

Physiological Dynamics in Animals & Plants – Lecture 7 – Membrane Architecture

- I. History of analysis of membrane structure
 - A. Charles Overton – 1895 – Proposed that membranes are made of lipids.
 - B. Irving Langmuir – 1917 – Extracted lipids from cells
 - C. E. Gorter and F. Grendel – 1925 – measured surface area of erythrocyte and lipid film extracted from erythrocyte to show that there is enough lipid to cover the cell twice.
 - D. Hugh Davson and James Danielli – 1935 – proposed that membrane was a “sandwich” of lipid between two layers of protein.
 - E. S.J. Singer and G. Nicolson – 1972 – proposed fluid mosaic model in which membrane is sea of lipid with icebergs of protein floating in lipid bilayer.
- II. Current model of membrane structure
 - A. Phospholipid bilayers are the structural units of all membranes.
 - 1. Phospholipids are amphipathic with hydrophilic “heads” and hydrophobic “tails.
 - 2. Each layer of phospholipid = a membrane leaflet.
 - B. Proteins interact with membranes in different ways.
 - 1. Integral (intrinsic) proteins are embedded in or plugged through the phospholipid bilayer.
 - a. They may be embedded based on their hydrophobicity, or they may be covalently attached to lipids.

b. Example – potassium ion channels of plant cells

2. Peripheral (extrinsic) proteins are adsorbed to the surfaces of the phospholipid bilayer either to the lipid or to other membrane proteins.
3. Functions of membrane proteins are varied and include: transport proteins, enzymes, receptors, junctions, cell adhesion proteins, cell recognition proteins, and connection of the extracellular matrix to the cytoskeleton, etc.

III. Principles of membrane organization.

- A. All membranes contain proteins and lipids; many contain carbohydrates.
 1. Lipid composition varies with type of membrane
 2. Protein-to-lipid ratio varies with type of membrane The two membrane leaflets have different lipid compositions.
- B. The membrane is fluid = most proteins are laterally mobile in the phospholipid bilayer.
 1. First demonstrated by Frye and Edidin (J. Cell Sci. 7: 319, 1970)
- C. Proteins bind assymmetrically to the lipid bilayer.
- D. The cytoskeleton affects organization and mobility of some surface membrane proteins.