BIOL 240 (Part I) – Important Terms and Concepts 9/11/2009 (this is NOT an exhaustive list!)

GENERAL MICROBIOLOGY: *Tortora, et al. (2010) 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. Chemotherapy, synthetic drugs, antibiotics; **Alexander Fleming** – penicillin; Bacteriology, mycology, Parasitology, Immunology, virology. Bioremediation, Gene therapy, Normal Microbiota/flora; 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.*** **Redox reactions**; Reduction, Oxidation; Dehydrogenation; **ATP.** Light & Chlorophyll; **NADH, NADPH, $FADH_2$**. ***Substrate-level Phosphorylation.*** *Amphibolic pathways.*

Microbiology Midterm 1 (Fall 2009): Study Questions

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

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.**

3. **Describe 4 unique properties of water that make it so valuable to living systems, although it is an "inorganic" molecule itself.**
4. **Describe and give examples of each level of protein structure.**
5. Describe 4 characteristics of **DNA** 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.

7. **List and describe 8 differences that distinguish between "Prokaryotic" & Eukaryotic cells.**
8. **Describe/diagram 5 EXTRAcellular structures unique to bacteria, and explain their function in the organism.**
9. **Compare the structures 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.**
11. **Compare simple 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. Explain the prevailing theory for the origin of mitochondria and chloroplasts in eukaryotic cells, and list 3 examples of supporting evidence.

13. **Diagram and describe how <u>enzymes</u> speed up chemical reactions, and how they affect the <u>energy</u> and <u>equilibrium</u> of a reaction. Describe 6 different physical and chemical factors that can <u>regulate</u> enzyme activity.**

14. 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 of the course!]

- ***<u>Helpful tip:</u>*** *for comparison/contrast questions, it is often simplest to construct a <u>Table</u>!!*