**AP Biology Cell Unit Study Guide**

1. Cell Membrane structure
   1. Phospholipid structure
      1. Hydrophilic head
      2. Hydrophobic tail
   2. Bilayer
      1. Fatty acids face in away from water
      2. Types of fatty acids affect membrane fluidity {(saturated v. unsaturated)
   3. Fluid mosaic model
      1. Cholesterol maintains fluidity
      2. Protein Types
         1. Integral penetrate cell membrane
         2. Peripheral stay on outside of membrane
      3. Glycoproteins and glycolipids
         1. Molecules with short carbohydrate chains, used primarily for cell recognition
2. Cell Membrane Function
   1. Diffusion
      1. Particles move along concentration gradient from high to low concentration
      2. Due to Brownian motion of particles- particles move randomly- not in a specific direction, but because they bounce off each other they tend to spread out.
   2. Osmosis
      1. Diffusion of water through a semipermeable membrane (like a cell!)
      2. Tonicity
         1. Isotonic environment- same amount of solute/water inside and outside of cells. Most fluids in our body are isotonic
         2. Hypertonic environment- more solute/less water outside of cell than inside. Water will leave the cell, causing it to shrink.
         3. Hypotonic environment- more water/less solute outside of cell than inside. Water will move into the cell causing lysis.
            1. Contractile vacuole- organelle in freshwater protists that pumps out excess water to avoid lysis
   3. Transport Proteins
      1. Channel proteins
         1. Simple tubes that allow particles to move along their concentration freely
         2. Aquaporins- transport water
      2. Carrier Proteins
         1. Proteins that undergo a conformational change to allow particles move through the membrane along their concentration gradient
      3. Protein Pumps
         1. Use ATP to actively move particles through the membrane against concentration gradient
   4. Passive Transport- does not require added energy
      1. Diffusion through the membrane is possible with small nonpolar particles such as steroids, carbon dioxide and oxygen
      2. Diffusion of charged or polar particles is much slower because of repulsion be the fatty acid tails of phospholipids
      3. Facilitated diffusion occurs with the help of channel and carrier proteins that allow charged or polar molecules to move through the membrane
   5. Active Transport- requires added energy
      1. Protein pumps move particles (often ions) through membrane against concentration gradient with energy (ATP). This can concentrate ions on the inside or outside of the membrane
      2. Endo/exocytosis moves larger particles and greater numbers of particles into or out of the cell through vesicles- often mediated with receptors
3. Organelles
   1. Understand the structure and function of the following organelles (check the organelle slideshow)
      1. Nucleus
      2. Nucleolus
      3. Ribosome
      4. Endoplasmic reticulum
      5. Golgi
      6. Ribosome
      7. Vesicle
      8. Peroxisome
      9. Lysosome
      10. Chloroplast
      11. Mitochondria
   2. Know how the first 7 organelles work together to manufacture and transport proteins
   3. Know that the last two are likely the result of endosymbiosis and have their own DNA
4. Cell Types
   1. Prokaryotic
      1. Bacteria
      2. Small, simple, no membrane-bound organelles
   2. Eukaryotic
      1. Plants, animals, protists, fungi
      2. Larger, more complex with membrane-bound organelles
      3. Organelles add surface area, allowing these cells to grow larger
5. Cell Communication
   1. Signal Reception
      1. Non-polar signals (steroids) can move through the cell membrane and attach to a receptor within the cell (intracellular)
      2. Other ligands stay outside of the cell and attach to membrane receptors
         1. G Protein- coupled receptor
         2. Receptor Tyrosine Kinases
         3. Ion channel receptors
   2. Transduction (many steps)
      1. Relay signals between molecules (activation)
      2. Amplification of signal- one ligand can generate a very large response)
      3. Multiple steps add opportunity for regulation and coordination of steps.
      4. Phosphorylation by kinases often activates signal proteins
      5. Phosphatase enzymes dephosphorylate (deactivate) proteins
   3. Response
      1. Response may be activation of an enzyme or gene transcription
6. Cell Cycle
   1. Interphase
      1. G1- Gap 1- Normal growth and cell function
      2. S- Synthesis- DNA is copied
      3. G2- Gap 2- Growth, extra organelles made
   2. Mitosis
      1. Prophase- DNA condenses into chromosomes, nuclear membrane breaks apart
      2. Metaphase- Sister chromosomes line up in the middle of the cell, arranged by spindle fibers
      3. Anaphase- Sister chromatids pulled apart by shortening of spindle fibers
      4. Telophase- sister chromatids reach opposite poles, decondense, new nuclear envelopes form
   3. Cytokinesis
      1. Cell division
         1. Cytoplasm pinches (cleavage furrow)
         2. In Plants cell plate forms
   4. Control of cell cycle
      1. Often signaled by growth factors (signal transduction pathway)
      2. Density-dependent inhibition and anchorage-dependent inhibition (cells don’t divide if crowded or not anchored)
      3. Cyclins activate CDKs (Cyclin Dependent Kinases) to initiate next phase in cell cycle.
      4. Checkpoints- cell cycle I halted until go signal moves cycle forward
         1. G1, G2, M
         2. If no go-ahead signal received, cell switches into G0
   5. Cancer (uncontrolled cell proliferation)
      1. Result of multiple mutations that cause cell to ignore signals (density-dependent and anchorage dependent)
      2. Tumor
         1. Benign- abnormal cells remain at original site (wart)
         2. Malignant- Invasive and can damage healthy organs and tissue
         3. Metastasis- cell from original tumor detach and grow elsewhere in the body
      3. Treatment- difficult to target your own cells
         1. Radiation- damages quickly dividing cancer cells (messes up DNA replication)
         2. Chemotherapy- interfere with stages of division
         3. Immunotherapy- utilizes natural immune response to target cancerous cells