Biology Exam Review

Unit #1 – Biochemistry

Chapter 1 – Chemical Basis of Life

- **Subatomic Particles:** protons, electrons, neutrons
  Isotopes: same element with different number of neutrons, same chemical properties
  Radioisotopes: radioactive isotope with an unstable nucleus that decays and emits energy
  Valence Electrons: the electrons of an atom in the outermost energy level
- **Carbon-14:** Trace movement of carbon through biological pathways
  Calcium 45: Measure rate of bone formation
- Intramolecular bonds are determined by the difference in electronegativity
  <0.5 = covalent
  >0.5 - 1.7 = polar covalent
  >1.7 = ionic
- Intermolecular bonds: LDF, dipole dipole forces and H- bonds (van der Waals forces).
  Special properties of water and Hydrogen Bonding:
  - Excellent solvent
  - Adhesive/Cohesive
  - High specific heat capacity
  - High conductivity
  - High boiling and melting point
  - Most dense at 4°C
- Higher concentration of H^+ ions = decrease in level of pH (0) = more acidic
  Lower concentration of H^+ ions = increase in level of pH (14) = more basic
  $pH = - \log_{10} [H^+]$
- Buffers are substances that resist changes in pH.
  In humans there is a carbonic acid - bicarbonate.
  $\mathbf{H_2O + CO_2 \leftrightarrows H_2CO_3 \leftrightarrows HCO_3^- + H^+}$
  When there is an excess amounts of H^+ ions in our body, they bond with bicarbonate ions to make carbonic acid. However, if a base enters the body, carbonic acid is ionized to maintain pH levels.
- **Functional Groups:** reactive cluster of atoms attached to the carbon backbone of organic molecules
  Hydroxyl – OH group
  Carboxyl – double bond O and OH group
  Amino – N with 2 H **OR** 1 H
  Sulfhydryl – S bonded to 1 H
  Phosphate – phosphate bonded to 4 O (3 negative and 1 double bond)

Chapter 6 - Biotechnology

- **Restriction enzymes (R.E.)** - Enzymes that cut DNA at a specific locations.
- Molecular scissors creating **fragments** by cutting DNA at **specific recognition** sites
- Each restriction enzyme only cuts at one recognition site in only one direction
- Restriction enzymes cuts phosphodiester bond in the DNA backbone and nucleotides are palindrome.
- **Natural Source** = mechanism evolved by bacteria (E. Coli) to resist viral attack and to help in the removal of viral sequences. They are part of what is called the restriction modification system.
- **Blunt end** - "Texture" of the end of DNA after restriction enzymes cut straight across a DNA strand, difficult to recombine.
  Sticky end - End of DNA after restriction enzymes cut a zig zag across a DNA strand, easy to recombine with a complementary sticky end because of H-bonds (complementary sticky end need to be cut by the same enzyme (same sites) to recombine)
- *R.E. can break down the DNA of their own bacteria. Methylases prevent that.*
  Methylases - Enzymes add methyl groups ($-CH_3$) to specific recognition sites. This changes the shape of the site, which blocks the restriction enzyme.
  DNA Ligase - enzyme used to join cut strands of DNA
- **Gel Electrophoresis** - technique to separate DNA fragments based on size. *Steps...*
- Prepare a thin slab of agarose (gel) and place it in a box between two electrodes and cover the gel with a buffer.
- DNA fragments are placed in "wells" at one end of the agar. Electric current is turned on, which causes the fragments to move. This is because the phosphate groups in the DNA have are negative. Therefore, positive charge is placed at the opposite side.
- Smaller fragments travel further because it is easier to move.
- A stain is used to make DNA fragments visible, usually ethidium bromide. The stain inserts itself among the complementary base pairs of the DNA and fluoresces under UV light.
- The length of these fragments can be determined using a standard sample which is ran alongside the experimental fragments.
- *In this example insulin and human cells will be used.*
- Human DNA is cut into fragments (R.E.), one or more fragments must contain target gene (insulin code)
- Cut bacterial DNA (plasmids with antibiotic resistant) and make it linear
- Insert DNA fragments with gene into each plasmid
- Transform bacteria cells with recombinant DNA plasmids. Bacteria will divide, hence multiply the code for the gene.
- Identify bacteria with gene inserted into it and extract for insulin.
- Medical - production of insulin
- He told me its not on the test but think logically.

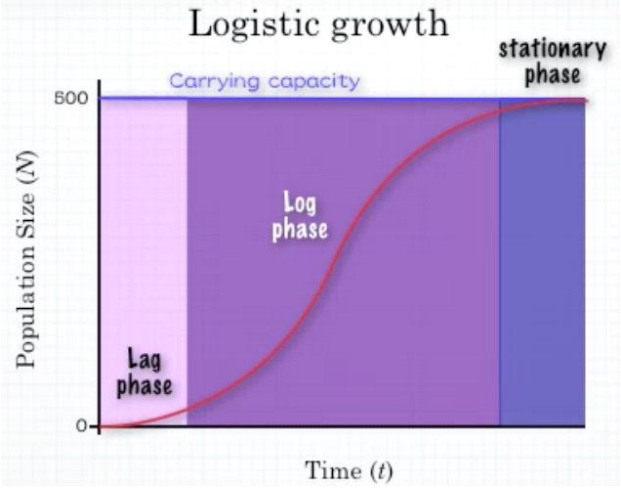
- The first cells were fat based. There were inorganic chemicals that could have reacted to produce the organic molecule, but there were not high enough concentrations of these reactants. Therefore, we know that when fats are in water they create a cell like spherical shape and arrange themselves due to their hydrophilic and hydrophobic ends. This effectively separates the outside environment from the inside of the cell. The chemicals are not in high concentrations and can react which each other to form the organic compounds inside the phospholipid membrane.
- Endosymbiosis occurs between ancient eukaryotic cells and aerobic prokaryotic cells. In this relationship the prokaryotic cell is protected, while the host cell benefits from increased ATP production. Later on in history, the host cells may have engulfed photosynthetic prokaryotic cells. In this case, the photosynthetic cell was protected, while the host benefitted from the glucose production. (add diagram)
- The 3 major groups that all living things can be classified in are: Archaebacteria, Eukaryotes, and Eubacteria.
- The Cenozoic era: dinosaur extinction
- Pre- extinction organisms (135-180 Mya) - birds appear, reptiles rule land, air and sea, mammals appear, angiosperm plants appear
- Post extinction (65mya) - extinction of large reptiles, mammal radiation begins, angiosperm plants dominate
- Cladograms show change in morphology over geological time.
- **Theory of gradualism** - a theory that attributes large evolutionary changes in species to the accumulation of many small and ongoing changes and processes

  Theory of punctuated equilibrium - a theory that attributes large evolutionary changes to relatively rapid spurts of change followed by long periods of little or no change
- **Divergent evolution** - occurs when two or more species evolve increasingly different traits, resulting from differing selective pressures or genetic drift

  Convergent Evolution - occurs when two or more species become increasingly similar in phenotype in response to similar selective pressures

  Coevolution - process, sometimes referred to as reciprocal adaptation, in which one species evolves in response to the evolution of another species

Carrying Capacity (K) – the maximum number of individuals in a population that can be sustained by the environmental resources.

- 

- **Density-dependent factors:** effect is related to the size of that population.
  Usually, high population density leads to a reduction in population growth rate.
  Intraspecific Competition – Individuals of the same species compete for resources like food. Greater the population size, the more difficult to obtain resources. Tends to limit population growth.
  Predation – When one species (predator) catches and consumes another species (prey). Population size of the predatory species can have a direct influence on the population size of the prey species (vice versa).
  Disease – Caused by pathogens (germs) and can be transmitted rom one individual to another. Spreads rapidly through densely packed populations, since the probability of coming in constant with an infected individual is high.
  Sometimes a low population density leads to a reduction in growth rate.
  Allee Effect – Warder Allee discovered that when a population is sufficiently small the changes of individuals finding each other to mate is reduced. This decreases growth rate.