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BSC 215
READING: pages 68-85

CHAPTER 3- THE CELL

The cell: smallest unit of life

Cell processes::
- Metabolism- chemical rxns that a cell carries out to maintain life
    - -anabolic=building
    - -catabolic=breaking down
    - -oxidation/reduction-convert energy from nutrients to chem. energy (ATP)
- Transport of substances
- Communication b/w cells
- Cell reproduction

Structure
- Plasma membrane: support, communication, cell identification
    - The "fence"
- Intracellular space: space w/in cells that contains cytosol
- Extracellular space: space outside that contains extracellular fluid or "ECF"
- Cytoplasm: inside membrane
    - Fluid cytosol and structures (organelles & cytoskeleton)
- Cytosol: intracellular fluid (ICF) ½ of cell's total volume
    - Mostly water
    - Site of protein synthesis
    - Site of glycolysis
- Inclusions: clusters of identical storage molecules in cytosol
    - Stores nutrients from ECF & cell made proteins
- Organelles: molecular machines that perform specific functions
    - They keep cell organized-"compartmentalized"
- Cytoskeleton: network of protein filaments
    - Supports, maintains shapes, hold organelles in place
    - Also responsible/supports transportation w/in cell
- Nucleus: surrounded by phospholipid bilayer- "nuclear envelope"
    - Contains DNA and makes most of RNA
- Structure-function core principle: cells are shaped differently based on function

Phospholipid Bilayer

- phospholipids are amphiphillic: have both nonpolar and polar parts
- Requirements:
    - 1. Molecules must have parts that can interact w/ water in ECF & cytosol
        - membrane's hydrophilic regions that interact w/ water must have polar covalent bonds
    - Molecules must also have parts that repel water to keep eater in ECF and cytosol separate

Fluid mosaic model: current model of the plasma membrane

- plasma membrane is a structure w/ multiple components whose arrangement is dynamic (it changes all the time)

Fluidity: ability of phospholipids and other components to move w/in the membrane- this is very important

Membrane proteins: carry out many of the membrane's functions and give different cell types their unique properties

- Integral proteins: normally span the width of the membrane
    - When they reach both sides of the membrane→ transmembrane proteins
- Peripheral proteins: only on one side of the membrane or the other

Functions of membrane proteins

- Transporting substances: most transmembrane proteins serve as protein channels
    - Some integral proteins called carrier proteins transport molecules in and out of the cell
- Act as receptors
    - Membrane proteins that bind to chemical messengers are called ligands
    - Receptor-ligand interactions are responsible for physiology of most systems
- Act as enzymes
- Provide structural support
- Link adjacent cells

Plasma membrane components:

- Cholesterol: stabilizes the plasma membrane structure when temperature changes
- glycolipids
- glycoproteins
    - both function in cell recognition

Passive Transport: NO energy needed
Active: requires energy (ATP)
What determines if a process is passive or active?

1. type of substance crossing
2. membrane's permeability
3. concentration of substance inside/outside of the cell

concentration gradient drives passive transport

Diffusion: movement of solute molecules from area of high concentration→ low

- rate of diffusion depends on size/phase of particles. Temperature, size of concentration gradient, barriers

Simple diffusion: nonpolar solutes (ex: hydrocarbons, lipds) that don't have assistance from a membrane protein

Facilitated diffusion: charged/polar solutes that cross the phospholipid bilayer w/ help of a membrane protein

- rely on carriers/channels because they are repelled by the phospholipid bilayer's fatty acid tails

Osmosis: movement of solvent (H2O) across a membrane with channel proteins called aquaporins in the plasma membrane

- some H2O molecules pass directly b/w membrane phospholipids but its not super common
- driven by osmotic pressure: "pulling" force that solutes exert on water molecules
- solutions w/ higher solute concentration has greater osmotic pressure

Tonicity: way to compare osmotic pressure b/w 2 solutions (in our cells, it is used to compare cytosol and ECF)

- body's ECF is isotonic to the cytosol of a cell, meaning ECF has about the same solute as cytosol

hypertonic extracellular solution= cell LOSES water
- cell can crenate (shrivel and die)

hypotonic extracellular solution= cell GAINS water

- cell can lyse (swell and burst)

Primary Active Transport: protein in plasma membrane binds/transports/"pumps" a solute against its concentration gradient using energy from hydrolysis of ATP

- uniport pump: drives a single substance in/out of a cell
- symport: drives 2 or more substances in the same direction
- anitport: drives 2 or more in opposite directions
- Na+/K+ pump: main primary active transport pump in body
    - Homeostasis requires the maintenance of the concentration gradient of these