Syllabus

Membrane Biology

Fall 2023
CBCH-3316
CRN: 11271
Lecture
M, W (3 PM-4.20 PM)
Liberal Arts Building (LART), Room #106

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)**

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.

Use of artificial intelligence

The use of generative AI tools such as Chat GPT is not permitted in this course.

Plagiarism detecting software

Some of your course work and take home assignments may submitted to the "Grammarly Plagiarism Checker' to detect possible plagiarisms.

Scholastic Integrity

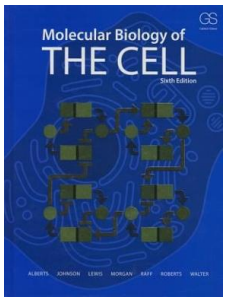
Maintaining the academic honesty is critical and any sort of dishonesty is considered a violation of the UTEP Handbook of Operating Procedures. Academic dishonesty includes cheating, plagiarism, and collusion. All suspected violations of academic integrity at UTEP must be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit HOOP: Student Conduct and Discipline

Attendance and participation

Our class meetings are in-person at the Liberal Arts, Room 106, every Monday and Wednesday from 3:00 PM to 4.30 PM beginning August 28 through December 6. Please note that attendance for presentations is mandatory and will be monitored through a sign-in sheet or a BlackBoard poll sent by the speakers at any time. Inform the instructor beforehand if you face technical difficulties during the lecture or need additional assistance.

Textbooks:

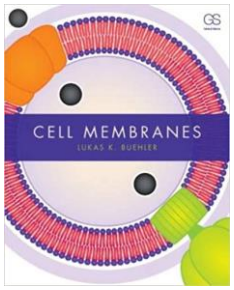
Molecular Biology of the Cell by Alberts and others, 6th edition



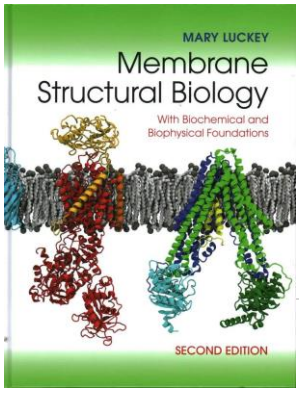
(UTEP Bookstore).

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)

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:

- 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.
- Participants will be asked to describe their ideas of selected topics before class and compare that with other students.
- The instructor will provide data and figures from primary literatures, and students will discuss the concept/idea of a particular topic.
- The class will work on problems, presentations and drafting short reports on the various aspects of Membrane Biology
- 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:

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

September 4	***Labor Day***
November 3	**Fall Drop/Withdrawal Deadline**
November 23-24	**Thanksgiving Holidays**
December 7	**Last Days of Class**
December 11	**Final Exam 1-3.45 PM**

Course Materials

1. The Role of Membranes in Cells and Organism
(August 28-30, 2023)

(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)
September 6-13, 2023

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)

3. Tools for Studying Membrane Components: Detergents and Model Systems

(Membrane Structural Biology by Mary Luckey)
September 18, 2023

Detergents
Model Membranes
Liposomes
Nanodiscs
Exam-1 (September 20, 2023)

4. Membrane Proteins

(Molecular Biology of the Cell by Alberts, Ch-10)
September 25-27, 2023

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 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
Exam-2: October 2, 2023

5. Membrane transport

(Molecular Biology of the Cell by Alberts, Ch-11) October 4-11, 2023

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 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

6. The cytoskeleton and membranes

(Molecular Biology of the Cell by Alberts, Ch-16) October 16-23, 2023
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: October 25, 2023

7. Vesicular Trafficking

(Molecular Biology of the Cell by Alberts, Ch-13) October 30; November 1-6, 2023
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

Presentations (November 08-December 06, 2023)

For presentations you should form a group consisting of 3 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 11, 2023

(Posted on August 27, 2023)