Name: _____ Period: _____

Biology I – BIOLOGY KEYSTONE REVIEW: MODULE A, ANCHORS 1-4

Basic Biological Principles

Module A Anchor 1

Key Concepts:

- Living things are made of units called cells, are based on a universal genetic code, obtain and use materials and energy, grow and develop, reproduce, respond to their environment, maintain a stable internal environment, and change over time.
- Prokaryotic cells do not separate their genetic material within a nucleus. In eukaryotic cells, the nucleus separates the genetic material from the rest of the cell.
- The cells of multicellular organisms become specialized for particular tasks and communicate with one another.

Characteristics of Life:

1. List the characteristics of life common to all living things.

2. If an organism lacks any of these characteristics, is it considered living? Why or why not?

3. Which of the following characteristics of living things explains why birds fly south for the winter?

   A. Living things respond to their environment
   B. Living things maintain homeostasis
   C. Living things are made of cells
   D. Living things are based on a universal genetic code

4. Which characteristic(s) of living things is more important to the survival of the species as a whole, rather than the individual organism? Why?

Prokaryotes vs. Eukaryotes:

1. Compare and contrast prokaryotes and eukaryotes in terms of structures; list specific organelles which are present in each, as well as other structural similarities and differences.

2. Compare and contrast prokaryotes and eukaryotes in terms of genetic material.

3. How are the similarities and differences between prokaryotic and eukaryotic cells dependent on their size?

4. How do the structures of prokaryotic and eukaryotic cells influence their functions?

5. Not all cells are alike. Which of the following is NOT a true statement about differences between cells?

A. Cells come in many different shapes
B. Different kinds of cells are different sizes
C. Some cells have a nucleus and others do not
D. Most cells have a membrane, but some do not

Levels of Organization:

1. Describe the relationship between organelles, cells, tissues, organs, and organ systems.

2. Cells in multicellular organisms have many sizes and shapes. These differences are referred to as cell specialization. Cell specialization allows cells to:

A. Reproduce
B. Perform different functions
C. Respond to their environment
D. Be less complex

3. The cells of unicellular organisms are:

A. Specialized to perform different tasks
B. Larger than those of multicellular organisms
C. Able to perform all the functions necessary for life
D. Unable to respond to changes in their environment

4. Give an example of changes that take place as cells in a multicellular organism differentiate.

5. Explain the relationship between cell specialization, multicellular organisms, and homeostasis.

6. How are unicellular and multicellular organisms alike? How are they different?

Chemical Basis of Life

Module A Anchor 2

Key Concepts:

- Water is a polar molecule. Therefore, it is able to form multiple hydrogen bonds, which account for many of its special properties.
- Water's polarity gives it the ability to dissolve both ionic compounds and other polar molecules.
- Carbon can bond with many elements, including hydrogen, oxygen, phosphorus, sulfur, and nitrogen to form the molecules of life.
- The function of macromolecules is directly related to their chemical structure.
- Living things use carbohydrates as their main source of energy. Plants, some animals, and other organisms also use carbohydrates for structural purposes.
- Lipids can be used to store energy. Some lipids are important parts of biological membranes and waterproof coverings.
- Nucleic acids store and transmit hereditary, or genetic, information.
- Some proteins control the rate of reactions and regulate cell processes. Some proteins build tissues such as bone and muscle. Others transport materials or help fight disease.
- Chemical reactions always involve changes in the chemical bonds that join atoms in compounds.
- Chemical reactions that release energy often occur spontaneously. Chemical reactions that absorb energy will not occur without a source of energy.
- Enzymes speed up chemical reactions that take place in cells. This function is directly related to their structure, with each enzyme being specifically shaped to catalyze one particular reaction. Loss of structure causes loss of function.
- Temperature, pH, and regulatory molecules can affect the activity of enzymes.

Properties of Water:

1. Describe the following properties of water and explain how each is important to living things: cohesion, adhesion, polarity, heat of vaporization, freezing point.

2. How is polarity related to cohesion and adhesion?

3. Compared to most other substances, a great deal of heat is needed to raise the temperature of water by a given amount. This is because water

A. is an acid
B. readily forms solutions
C. has a high heat capacity
D. acts as a buffer

4. Frozen water is less dense than liquid water. Explain why this is important for aquatic organisms.

Macromolecules:

1. How is the structure of carbon related to its function in macromolecules? Think about the types of shapes carbon can form and why.

2. Describe the processes of hydrolysis and dehydration synthesis. How are they related to each other?

3. List and draw the monomer and polymer units of each macromolecule along with their function in living things: carbohydrates, proteins, nucleic acids.

4. List and draw the types of lipids, along with the subunits and uses of each.

5. Why are carbohydrates, proteins, and nucleic acids considered polymers, while lipids are not?

6. How is the structure of each of the four macromolecules related to its function in living things?

Carbohydrate –

Nucleic acid –

Protein –

Lipid –

7. How does the structure of a protein make it capable of such a large range of function?

Enzymes:

1. What occurs during a chemical reaction?

2. What is the difference between a product and a reactant?

3. Energy is used differently in different types of chemical reactions. Explain how energy use differs in energy-releasing and energy-absorbing reactions. Which type often requires a catalyst?

4. How is energy related to the products and reactants of a chemical reaction?

5. What is the role of an enzyme in living organisms?

6. In what way do enzymes increase the rate of reactions? How do enzymes accomplish this task?

7. Describe the cycle in which enzymes and substrate interact.

8. How/Why is the structure of an enzyme so important to its function in living things? Why does the structure of an enzyme determine the type of reaction it will catalyze?

9. What happens to enzyme function when the temperature or pH conditions change? Why?

10. The energy needed to get a reaction started is the:

A. adhesion energy C. cohesion energy
B. activation energy D. chemical energy

Bioenergetics

Module A Anchor 3

Key Concepts:

- ATP can easily release and store energy by breaking and re-forming the bonds between its phosphate groups. This characteristic of ATP makes it exceptionally useful as a basic energy source for all cells.
- In the process of photosynthesis, plants convert the energy of sunlight into chemical energy stored in the bonds of carbohydrates.
- Photosynthetic organisms capture energy from sunlight with pigments.
- An electron carrier is a compound that can accept a pair of high-energy electrons and transfer them, along with most of their energy, to another molecule.
- Photosynthesis uses the energy of sunlight to convert water and carbon dioxide into high-energy sugars and oxygen.
- Among the most important factors that affect photosynthesis are temperature, light intensity, and the availability of water.
- Organisms get the energy they need from food.
- Cellular respiration is the process that releases energy from food in the presence of oxygen.
- Photosynthesis removes carbon dioxide from the atmosphere and cellular respiration puts it back. Photosynthesis releases oxygen into the atmosphere, and cellular respiration uses that oxygen to release energy from food.
- In the absence of oxygen, fermentation releases energy from food molecules by producing ATP.
- For short, quick bursts of energy, the body uses ATP already in muscles as well as ATP made by lactic acid fermentation.
- For exercise longer than about 90 seconds, cellular respiration is the only way to continue generating a supply of ATP.

ATP and Energy Molecules:

1. What are the different energy molecules in the cell? Describe the energy storage capacity of each and relate this to their function in living organisms.

2. What are the three parts of an ATP molecule?
   A. adenine, thylakoid, and phosphate group
   B. stroma, grana, and thylakoid
   C. adenine, ribose, and phosphate group
   D. NADH, NADPH, and FADH

3. Energy is released from an ATP molecule when:
   A. a phosphate group is added
   B. a phosphate group is removed
   C. adenine bonds to ribose
   D. the molecule is exposed to sunlight

4. How do heterotrophs and autotrophs differ in the way they obtain energy?

Photosynthesis:

1. Which organelle is involved in photosynthesis? List and describe the parts of this organelle.

2. Explain what happens to energy during photosynthesis. In what form does it enter photosynthesis? In what form does it exist during photosynthesis? In what form does it leave photosynthesis? How is this related to the overall goal of photosynthesis?

3. Plants absorb energy with light-absorbing molecules called:
   A. stroma
   B. grana
   C. thylakoids
   D. pigments

4. What is the primary pigment involved in photosynthesis? Why do plants also contain accessory pigments?

5. A student exposed one plant to only red light and another to only green light. Which should grow better and why?

6. Write the basic equation for photosynthesis using the names of the molecules involved. Identify the products and reactants. Is light a product or reactant? If not, what does it supply to the equation?

7. A student is collecting gas being given off by a plant in direct sunlight. The gas is most likely:
   A. water vapor
   B. carbon dioxide
   C. oxygen
   D. ATP

Cellular Respiration and Fermentation:

1. What are the products and reactants of cellular respiration? Where does the reaction take place in cells?

2. How is energy transformed during cellular respiration? In what form does it enter cellular respiration? In what form does it leave cellular respiration? How is this related to the overall goal of cellular respiration?

3. What is a calorie? Briefly explain how cells use a high-calorie molecule such as glucose.

4. Compare and contrast photosynthesis and cellular respiration in terms of product, reactant, and energy transformations in each.

5. Why are photosynthesis and cellular respiration considered opposite reactions?

6. Compare and contrast fermentation and cellular respiration in terms of product, reactant, and energy transformations involved.

7. Because fermentation takes place in the absence of oxygen, it is said to be
   A. aerobic
   B. anaerobic
   C. cyclic
   D. oxygen-rich

8. In what circumstances is fermentation a better option than cellular respiration and vice versa?

9. Certain bacteria thrive in conditions that lack oxygen. What does that fact indicate about the way they obtain energy?

10. In certain cases, regular exercise causes an increase in the number of mitochondria in muscle cells. How might that situation improve an individual's ability to perform energy-requiring activities?

11. Why must plants contain mitochondria, despite the fact that they can turn light energy into chemical energy?

Homeostasis and Transport

Module A Anchor 4

Key Concepts:

- Buffers play an important role in maintaining homeostasis in organisms.
- To maintain homeostasis, unicellular organisms grow, respond to the environment, transform energy, and reproduce.
- The cells of multicellular organisms become specialized for particular tasks and communicate with one another to maintain homeostasis.
- All body systems work together to maintain homeostasis.
- Passive transport (including diffusion and osmosis) is the movement of materials across the cell membrane without cellular energy.
- The movement of materials against a concentration differences is known as active transport. Active transport requires energy.
- The structure of the cell membrane allows it to regulate movement of materials into and out of the cell. The structure also determines how materials move through the cell membrane.

Plasma Membrane and Organelles:

1. What is the phospholipid bilayer? How does the structure of a phospholipid relate to its function in plasma membranes?

2. What is the fluid mosaic model?

3. What are the basic parts of the fluid mosaic model of the plasma membrane? Describe each in terms of structure and function.

4. The cell membrane contains channels and pumps which help in transport. What are these materials made of?

A. carbohydrate
B. lipid
C. Protein
D. nucleic acid

5. Explain how each of the following organelles is involved in cell transport:

Vacuoles and vesicles –

Golgi apparatus –

Endoplasmic reticulum –

Cytoskeleton –

6. Explain the relationship between the endoplasmic reticulum and Golgi apparatus in terms of cell transport.

Transport Mechanisms:

1. How do passive and active transport differ?

2. List and describe the types of passive transport.

3. Why do some molecules require the use of protein channels, as in facilitated diffusion?

4. Diffusion occurs because:

A. molecules are attracted to one another
B. molecules constantly move and collide into one another
C. cellular energy forces molecules to collide with one another
D. cellular energy pumps molecules across the cell membrane

5. During diffusion, when the concentration of molecules on both sides of the membrane is equal, molecules will:

A. move across the membrane to the outside of the cell
B. stop moving across the membrane
C. continue to move across the membrane in both directions
D. move across the membrane to the inside of the cell

6. Explain equilibrium.

7. What is the relationship between diffusion and osmosis?

8. Compare and contrast hypertonic, hypotonic, and isotonic solutions.

9. Explain, in terms of osmosis, why a raisin placed in a cup of pure water overnight will puff up.

10. Two solutions are placed on either side of a selectively permeable membrane. The membrane is permeable to solute. There is a higher concentration of solute particles on the left side of the membrane. In which direction will the solute particles move? Why?

11. List and describe the types of active transport.

12. How do active transport and facilitate diffusion differ?

Homeostasis:

1. Which of the following activities is NOT a way for unicellular organisms to maintain homeostasis?

A. reproduction
B. growth
C. cell specialization
D. response to environment

2. Explain the relationship between multicellular organisms, cell specialization, and homeostasis.

3. What do unicellular organisms do to maintain homeostasis?

4. The contractile vacuole is an organelle found in paramecia, a group of single-celled organisms. Contractile vacuoles pump out fresh water that accumulates in the organisms by osmosis. Explain how this is an example of the way paramecia maintain homeostasis.

5. How do buffers help an organism to maintain homeostasis?

6. In what way are the characteristics of living things related to homeostasis?

Obtain and use materials:

Obtain and use energy:

Grow and develop:

Reproduce:

Respond to environment:

7. What is a feedback mechanism/feedback inhibition? What is the role of a feedback mechanism in maintaining homeostasis?

8. Briefly explain how animal body systems work together to maintain homeostasis.