CH8 - METABOLISM NOTES

I. Metabolism, Energy, and Life

A. The chemistry of life is organized into metabolic pathways

Energy = _____

Metabolism = _____

2 Types of Pathways

1. Catabolic Pathway
    a. Metabolic pathways which _____ energy by breaking down complex molecules to _____ molecules
    b. "_____" metabolic pathway – energy is released from _____ (glycogen to glucose)
    c. Ex: Triglycerides are broken down into free fatty acids for energy usage

2. Anabolic Pathway
    a. Metabolic pathways which _____ energy to _____ complex molecules from simpler ones.
    b. "_____" metabolic pathway – energy used to drive uphill reactions.
    c. Ex: synthesis of proteins from amino acids

B. Organisms transform energy

Types of Energy

1. Kinetic energy -

2. Thermal energy -

3. Potential energy -

4. Chemical energy -

Open system = _____

C. The energy transformations of life are subject to two laws of thermodynamics

2 Laws of Thermodynamics

1. First Law =
    a. Energy can _____
    b. Energy can be _____

3. Second Law =
    a. Every energy transfer or transformation _____ _____ (randomness) of the universe
    b. Organisms can increase their order, as long as the order of their surroundings _____

D. Organisms live at the expense of free energy and require a highly ordered system

- Order is maintained by constant free energy _____ into the system
  - _____ of order or free energy flow results in _____
  - Increased _____ and entropy are offset by biological processes that _____ or increase order

- Living systems do not violate the 2nd law of thermodynamics because:
  - Order is maintained by _____ cellular processes that increase entropy (negative free energy change) with those that _____ entropy (positive free energy change)
  - Energy input must _____ free energy _____ to entropy to _____ and power cellular processes

Gibb's Free Energy Equation

- ΔG = change in_____
- ΔH = change in _____
- T = _____ in Kelvin units
- ΔS = change in _____

Entropy vs. Enthalpy = _____

E. ATP powers cellular work by coupling exergonic and endergonic reactions

Exergonic Reactions: Spontaneous chemical reaction in which there is a _____ of free energy (ΔG _____)

- Total free energy of the products is _____ the total free energy in the reactants (_____)
  - Occurs _____ and releases energy
  - _____
  - Example: food broken down and releases energy from chemical bonds

Graph

Endergonic Reactions: Reactions that require the _____ of energy (ΔG _____).

- Products have _____ energy than reactants.
    - Absorb energy and are _____
    - Requires _____
    - Ex: plants use carbon dioxide and water to form sugars

Graph

Energy Coupling

- Heat alone is an _____ energy source
- Energy Coupling: the use of an _____ reaction to drive an _____ one.
    - Ex: the breakdown and formation of ATP
- ATP is responsible for MOST energy coupling in cells – _____ is coupled with endergonic reactions
    - _____ is released to the surrounding environment

- Bonds linking the phosphate groups may be broken by hydrolysis.
- Energy from ATP hydrolysis is coupled to endergonic reactions by transferring _____ from ATP to another molecule = _____
    - Phosphorylated molecule is _____, therefore able to perform work.

ATP Structure