Membrane Biology

Fall 2014

CBCH-3316

CRN 13880

Lecture: **M, W (10.30 pm-11.50 pm); HSSN 211**

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Office Hours: **T and R: 3-4 PM (or through prior appointments).**

Recommended texts:

Lehninger's Biochemistry or any Standard Biochemistry Text Book or any other Biochemistry Text Book.

Membrane Structural Biology by Mary Luckey, 2008

Molecular Biology of the Cell by Alberts and others, 2008

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 book.

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

Examination Procedure

There will be three class exams and a final exam. In addition, there will be classroom presentations and project report, which will be counted. Your grade will be distributed as follows:

Three Class Exams:	35%
Group Presentation (2-3 persons per group):	15%
Presentations:	15%
Final Exam:	30%
Attendance:	5%
Grand Total:	100%

Notes:

1) You are strongly encouraged to form groups consisting of 2-3 people-this will be helpful in discussing and presenting materials in the class.
2) Try not to miss any exam or class without proper notification.
3) Attendance is must and everyone needs to sign the attendance roster which carries 10% of your total grade.
4) You may not be allowed to take the test if you are absent for two weeks in a row prior to the test.

Grading Policy

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

Course Materials

Introduction

(Membrane Structural Biology by Mary Luckey)

General features of membranes
Fluid-mosaic model

Diversity of Membrane Lipids:

(Membrane Structural Biology by Mary Luckey)

Classification of lipids
Fatty acids and triglycerides
Phospholipids
Sphingolipids
Sterol and isoprenoids
Lipid bilayers
Membrane asymmetry
Lipid phases and lipid rafts
Detergent-resistant membranes
Lipid vesicles

Tools for Studying Membrane Components: detergents and Model systems

(Membrane Structural Biology by Mary Luckey)

Detergents
Model Membranes
Liposomes
Nanodiscs

Exam-1

Biosynthesis of Membrane lipids

(Lehninger's Biochemistry)

Biosynthesis of a) Fatty acids b) Phospholipids and c) Sphingolipids

Membrane Proteins

(Molecular Biology of the Cell by Alberts)

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

Exam: 2

Membrane transport

(Molecular Biology of the Cell by Alberts)

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

Membrane Signaling via G-protein Coupled Receptor

(Molecular and Cellular Biology, Lodish and others, 6th Edition)

General elements of G-protein coupled receptor Systems
G-protein coupled receptors that regulate ion channels
G-protein coupled receptors that activate or inhibit adenylyl cylase
G-protein coupled receptors that activate phospholipase C

Exam-3

Presentations and Projects

For presentations you should form a group consisting of 2-3 people per group. I will discuss more regarding this in the class room.

Final projects (based on your presentations), you could select from "understanding membrane structures", "recent progress in membrane biology", "membrane signaling and roles of membranes in health and diseases'.

EXAMINATION (FINAL)

Posted on August 1, 2014