

Syllabus

Membrane Biology

Fall 2022

CBCH-3316

CRN: 12278

Lecture

M, W (3 PM-4.20 PM)

Classroom Building (CRBL) C305

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

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

COVID-19 PRECAUTION STATEMENT

The University will continue to focus on the well-being and health of all campus visitors by following CDC, state and regional guidelines. For complete information and specific details on UTEP resuming on-campus operations and instruction, please visit <https://www.utep.edu/resuming-campus-operations/>.

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.

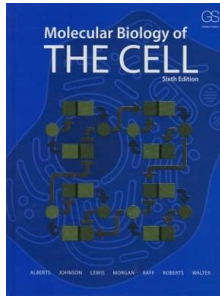
The schedule assigned by the Goldmine will be followed.

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

Attendance is required.

Textbooks:

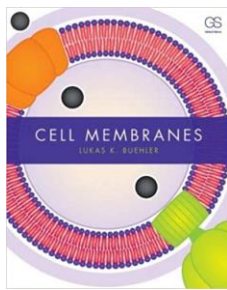
Molecular Biology of the Cell by Alberts and others, 6th edition



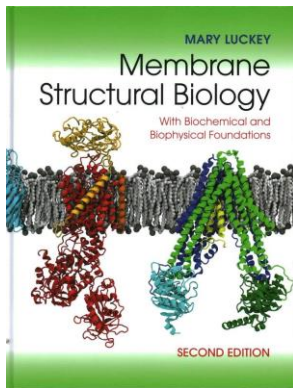
(UTEP Bookstore).

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 drafting 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, 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

Important dates

Class starts:	August 22, 2022
Labor Day Holiday:	September 5, 2022
Fall Drop Deadline:	October 28, 2022
Thanksgiving Holiday:	November 24-26th
Dead Day:	December 2 nd , 2022
Final Exam:	December 5th, 2022 (1 PM-3.45 PM)

Course Materials
1. 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 distinct roles in the cell membranes
Membranes provide four basic cellular functions
Membranes are self-renewing structures
Membrane displays a unique combination of mechanical and electrical properties
Membranes are linked to disease and serve as therapeutic targets
Fluid-mosaic model
(Practice quiz)
2. 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
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)

3. Tools for Studying Membrane Components: Detergents and Model Systems (Membrane Structural Biology by Mary Luckey)

Detergents

Model Membranes

Liposomes

Nanodiscs

Exam-1

4. Membrane Proteins

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

Membrane proteins can be associated with the lipid bilayer in numerous ways

Lipid anchors control the membrane localization of 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)

5. 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 on K^+ leak channels and the K^+ gradient across the plasma membrane
The resting potential decays only slowly when the Na^+-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

6. 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
Transport from the ER through the Golgi complex

Exam-3

7. Vesicular Trafficking

(Molecular Biology of the Cell by Alberts, Ch-13)
The molecular mechanisms of membrane transport: compartmental diversity
Transport from the ER to Golgi
COP-I, COP-II and clathrin-coated vesicles
Adaptor proteins and phosphoinositides
Rab proteins guide transport vesicles
SNARE Proteins
Vesicular Tubular Clusters
Oligosaccharide chains are processed in the Golgi Apparatus

8. Presentations

For presentations you should form a group consisting of 3-4 people per group. The presentations will start from mid-October. The topic will be related to membrane structure, functions, receptors, signaling etc. I will discuss more regarding this in the classroom.

Final Exams on December 5, 2022

Posted on August 21st, 2022