

BIOL 1005 – Concepts in Biology

Outline of topics covered for Midterm I: September 18, 2018 (*final version! posted 9/13/18*)

DISCLAIMER: This outline is meant to help you organize your lecture notes. It is not intended to be a substitute for your lecture notes. Furthermore, it is NOT EXHAUSTIVE. Just because a word or phrase does not appear on this study guide, doesn't mean you "don't have to know it." In general, you are best off studying your lecture notes and letting this outline serve as a guide to help you get your notes organized.

Overriding topic for this portion of the class: what do living things have in common?

I. Introduction to biology

- A. What is biology, and what properties distinguish life from non-life?
- B. Levels (or scales) at which biology is studied. How does each level relate to the others?
- C. How to read an evolutionary tree
 - a. Identify common ancestors/clades/nodes
 - b. Use common ancestors to determine which clades are most closely related to each other
- D. A tour of life's evolutionary tree
 - a. Characteristics of each of the three domains (Bacteria, Archaea, Eukarya). Do all of the levels in item I.B. apply to all clades? If not, why not?
 - b. Characteristics of each of the three most familiar eukaryotic clades (animals/fungi/plants)
 - c. Why is the word "Protista" not a legitimate name for a clade?
- E. Where do viruses fit into life's evolutionary tree (or do they)?

II. Intro to evolution as the explanation for biodiversity; natural selection as a mechanism of evolution

III. Nature of science

- A. What activities specifically characterize the *scientific* way of thinking about the natural world?
- B. Types of questions that can/cannot be answered scientifically
- C. The parts of an IF ... AND ... THEN... statement
- D. What is the difference between a hypothesis and a prediction?
- E. Parts of an experiment: independent variable, control, dependent variable(s), standardized variables

IV. Chemical basis of life

- A. Introduction: what is the relationship between cells, molecules, and atoms? What is the difference between the terms "organic" and "inorganic"? What are the main molecules that make up cells?
- B. Essential elements: four most abundant; difference between minerals and vitamins
- C. Structure of the atom
 1. Particles that make up the atom (proton, neutron, electron) – location and charge (if any)
 2. Define and apply the terms *atomic number*, *mass number*, and *isotope*
- D. How atoms bond to form molecules
 1. How electron arrangement in "shells" determines numbers/types of bonds an atom forms
 2. Types of strong chemical bonds
 - a. Ionic bonds – what is an ion, and how does it form? Why do ions always have *full* positive/negative charges? What holds together the atoms in an ionic bond?
 - b. Covalent bonds – what are they and how do they form? What holds together the atoms in a covalent bond? Use an element's atomic number to explain how many bonds it "likes" to make.
 1. The difference between single vs. double vs. triple covalent bonds
 2. Polar vs. nonpolar covalent bonds; use differences in "hoggy-ness" to be able to tell if any bond with C, H, O, or N is polar or nonpolar. Why do polar bonds always mean one atom has a partial positive charge and one atom has a partial negative charge?
- E. Major inorganic and organic molecules in cells
 1. **Inorganic:** Water (H₂O)
 - a. What are hydrogen bonds and how do they relate to the two polar covalent bonds in a water molecule?
 - b. How do microbes, plants, and animals acquire water? How do plants and animals conserve water?

- c. Why water is essential to life (as far as we know); the book lists a bunch of reasons, but in lecture we focused on water's role as a solvent and water's role in metabolic reactions
 - d. How to use bond polarity to know if a substance is hydrophilic or hydrophobic
 - e. Acids, bases, the pH scale, and buffers [*we skipped this in lecture; please study section 2.4 of the book on your own*]
2. **Polymers** made of **monomers** (monomers form polymers via the reaction *dehydration synthesis*; conversely, the reaction *hydrolysis* breaks polymers into monomers). What do these processes have to do with your digestive system and with the use of raw materials by your cells?
 - a. **Carbohydrates**: Molecular structures and functions of monosaccharides (e.g. glucose, C₆H₁₂O₆) and polysaccharides in plants and animals; why whole grains are better for you than refined sugar and starch; why saccharin and sucralose (Splenda) are low- or no-calorie artificial sweeteners.
 - b. **Proteins**: Categories of protein functions; what makes life's 20 amino acids different from each other; how amino acids join to form polypeptides; Nutrasweet (aspartame) as a dipeptide and low-calorie sweetener; importance of protein "shape"; what it means for a protein to be denatured; the function of **enzymes** and their importance to life.
 - c. **Nucleic acids**: types and functions of nucleic acids; what makes nucleotides different from each other; how nucleotides join to form a DNA or RNA molecule; ATP as a nucleotide
 3. **Lipids**: what do they all have in common? Molecular structure and function of **fats**; what emulsifiers do; molecular structure and function of **steroids**; **phospholipids** will be described with membranes.

IV. Cell parts and their functions

A. Features all cells have in common

1. Cell (plasma) membrane enclosing cytoplasm

- a. Molecular structure of phospholipids, including hydrophilic and hydrophobic parts
- b. How (and why) phospholipids form a bilayer in water
- c. Why the membrane is permeable to some but not all substances; role of membrane proteins

2. DNA and RNA (what are they for?)

3. Ribosomes (what are they for?)

- ##### B. Learn these on your own:
- (1) differences between prokaryotic & eukaryotic cells;
 - (2) differences between plant and animal cells;
 - (3) functions of nucleus, rough/smooth ER, Golgi, chloroplasts, mitochondria, cilia, flagella, plant cell wall.

V. Metabolism = all reactions in the cell

A. What are the possible fates of the matter (atoms) and the energy in the food you eat?

B. ATP chemical structure; ATP hydrolysis as the energy source for cell's energy-requiring processes

C. Relationship between (and locations of) digestion, respiration, and photosynthesis

1. Digestion: What happens in digestion, and where do the products of digestion go?
2. Respiration: What happens to the atoms in glucose and O₂? What happens to the energy in glucose's chemical bonds? How many ATP form per glucose? Which organisms do respiration?
3. Photosynthesis: What do autotrophs do with the atoms in CO₂ and H₂O? What is the energy source for this process? Which organisms do photosynthesis?

D. Are all diets (of the same calorie count) equally healthy? Why or why not?

A few study tips:

- The biggest mistake students make is to study by "going over" notes. You must prove to yourself, BEFORE the exam, that you can remember and understand, not simply memorize or recognize a term. How?
 - Use the old exams wisely! Don't just look up the answers to questions on a blank exam; instead, try taking an exam without using your notes. When you've done your best, look up the answers and ask about those you are unsure of. This is a great way to see where you need to brush up a bit.
 - WRITE the answer to every possible question you can make up about the material, from the big picture to the little details. (Write, because you can't prove you know something until you actually try to write it down.)
 - Looking for good questions to answer? Try the Practice Questions on my website; they're on the same page with this review sheet and with the old exams.

- Construct a concept map with any 15-20 words from lecture (without using your notes); try this with friends, because you can learn by comparing your maps or by taking turns adding terms to a map you build together.
- Try explaining the material clearly to someone else without using your notes.
- You can't learn something if it doesn't make sense to you. If you've studied your notes and your textbook and something still doesn't make sense, ASK. Don't just say "Oh, I get the gist of it" or "Oh, she's not going to ask about that" – because just getting "the gist" isn't enough, and I will probably ask about that exact thing!

***Don't be shy -- come to Action Center on Monday, Sept. 17 from 3:30-5:30 pm. in the Housing Learning Center in Adams dorm (first floor, across from Cane's).
Come and go as you please.***

Also, Nazha may has scheduled tutoring hours for Friday afternoon (9/14). Vist <https://tutor.ou.edu/> and see Canvas announcement for details on how to sign up (24 hr. in advance, always).

I can help too! My office hours (GLCH 224): Tue./Thurs. mornings 8:30-10 and Wed. afternoons from 2-3.