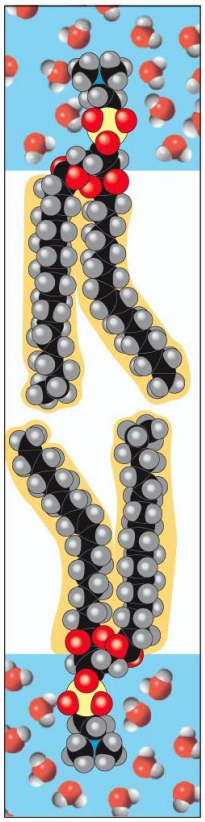
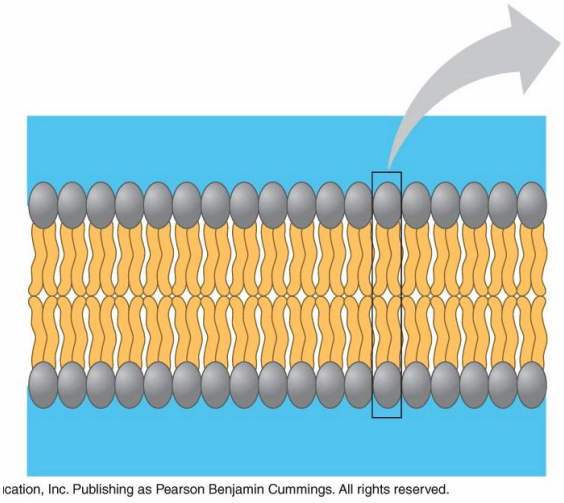
Unit 2: Cellular Organization and Processes

Section 2-2: Membrane Structure and Transport
Book Reading: Chapter 7 pages 124-138; Chapter 36 pages 739-742

<u>General Structure and Function</u>



- Phospholipid Bilayer
  - The membrane is composed of two layers of phospholipids
  - Phospholipids are ampipathic
    - *the head is hydrophobic or hydrophyllic?*
    - *the tail is hydrophobic or hydrophyllic?*
  - Arranged in such a way that the heads face out toward the cytoplasm or extracellular space, and the tails face each other on the inside of the membrane



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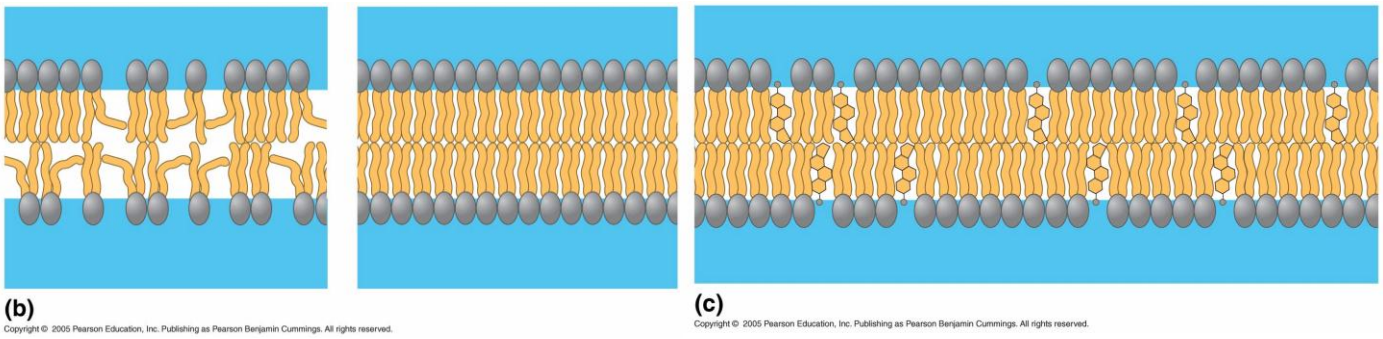
- Selectively Permeable
  - *define*

<u>Fluid Mosaic Model</u>

- Fluidity
  - Phospholipids can change places rapidly
  - Proteins can also move fluidly throughout the membrane
    - Slower rate because *of what*
    - More structured movement, likely guided by the cytoskeleton in some way

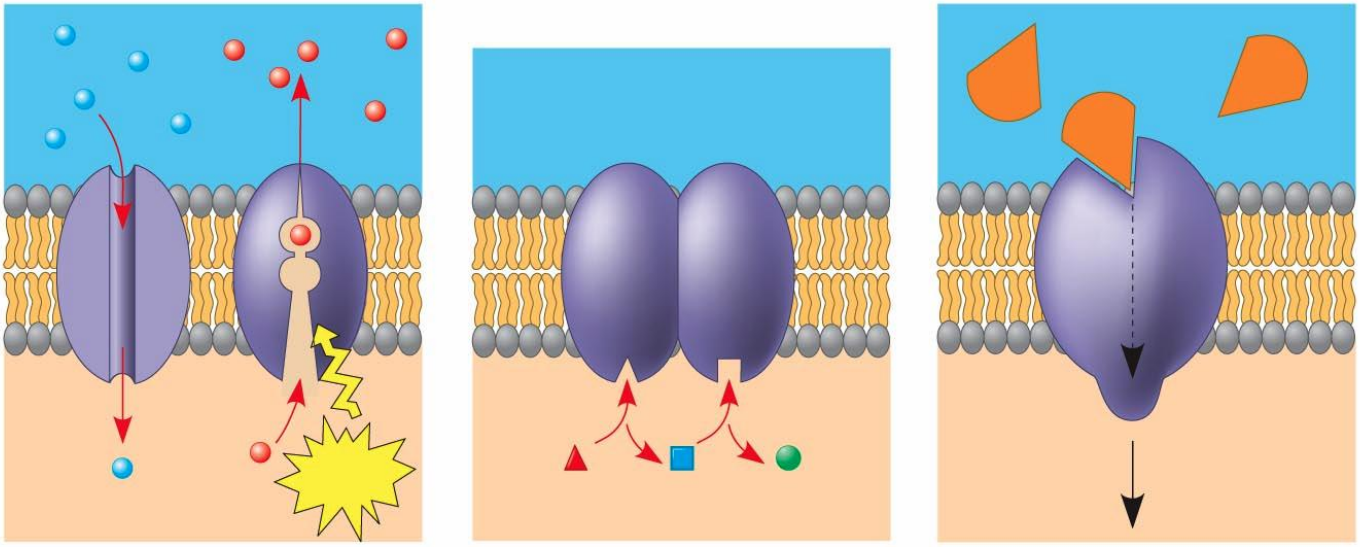
- Maintaining Fluidity
  - Decrease in temperature can cause the phospholipid bilayer to *do what?*
  - Unsaturated hydrocarbons help maintain fluidity *how?*

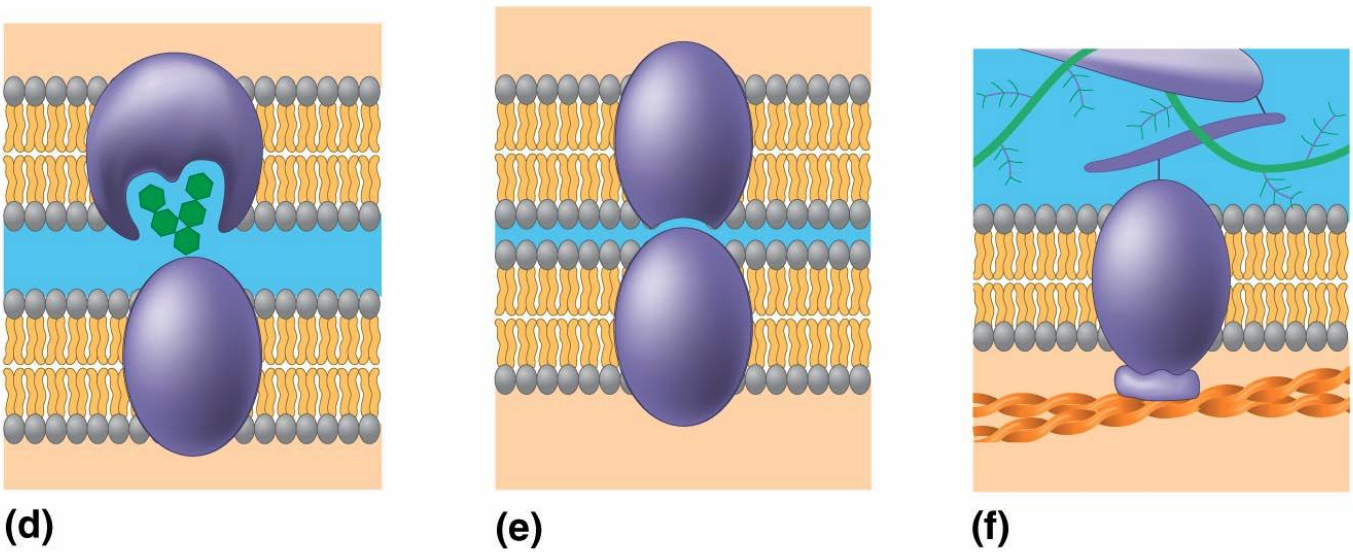
- Cholesterol molecules in the membranes of animals has several effects on fluidity:
  - At normal temperatures,
  - Advantage as the temperature drops however, because the cholesterol helps the membrane



❖ Mosaic

- Refers to the various proteins that are found in/on the membrane
  - Integral Proteins/Transmembrane Proteins- *where are they specifically located?*
  - Peripheral Proteins- *where are they specifically located?*
- General Functions of Membrane Proteins
  - Transport-
    - Channel
    - Carrier
  - Enzymatic Activity-
  - Signal Transduction-
  - Cell-to Cell Recognition-
  - Intercellular joining-
  - Attachment to the cytoskeleton and extracellular matrix-





- ❖ Role of Carbohydrates in Cell-to Cell Recognition
  - Membrane carbohydrates are usually *shaped how?*
  - Function in cell-to-cell recognition
    - *list*
    -
    -
  - Glycolipid- *define*
  - Glycoprotein- *define*

Two Kinds of Transport Proteins

- The Rules of Membrane Passage
  - The plasma membrane is hydrophobic and phospholipids are tightly packed- *what kinds of molecules are able to cross the membrane quickly?*
    - Oxygen
    - Carbon dioxide
    - Hydrocarbons
  - If a chemical is "too charged or too large" it must have another way to get across the membrane

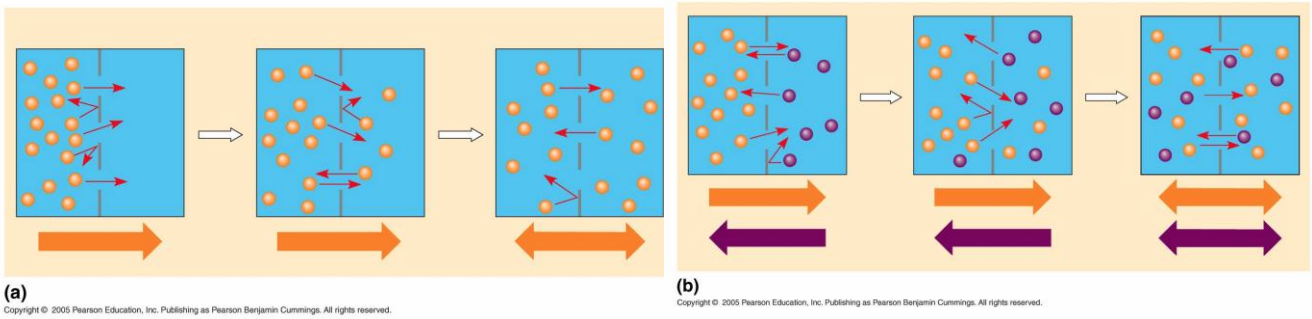
- Channel Proteins
  - *what do they provide?*
  - Aquaporins- *define*

- Carrier Proteins
    - *How do they function? What kinds of molecules do they carry?*

Passive Transport

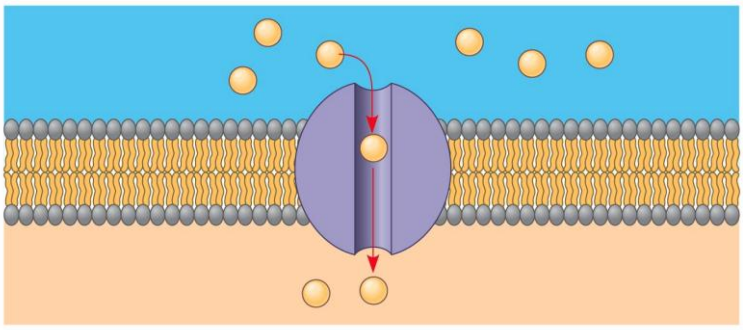
Passive Transport- *define*

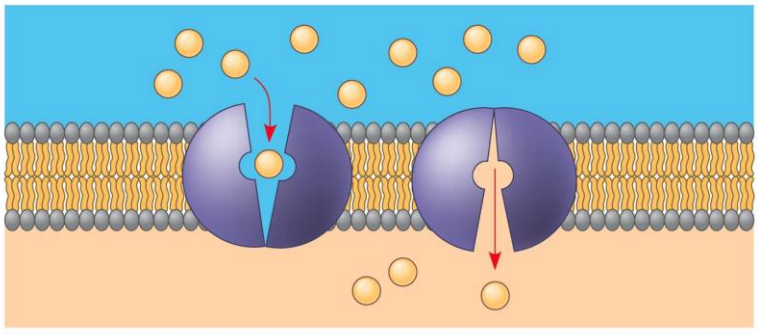
- Diffusion
  - *define*
  - Molecules will move down their concentration gradient until the substance is evenly spread
  - Diffusion is a *spontaneous/nonspontaneous?* process
  - It can occur for small, nonpolar substances directly across a membrane



❖ Facilitated Diffusion

- The diffusion of a substance with the assistance of a transport protein
- Channel proteins-
  - Aquaporins
  - Ion Channels
  - Gated Channels
- Carrier proteins-





❖ Osmosis

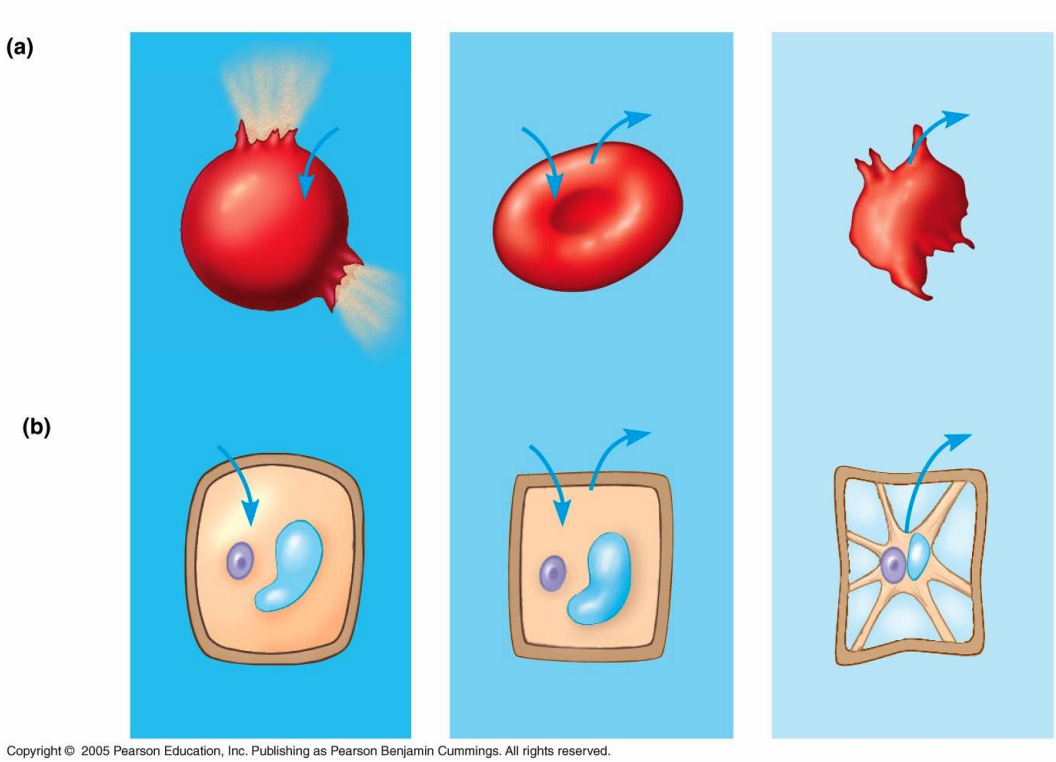
- *define*
- Tonicity
  - *define*
  - Dependent on the concentration of *what* that cannot cross the membrane

- Hypotonic Solution
  - Contains *more, less, or the same amount of dissolved solutes as the cell?*
  - Will cause water to *do what*
  - Animal cell will *do what*
  - Plant cell will *do what*
  - Favorable condition for a *what kind of cell?*

- Isotonic Solution
  - Contains *more, less, or the same amount of dissolved solutes as the cell?*
  - Will cause water to *do what*

- Animal cell will *do what*
- A plant cell will become *what?*

- Hypertonic Solution
  - Contains *more, less, or the same amount of dissolved solutes as the cell?*
  - Will cause water to *do what*
  - Animal cell will *do what*
  - Plant cell will undergo plasmolysis- *define*



<u>Water Potential</u>

❖ The Problem with Cell Walls

- Osmosis can easily be predicted when there is not a physical barrier to stand in the way of the movement of water into our out of a cell
- Plant cells have cell walls so osmosis into our out of a plant cell depends on two factors:
  - *list*
  -

❖ Water Potential

- Water potential (Ψ) is *define*

- Measured in units of *what*
- When water is bound to a solute

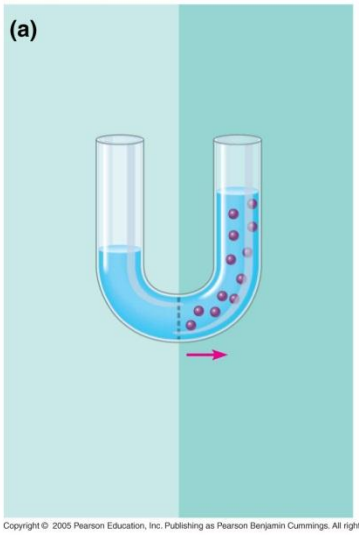
- Water will ALWAYS move from *where to where?*

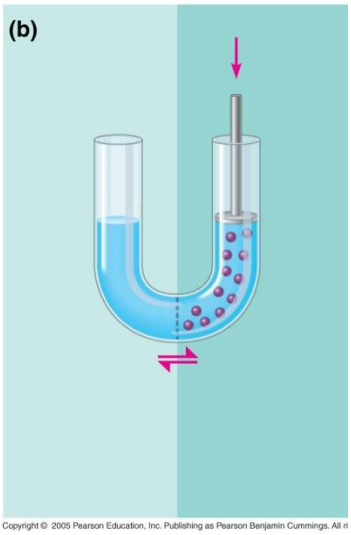
❖ The Formula

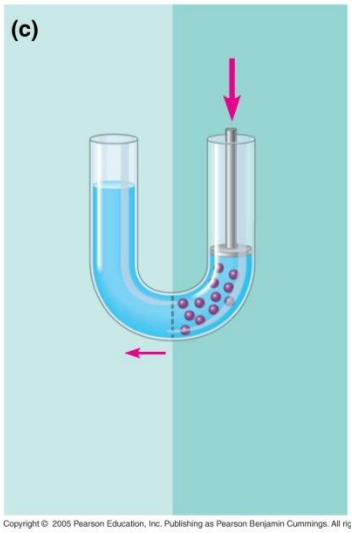
- $\Psi = \Psi_s + \Psi_p$
- Ψ_s= *stands for what*
  - Solute potential of pure water is
  - Adding a solute ALWAYS lowers solute potential so it can be negative, but never positive
- Ψ_p= *stands for what*
  - Can be positive or negative relative to atmospheric potential
  - Turgor Pressure results when the cell is under positive pressure relative to the atmosphere

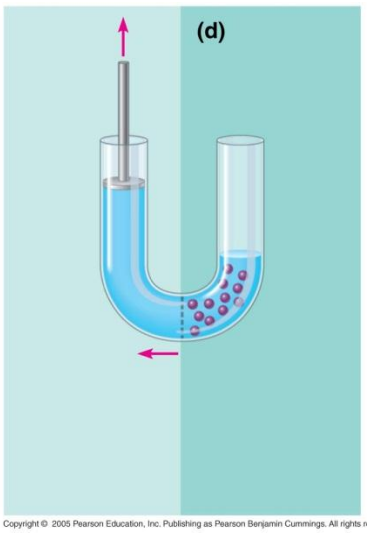
❖ Examples

- Be prepared to calculate water potential









- Another Wacky Formula
  - Solute Potential Ψ_s= -iCRT
  - i=
    -
    - unique to
    - in chemistry represented by K_{eq}
  - C= molar concentration of the solute (molarity)
  - R= Pressure constant 0.831 L*atm/mol*K
  - T= Temperature in Kelvin (°C+ 273)

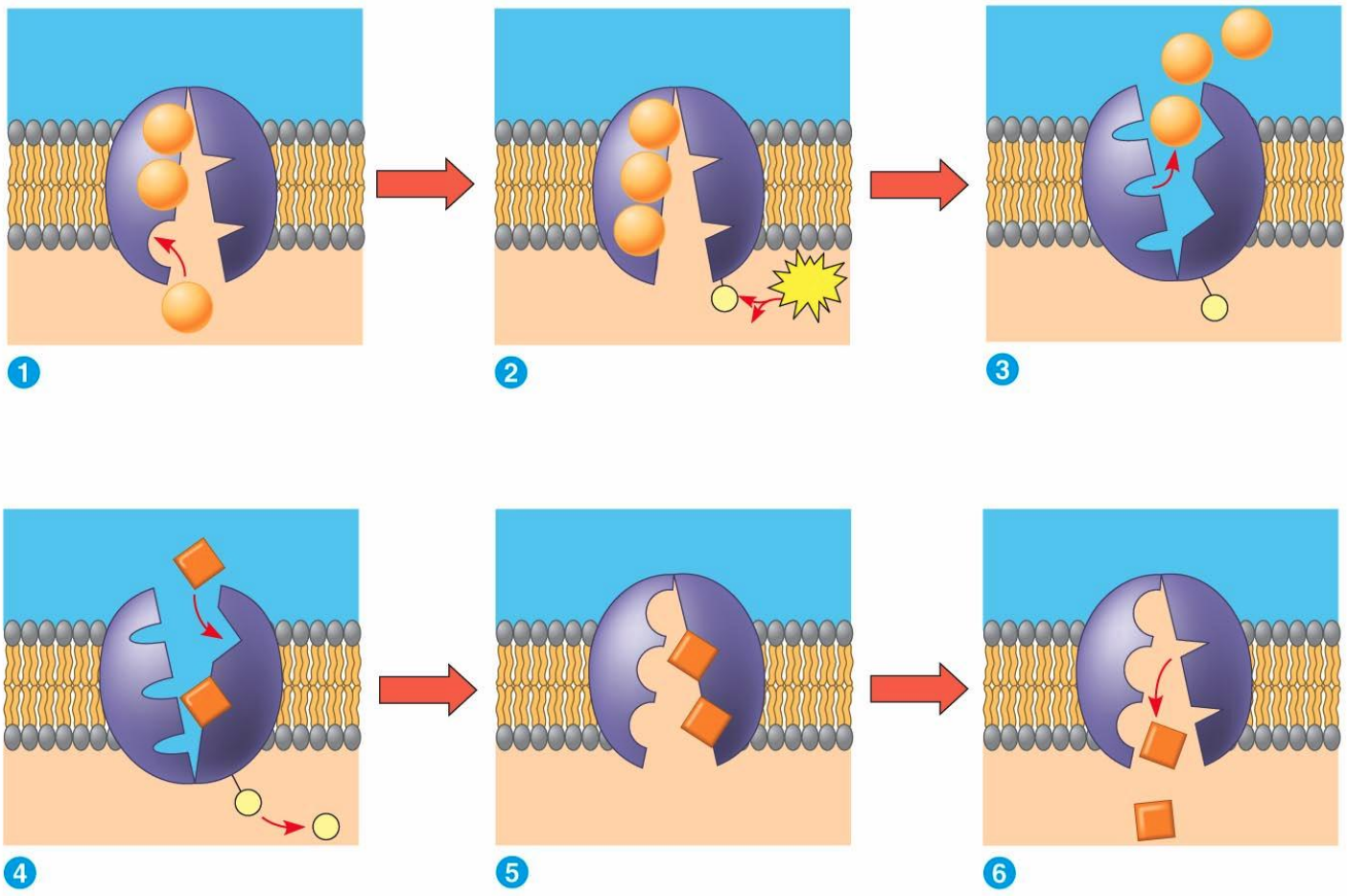
<u>Active Transport</u>

- Active Transport- *define*

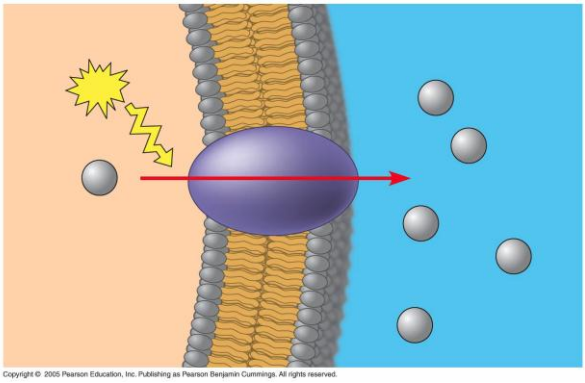
- Electrogenic pumps
  - Membrane protein that generates voltage across a membranes by actively pumping ions across a membrane to contribute to membrane potential
  - Membrane Potential
    - Voltage-

- Cytoplasm is in general more

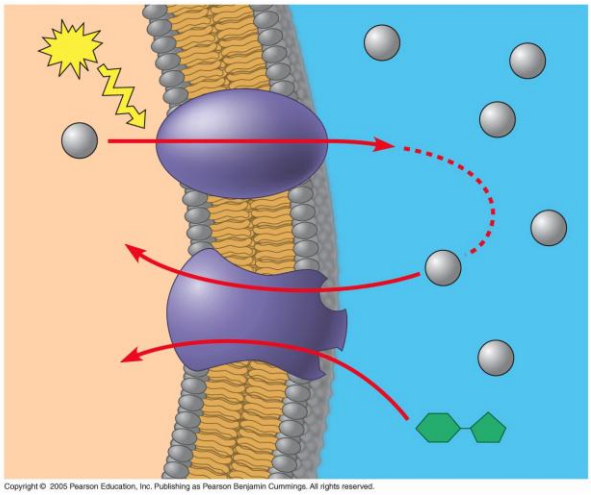
- Sodium Potassium Pump
  - Found in *what kinds of organisms?*
  - Pumps out 3 sodium ions for every two potassium ions that enter the cell
  - Helps to keep the inside of the cell at a



- Proton Pump
  - Found in *what kinds of organisms*
  - Pumps hydrogen ions (protons)
  - Uses ATP therefore is *what kind of transport*
  - Results in a proton gradient with higher H+ *located where? Inside or outside of cell?*
  - Produces a membrane potential- a separation of opposite charges across a membrane that is a form of potential energy that can be harnessed by the cell to perform cellular work



- ❖ Cotransport (an example of using proton pump action)
    - Coupling the "downhill" diffusion of a substance with the "uphill" diffusion of another substance against its concentration gradient



<u>Bulk Transport</u>

- ❖ Exocytosis
    - Vesicle that has left the golgi apparatus moves toward the plasma membrane
    - The membrane of the vesicle fuses with that of the plasma membrane and releases the contents to the outside
    - Common in secretory cells

- ❖ Endocytosis
    - Cell takes in macromolecues and small matter by forming new vesicles from the plasma membrane
    - Essentially the opposite of exocytosis
    - Examples:

- Phagocytosis
- Pinocytosis
- Receptor-mediated endocytosis