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Living things are open systems that require a constant supply of energy to function. Several metabolic pathways are utilized to facilitate the transfer and use of that energy.

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**Questions with stars: Do your best to answer but they can be skipped if you are unsure. Leave space on your paper for the answers though. We will discuss in class.**

1. a. Define free energy. Identify the main source of free energy for life on earth.  
\* b. Identify the 3 main reasons why a constant supply of energy is necessary for living things. (leave space on your paper for this answer, 2 lines, we will go over in class)  
c. State the type of energy living things store their free energy as. Give an example of this type of energy storage from our previous unit (hint: animals and plants do it similarly but different)  
\* d. How do autotrophs/producers obtain their free energy? How do heterotrophs obtain their free energy?
2. Explain how living things follow the first and second laws of thermodynamics.  
\*\*\*How do endotherms (organisms that maintain a constant body temperature despite environmental conditions) like us take advantage of the 2<sup>nd</sup> law of thermodynamics?
3. Define metabolism and explain its importance in living things.
4. a. Explain Catabolic Pathways in your own words. Use a simple sketch as part of your answer.  
b. Name the major pathway of catabolism that all organism use (there are other catabolic pathways but this is a big one!) (hint: glucose + oxygen → carbon dioxide + water + ATP)
5. a. Explain Anabolic Pathways in your own words. Use a simple sketch as part of your answer.  
b. Name the major pathway of anabolism that plants and some bacteria use (there are other anabolic pathways but this is the most important for all life) (hint: it's the process that is the opposite of above)
6. Create a graphic organizer to compare and contrast Catabolic and Anabolic Pathways.
7. a. Define exergonic and endergonic.  
b. Explain the role of molecule stability in determining if a chemical reaction will be exergonic or endergonic.  
c. Sketch and interpret the graphs that represent exergonic and endergonic reactions. Take special note of the energy in reactants vs. products.
8. Explain the purpose of energy coupling (catabolic and anabolic coupling). Be as descriptive as possible.
9. a. Describe what a metabolic pathway is. \*Explain how these pathways maximize efficiency and control the release of free energy?
10. a. Sketch the structure of ATP. b. Name all of its parts.
11. Describe the difference between ATP and ADP.

12. Describe the processes of how a phosphate is added or removed from ATP
13.
  - a. Explain what phosphorylation is (not phosphorylating ATP, just in general) .
  - b. Identify ATP's role in phosphorylation of other molecules
  - c. Name the enzyme used in phosphorylation
  - d. Explain the connection between phosphorylation and molecule stability
14. Explain how ATP stores energy
15. Describe how ATP transfers energy (how is this connected with energy coupling?)
16.
  - a. Sketch a diagram of the ATP cycle
  - b. Identify where the energy comes from and what the energy is used for