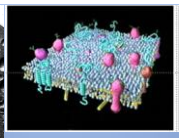
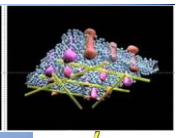
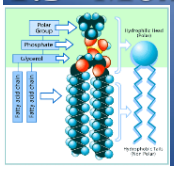
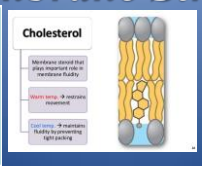
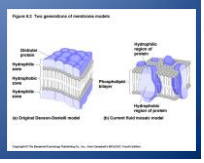




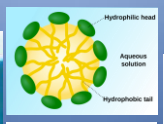

# Cell Biology
# 1.3- Membrane Structure

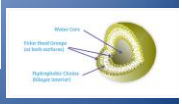
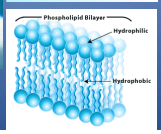





## Essential idea:

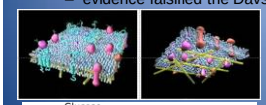
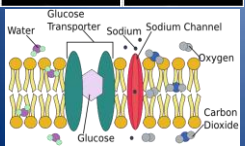
- The structure of biological membranes makes them fluid and dynamic.
  - Remember : An emergent property of amphipathic phospholipids is that they spontaneously form micelles or bilayers, including liposomes when placed in a water environment

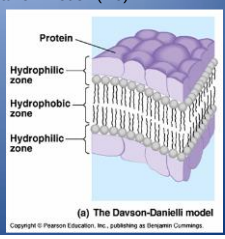




## Nature of science:

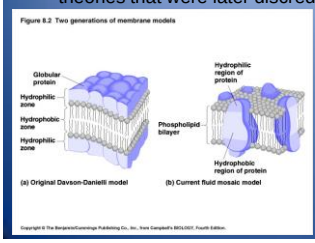
- Using models as representations of the real world
  - there are alternative models of membrane structure. (1.11)
- Falsification of theories with one theory being superseded by another
  - evidence falsified the Davson-Danielli model. (1.9)

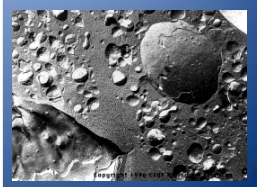






## Theory of knowledge:

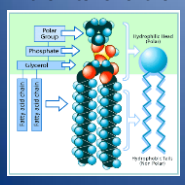
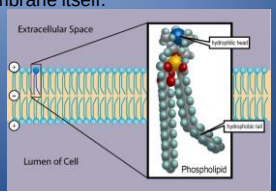
- The explanation of the structure of the plasma membrane has changed over the years as new evidence and ways of analysis have come to light.
- Under what circumstances is it important to learn about theories that were later discredited?





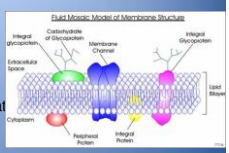
## Lipid Components

- Mainly phospholipids
  - Form bilayers in water due to the amphipathic (hydrophilic and hydrophobic) properties of phospholipid molecules.
  - Hydrophilic phosphates are oriented toward the aqueous external or internal environments
  - The hydrophobic fatty acid portions face each other within the interior of the membrane itself.

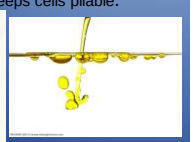




## Lipid Components

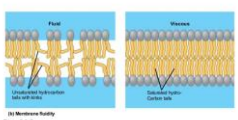
- Phospholipids create fluidity
  - Consistency of olive oil.
  - More unsaturated fatty acid residues = more fluid (kinks keep molecules spread out).
  - Phospholipid molecules move sideways at a rate of about 2 µ/sec (the length of a prokaryotic cell)
  - Phospholipids rarely flip-flop from one layer to the other.
  - Fluidity keeps cells pliable.





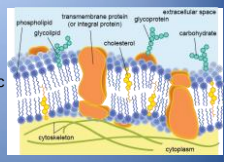


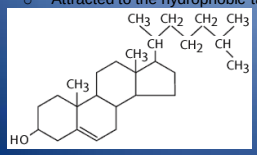
- The type of hydrocarbon tails in phospholipids
  - Affects the fluidity of the plasma membrane

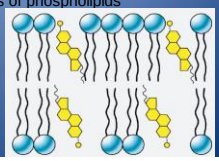


# Lipid Components

- Cholesterol (Steroid)
  - A component of animal cell membranes.
  - Hydroxyl group
    - Makes the head polar and hydrophilic
    - Attracted to the phosphate heads
  - Carbon rings
    - Not a fat or an oil
  - Non-polar (hydrophobic) tail
    - Attracted to the hydrophobic tails of phospholipids

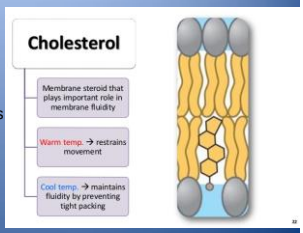


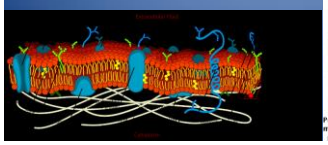
# Lipid Components

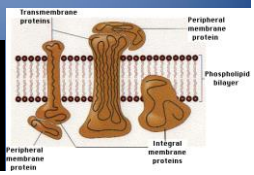
- Amount of Cholesterol regulates the fluidity and flexibility of the membrane.
  - Makes the phospholipids pack more tightly (less fluidity)
  - Disrupts the regular packing of the of the hydrocarbon tails
  - Prevents the tails from crystallizing (less solid)
  - Reduces the permeability to hydrophilic/water soluble molecules and ions (sodium and hydrogen).




# Protein Components

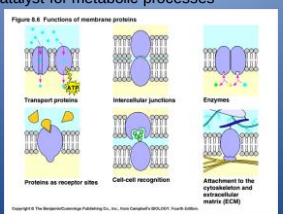
- Proteins
  - Membrane proteins are diverse in terms of structure, position in the membrane and function.
  - Integral Proteins
    - Transmembrane extend through both sides of a cell membrane.
    - Unilateral reach only partway across the membrane.
    - Peripheral proteins are not embedded in the membrane





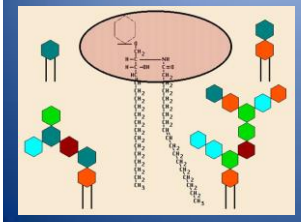

# Protein Components

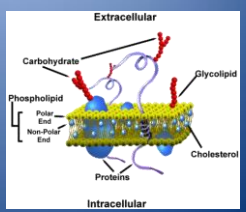
- Membrane proteins determine the membrane's functions.
  - Transport: Protein channels (facilitated) and protein pumps (active)
  - Receptor : attachment sites for peptide-based hormones (insulin, glucagon).
  - Anchorage: cytoskeleton and extracellular matrix(EMC)
  - Cell recognition: immune system, cell to cell
  - Intercellular junctions: Tight Junctions and plasmodesmata
  - Enzymes: Catalyst for metabolic processes




# Glycoproteins and Glycolipids

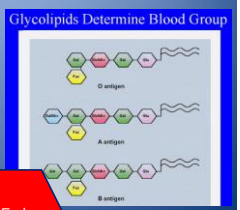
- Hydrophilic head is a variety of sugar (oligosaccharide)
- Cells develop their own carbohydrate chains
- Allows tissues and cells of embryos to sort themselves out (cell-cell recognition).






# Glycoproteins and Glycolipids

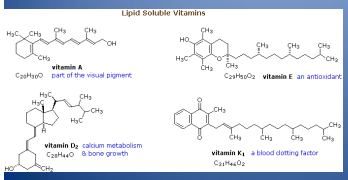
- Immune system rejection of transplanted tissues is due to recognition of unique glycolipids and glycoproteins
- Blood types are due to unique glycolipids on the membranes of red blood cells.

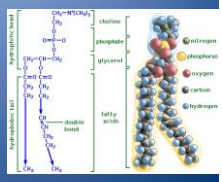



End

## Membrane Models Have Changed

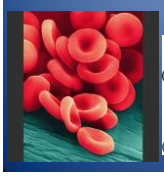
- Early Observations (early 1900's)
  - Observation: Lipid-soluble molecules entered cells more rapidly than water-soluble molecules
  - Deduction: Lipids are component of plasma membrane.
  - Later chemical analysis revealed the membrane contains phospholipids.

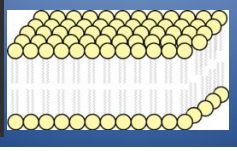


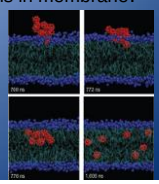




## Membrane Models Have Changed

- Gorter and Grendel (1925)
  - Observed: phospholipids extracted from a red blood cell covered 2X surface area (one bilayer)
  - Deduction: nonpolar tails directed inward, polar heads outward.
  - Blood cell analysis also revealed proteins in membrane.

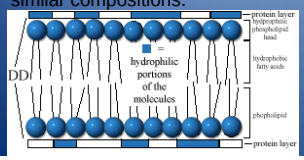


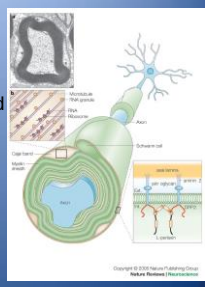




## Membrane Models Have Changed

- Danielli and Davson(1935)- proposed sandwich model with phospholipid bilayer between layers of protein.
- J. David Robertson (1950's)- with electron microscope available, proposed proteins were embedded in outer membrane and all membranes have similar compositions.



## Membrane Models Have Changed

- Singer and Nicolson(1972)- Fluid-mosaic model.
  - Embedded proteins are scattered throughout membrane in irregular pattern.
  - Proteins vary among membranes.
  - Electron micrographs of freeze-fractured membrane supports fluid-mosaic model.

Back