Biochemistry

What You Must Know:

1. The three subatomic particles and their significance
2. The types of chemical bonds and how they form
3. The importance of hydrogen bonding to the properties of water
4. The properties of water and how each contributes to life on Earth
5. How to interpret a pH scale
6. How changes in pH can alter biological systems
7. The importance of buffers in biological systems
8. The properties of carbon that make it so important
9. The role of dehydration and hydrolysis reactions with organic compounds
10. How the sequence and subcomponents of the 4 groups of organic compounds determine their properties
11. The cellular functions of carbs, lipids, proteins and nucleic acids
12. How changes in these organic molecules would affect their function
13. The 4 structural levels of proteins and how changes at any level can affect the activity of the protein
14. How proteins reach their final shape (conformation), the denaturing impact that heat and pH can have on protein structure, and how these changes may affect the organism
15. Directionality influences structure and function of polymers, such as nucleic acids (5’ and 3’ ends) and proteins (amino and carboxyl ends

Cells

What You Must Know:

1. Basic differences between prokaryotic and eukaryotic cells
2. Key ways in which prokaryotes differ fro eukaryotes with respect to genome, membrane-bound organelles, size and reproduction.
3. How mechanisms of transformation, conjugation and transduction contribute to genetic diversity in prokaryotes
4. The structure and function of organelles common to plant and animal cells
5. The structure and function of organelles found only in plant cells or only in animal cells
6. How different cell types show differences in subcellular components
7. How internal membranes and organelles contribute to cell functions
8. How cell size and shape affect the overall rate of nutrient intake and waste elimination
9. Be able to calculate surface area to volume ratios for various cell sizes and predict relative rates of diffusion into/out of the cell
10. How do additional structures enhance material exchange across a membrane
11. Consider cell features that may be abundant/absent in certain cells based on their functions
12. Be able to predict and justify how a change in an organelle would affect the function of that cell or organism
13. Why membranes are selectively permeable
14. The role of phospholipids, proteins and carbohydrates in membranes
15. How water will move if a cell is placed in an isotonic, hypertonic or hypotonic solution and predict the effect on the organism
16. How electrochemical gradients and proton gradients are formed and function in cells
17. The role of water potential in predicting movement of water in plants
18. How the transpiration cohesion-tension mechanism explains water movements in plants

Cell Communication

What You Must Know:

1. The three stages of cell communication: reception, transduction and response
2. How a receptor protein recognizes signal molecules and starts transduction
3. How a cell signal is amplified by a phosphorylation cascade
4. An example of a second messenger and its role in a signal transduction pathway
5. How a cell response in the nucleus turns on genes, whereas in the cytoplasm it activates enzymes
6. What apoptosis means and why it is important to normal functioning of multicellular organisms
7. Be able to describe a model that expresses the key elements of a signal transduction pathway leading to a cellular response: G-protein receptors, tyrosine kinase receptors and ligand gated ion channels
8. Describe examples of cell communication from the nervous and endocrine systems
9. Mechanisms by which plant cells communicate with other distant cells

Cell Cycle

What You Must Know:

1. The structure of a duplicated chromosome
2. The events that occur in the cell cycle (G1, S and G2)
3. The role of cyclins and cyclin-dependent kinases in the regulation of the cell cycle
4. Ways in which the normal cell cycle is disrupted to cause cancer, or halted in certain specialized cells
5. The features of mitosis that result in the production of genetically identical daughter cells including replication, alignment of chromosomes (metaphase), and separation of chromosomes (anaphase)
6. Describe the key characteristics of normal cell division: density-dependent inhibition and anchorage dependency
7. Compare the process of meiosis with mitosis
8. Describe the change in chromosomal number through the cell, the purpose of each process and starting material and product for each