glycosylated
Membrane proteins can be solubilized and purified in detergents
Bacteriorhodopsin is a light-driven proton pump that traverses the lipid bilayer as seven α helices
Many membrane proteins diffuse in the plane of the membrane
Cells can confine proteins and lipids to specific domains within a membrane
The cortical cytoskeleton gives membranes mechanical strength and restricts membrane protein diffusion

(Practice quiz followed by Exam-2)

Membrane transport

(Molecular Biology of the Cell by Alberts, Ch-11)

Principles of membrane transport
Classes of transport proteins
Active transport
Transporters and active membrane transport
Active transport can be driven by ion gradients
Transporters in the plasma membrane regulate cytosolic pH
Asymmetric distribution of transporters in epithelial cells
ATP-driven pump
Ca2+-pump is the best-understood P-type ATPase
The plasma membrane P-type Na+-K+ pump establishes the Na+-gradient across the plasma membrane
ABC transporters constitute the largest family of membrane transport proteins
Ion channels are ion-selective and fluctuate between open and closed states
The membrane potential in animal cells depends mainly on K+ leak channels

and the K+ gradient across the plasma membrane
The resting potential decays only slowly when the N+-K+ pump is stopped
Aquaporins are permeable to water impermeable to ions
The function of a neuron depends on its elongated structure
Voltage-gated cation channels generate action potentials in electrically excitable cells
Patch-Clamp recording
Transmitter-gated cation channels
Transmitter-gated ion channels
Chemical synapses
Neuromuscular transmission
(Practice quiz)
The cytoskeleton and membranes
(Molecular Biology of the Cell by Alberts, Ch-16)
The self-assembly and dynamic structure of cytoskeletal filaments
How cells regulate their cytoskeletal filaments
Molecular motors
Intracellular Membrane Traffic
(Molecular Biology of the Cell by Alberts, Ch-13)
Molecular mechanisms in membrane transport and the maintenance of compartmental diversity
Transport from the ER through the Golgi complex

Exam-3
Final Exams on December 11, 2020

Posted on August 22nd, 2020