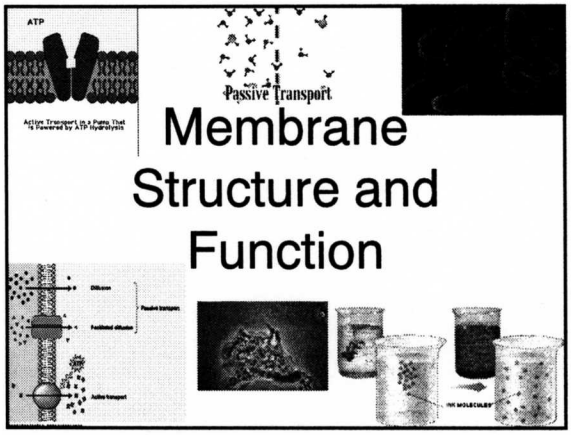
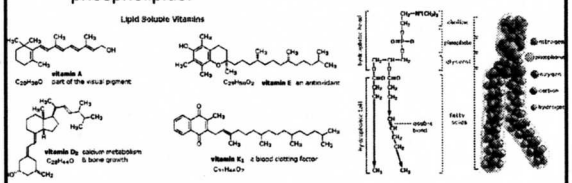


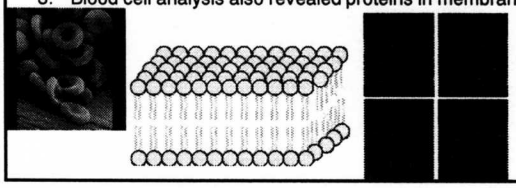
I. Membrane Models Have Changed

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



I. Membrane Models Have Changed

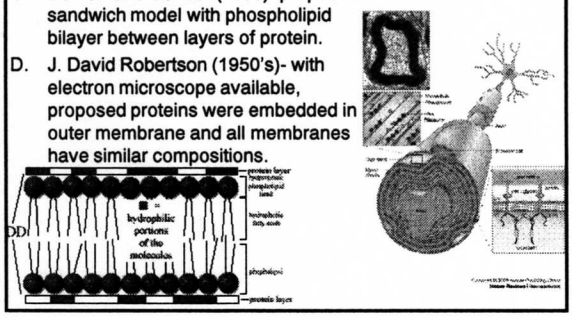
B. Gorter and Grendel (1925)
1. Observed: amount of phospholipid extracted from a red blood cell was just enough to form one bilayer
2. Deduction: nonpolar tails directed inward, polar heads outward.
3. Blood cell analysis also revealed proteins in membrane.



I. Membrane Models Have Changed

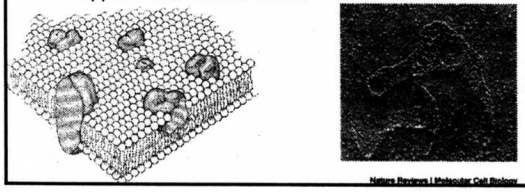
C. Danielli and Davson(1935)- proposed sandwich model with phospholipid bilayer between layers of protein.

D. J. David Robertson (1950's)- with electron microscope available, proposed proteins were embedded in outer membrane and all membranes have similar compositions.



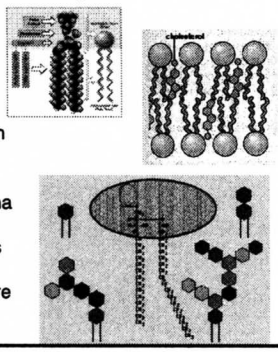
I. Membrane Models Have Changed

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



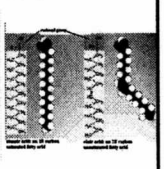
II. Membrane is Mosaic of Lipids, Proteins, Carbohydrates

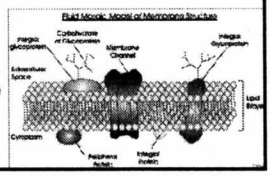
A. Lipid Components
1. Mainly phospholipids
2. Glycolipids
   a) Hydrophilic head is a variety of sugar
   b) Protective and assist in various functions.
3. Cholesterol
   a) Found in animal plasma membranes
   b) Makes membrane less fluid at warm temps.
   c) Makes membrane more fluid at cold temps.



II. Membrane is Mosaic of Lipids, Proteins, Carbohydrates

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

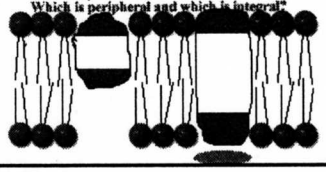




II. Membrane is Mosaic of Lipids, Proteins, Carbohydrates

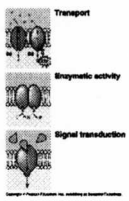
B. Proteins
   1. Integral Proteins
      a) Transmembrane extend through both sides of a cell membrane.
      b) Unilateral reach only partway across the membrane.
   2. Peripheral proteins are not embedded in the membrane.
   3. Plasma membrane is asymmetrical; lipid and protein composition of inside half differs from outside half.

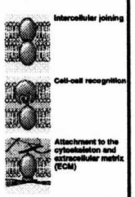
Which is peripheral and which is integral?



II. Membrane is Mosaic of Lipids, Proteins, Carbohydrates

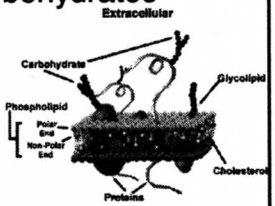
4. Membrane proteins determine the membrane's functions.
   a) Transport Proteins
   b) Enzymes
   c) Receptor Protiens- attachment sites for chemical messengers (hormones).
   d) Intercellular junctions
   e) Cell to cell recognition
   f) Attachment to cytoskeleton and extracellular matrix(EMC)

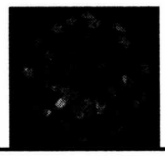




II. Membrane is Mosaic of Lipids, Proteins, Carbohydrates

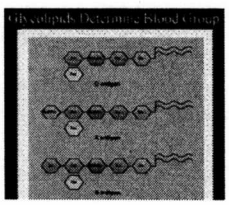
C. Carbohydrates
   1. Carbohydrate chain identifies cell.
   2. Function in Cell-Cell Recognition
   3. Chains vary by number of sugars and branching
   4. Glycolipids and Glycoproteins
      a) Cells develop their own carbohydrate chains allowing tissues and cells of embryos to sort themselves out.



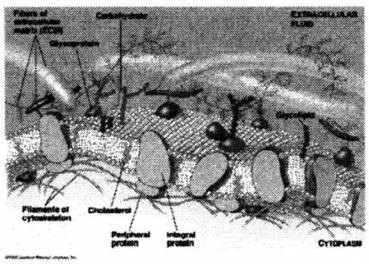


II. Membrane is Mosaic of Lipids, Proteins, Carbohydrates

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

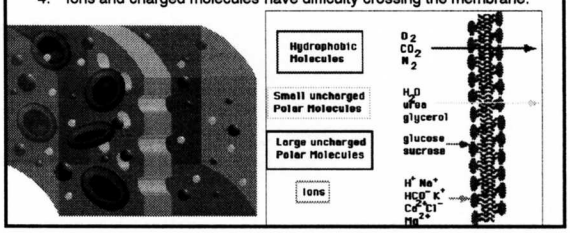


II. Membrane is Mosaic of Lipids, Proteins, Carbohydrates



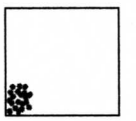
III. Properties of Membranes

A. Semipermeable membranes allows some molecules to pass through.
B. The plasma membrane is selectively permeable; only certain molecules can pass through freely.
   1. Small, nonpolar molecules pass through the membrane freely (lipids, O_2).
   2. Small, polar molecules pass through easily(CO_2, H_2O).
   3. Macromolecules cannot freely cross a plasma membrane.
   4. Ions and charged molecules have difficulty crossing the membrane.



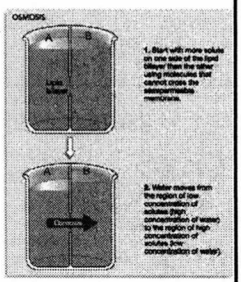
IV. Passive Transport

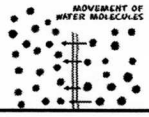
A. Molecules move across membrane without expenditure of energy.
B. Diffusion
   1. Movement from higher to lower concentration (down their concentration gradient).
   2. Due to random molecular motion.
   3. Membrane properties allow only a few types of molecules to cross by diffusion.
      a) Lipid-soluble molecules (alcohols).
      b) Gases readily diffuse through lipid bilayer. Oxygen from air sacs (alveoli) to blood in lung capillaries depends on concentration of oxygen in alveoli.
      c) Water moves in and out of cells with ease, probably through channels.



IV. Passive Transport

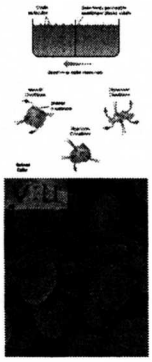
C. Osmosis- diffusion of water across a selectivly permeable membrane.
   1. Osmotic pressure is hydrostatic pressure
   2. Higher on side of membrane with higher solute concentration.
   3. Produced by water diffusing to that side of membrane.
   4. Osmosis is constant process in life: for example, water is absorbed in large intestine, retained by kidneys, and taken up by blood.





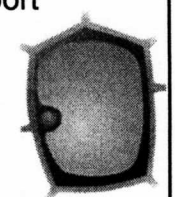
IV. Passive Transport

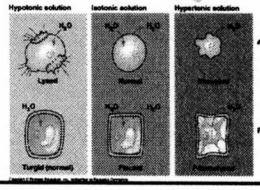
5. Tonicity- strength of a solution in relationship to osmosis; determines movement of water into or out of cells.
   a) Isotonic- the relative solute concentration of two solutions are equal.
   b) Hypotonic- relative solute concentration of one solution is less than another solution.(water moves away)
   c) Hypertonic- relative solute concentration of one solution is greater than another solution.(water moves towards)



IV. Passive Transport

6. Turgor pressor
   a) swelling of cell in hypotonic solution.
   b) how plants maintain erect position(turgid)
   c) may cause animal cells to lyse(burst)
7. Crenation
   a) when an animal cell shrinks or wrinkles.
   b) red blood cells placed in salt solutions above 0.9% crenates.
   c) in plant cells its called plasmolysis.





IV. Passive Transport

D. Facilitated Diffusion
   1. Carrier/Transport Proteins
      a) Carrier proteins combine with and transport only one type of molecule.
      b) Undergo a change in shape to move molecule across.
      c) Passive transport of specific solutes down their concentration gradient.
   2. Proteins may also act as selective channels.
   3. Cystinuria- genetic disease lacking carriers for cystine and other amino acids; not reabsorbed from urine.