BIOL 240 (Part I) – Important Terms & Concepts 2/9/2020 (this is NOT an exhaustive list!)

GENERAL MICROBIOLOGY: Tortora, et al. (2019) Chapters:

1. Germ, microbe, pathogenic. Linnaeus- "*Genus species".* Bacteria, "Prokaryotes", bacillus, coccus, spiral, Archaea; Eukaryotes: fungi, protista – protozoa & algae, animalia - helminthes. Acellular – viruses. Domains: (Eu)Bacteria, Archaea, Eukarya. Hooke/Virchow/Schleiden/Schwann – **Cell theory**, van Leeuwenhoek – first microscope.

Spontaneous generation: Redi, Spallanzani; ***Biogenesis***: living cells only from preexisting living cells; **Louis Pasteur** disproves *Spontaneous Generation* – swan (S)-necked flasks; Aseptic techniques; fermentation, pasteurization.

Germ theory of disease: Lister (phenol cleansing), **Koch** – Germs cause specific diseases (*Bacillus anthracis* – anthrax); **Koch's postulates** – microbe present in every diseased animal, Isolate organism from diseased animal, inject into healthy host → causes disease, reisolate from newly diseased animal. ***Etiology***. Chemotherapy, synthetic drugs, antibiotics; **Alexander Fleming** – penicillin; Bacteriology, mycology, Parasitology, Immunology, virology. Bioremediation, Gene therapy, Normal Microbiota; Emerging infectious diseases; *Prions.*

2. **Biological Chemistry:** Atoms, molecules; nucleus, protons, neutrons; electrons, atomic number, atomic weight isotopes; Electron shells/energy levels, Valence; Chemical bonds: **covalent, ionic (cation, anion), hydrogen bond**. Energy: **endergonic** reactions, **exergonic** reactions; synthesis/ **anabolism** (***condensation***/ dehydtration reactions), Decomposition/ **catabolism** (***hydrolysis*** reactions). Water – polar, solvent, H-bonds, *Hydrophilic, Hydrophobic.* dissociates (ionization/dissociation = H+, -OH) = pH. Acid, Base. pH Buffers. **CHNOPS**; Carbon Skeleton, functional groups (hydroxyl, amino, sulfhydryl, carboxyl, phosphate). **Carbohydrates** $(CH_2O)n$ = mono/di/poly-saccharides, Isomers; **Lipids** = hydrophobic, mostly CH, tryglycerides (saturated fat, unsaturated oil); pigments, steroids/cholesterol, phospholipids. **Proteins** = amino acids; enzymes, transporters, toxins, movement, hormones. **Primary, secondary (α-helix, β-pleated sheet) tertiary, quaternary protein structure**. –SH, disulfide bridges (cysteine). **Nucleic Acids** = DNA, RNA. Ribose/deoxyribose, nucleotides, purines (A, G), pyrimidines (C, T, U), double helix, hydrogen bonds (A=T, G≡C), phosphate-sugar-base; **ATP**, ADP, Pi.

3. Micrometer (**μm**) = 10^{-6} m, nanometer (**nm**) = 10^{-9} m, Magnification, **Resolution**, **Compound light microscope**, **Refractive Index**, immersion oil, Brightfield, darkfield, Phase-contrast, Diffraction, Fluorescence Microscopy, Confocal Microscopy, Electron Microscopy (Scanning EM, Transmission EM); Positive staining, Negative staining. **Basic Dyes, Acidic dyes**, Differential Stains, Simple stains; Mordant, **Gram stain** – crystal violet, iodine, ethanol, safranin. Decolorizing agent, counterstain. Acid-fast stain – carbol fuchsin, heat, acid-ethanol, methylene blue; capsule, endospore, Flagellum.

4. **"Prokaryote"**, **Eukaryote** – comparison. **Glycocalyx** – capsule, slime layer. **Flagella** – runs and tumbles; counterclockwise & clockwise rotation ("corkscrew"). Monotrichous, amphitrichous, lophotrichous, peritrichous. H-antigens. Axial filaments/ endoflagella, **Fimbriae**, **Pili**.

CELL WALL: peptidoglycan (NAG-NAM)n; Polypeptide crosslinks; D-amino acids; **Gram + vs. Gram- Cell Walls:** Teichoic acids (wall & lipo-); Outer membrane, O-antigens and Lipid A = **Lipopolysaccharide** outer leaflet. Gram stain Mechanism. **Mycoplasma** cell wall (Sterols), Archaea cell wall (***pseudomurein***). Damage: lysozyme, penicillin, protoplast, spheroplast.

Plasma Membrane – ***Fluid Mosaic Model*** ("proteins afloat in a sea of phospholipids"; integral & peripheral membrane proteins). Chromatophores, thylakoids, Simple Diffusion, Facilitated Diffusion, Active transport. **Isotonic, Hypotonic, Hypertonic** solutions. **Osmosis/ osmotic pressure.** Nucleoid, cytoplasm; **Ribosomes**, Inclusions (food, mineral & energy reserves – phosphate, lipid, polysaccharide, enzymes). **Endospores** – sporulation, germination, vegetative cell.

Eukaryotic Cells: Flagella & Cilia (9+2 microtubules); Euk. Cell walls = **cellulose**, chitin, glucan/mannan; **Glycocalyx** = bonded sugars to amimal plasma membrane proteins and lipids. Cytosol, **Cytoskeleton** (actin microfilaments, tubulin microtubules, keratin/lamin intermediate filaments – very dynamic structure and movement, cytoplasmic streaming; **Endocytosis** (Phagocytosis, Pinocytosis) & **Exocytosis**, **Lysosomes**. Nucleus-nuclear pores, nucleolus; ER, Golgi - cisterns, Vacuole, Mitochondria, Chloroplasts – thylakoids/ stroma/ grana; peroxisomes; Ribosomes, centrosomes/centrioles; Rough ER, Smooth ER. ***Endosymbiosis Theory***.

5. **METABOLISM**, enzymes, cofactors, regulating enzyme activity (pH, temperature, [substrate]); coenzymes, **feedback inhibition**, reaction rate. Collision theory, Apoenzyme, Holoenzyme. **Denaturation**, **Competitive & Noncompetitive Inhibition**. Redox reactions; Reduction, Oxidation. Dehydrogenation; ATP. Ribozymes, Enzymes, cofactors, **regulating enzyme activity**; coenzymes, feedback inhibition, reaction rate, Equilibrium, ***Activation Energy***, saturation. ***Energetic Coupling***.

Microbiology Midterm 1 (Spring 2020): Study Questions

Possible Short Essay Topics *(be prepared to draw diagrams as well!)*:

Ch. 1:

1. **Briefly explain how Louis Pasteur's experiments disproved the prevailing theories of the origin of life during his time, when the scientific community did not accept previous results from experiments by other scientists. *Draw diagrams of his experimental setup.***
2. Describe Koch's 4 Postulates and their application in modern medicine.

Ch. 2:

3. Describe 4 unique properties of water that make it so valuable to living systems, although it is an "inorganic" molecule itself.
4. **Describe, diagram and give specific examples of each level of protein structure. Include the types of molecular bonding and interactions that are important at each level.**
5. **Diagram and describe 4 chemical characteristics of DNA and its component monomers that make it a stable source of genetic information, and allow it to form a double-stranded helix.**
6. Describe 4 characteristics of **phospholipids** that allow them to perform their major biological function. Explain the connection between phospholipid structure and function.
7. **Using simple diagrams, compare and contrast the general chemical structures and shapes of each major type of macromolecule. Using specific examples, briefly explain how these structures directly contribute to the main cellular functions of each type of molecule.**
   (Hint: first consider structural and chemical properties of the MONOMERS, and then the polymers.)

Ch. 4: *(& See Ch. 3 objectives)*

8. **Describe and diagram 5 EXTRAcellular structures unique to bacteria and/or archaea, and explain their major functions in the organism.**
9. **Diagram & compare and contrast the biochemical structures, chemical components, and general properties of the gram positive and gram negative cell walls. How does the Gram stain distinguish between the two?**
10. **Diagram and describe the prevailing model on the structure of biological membranes. Include a brief description each of 4 major types of membrane transport and 2 types of transporter molecules.**
11. Compare **simple diffusion, facilitated diffusion, and active transport** of a solute across a cellular membrane. What properties of the solute affect the mechanism and direction of its transport?
12. **List and explain the significance of *at least* 8 different characteristics that distinguish between "Prokaryotic" & Eukaryotic cells. Explain the functions of each of these cellular characteristics.**

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13. Using diagrams, list and describe the major functions of at least 10 different Eukaryotic organelles, including those that differ between animal and plant/algal cells.
14. **Explain the prevailing Theory for the Origin of mitochondria and chloroplasts in eukaryotic cells, and list 3 examples of supporting evidence.**

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15. **Ch. 5:** Diagram and describe how enzymes speed up chemical reactions, and how they affect the energy and equilibrium of a reaction. Describe 6 different physical and chemical factors that can regulate enzyme activity.
16. Diagram and describe an example of *energetic coupling* in a cell. Define energetic coupling.

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❖ **[**Bold-typed questions address *especially* important concepts for Part I Essays in the course!]**

❖ ***Helpful tip: for comparison/contrast questions, it is often simplest to construct a Table!!***