

Syllabus

Membrane Biology

Fall 2021
CBCH-3316
CRN: 12280
Lecture
M, W (3 PM-4.20 PM)

Health Sciences/School of Nursing Room # 206

Professor: Sid Das
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Office Hours: M, W: 4.30-5. 15 PM (or by prior appointment)

COVID-19 PRECAUTION STATEMENT

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID-19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org.

Guidelines:

Traditional (Face-to-Face) lecture style will be followed. Side by side the Blackboard Ultra (UTEP) platform for online instruction will also be used.

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

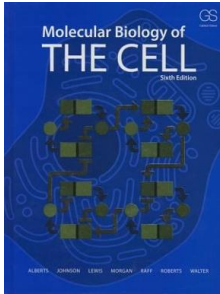
No webcams are required by students.

The schedule assigned by the Goldmine will be followed.

Inform the instructor beforehand if you face technical difficulties during the lecture or need some additional assistance.

Text Book:

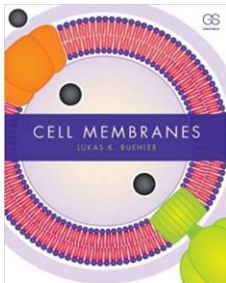
Molecular Biology of the Cell by Alberts and others, 6th edition



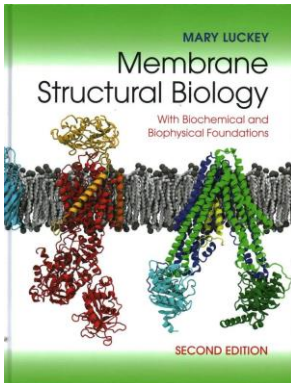
(UTEP Bookstore).

Reference Books:

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



Will be provided by the instructor.



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

Will be provided by the instructor

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 topics 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/idea of a particular 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, and the final exam. The lowest class exam grade (not the final) will be dropped.

Notes:

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

Grading Policy

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

Note: There will not be any points for traditional attendance in this semester. However, there will be points for participating in required activities and exams in timely fashion as mentioned.

Important dates

Class starts:	August 23, 2021
Labor Day Holiday:	September 6, 2021
Fall Drop Deadline:	October 20, 2021
Thanksgiving Holiday:	November, 25-26th
Final Exam:	December 6th, 2021 (1 PM-3.45 PM)

<u>Course Materials</u>
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
Membranes 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 form 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
Lipids 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 form 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 6, 2021

Posted on August 19th, 2021