

## Chapter 8 Metabolism

- Chemical reactions of life
- Anabolic pathways: synthesis of complex molecules from simpler ones. Require energy
- Catabolic pathways: breakdown of complex molecules into simpler ones. Release energy
- Thermodynamics: transfer of energy; determines whether a given chemical reaction can occur
- Energy: capacity to do work, supply heat
  - Kinetic Energy: energy of motion
    - Molecular KE transferred as heat.
    - Avg. speed measured as temperature.
    - Cannot be harvested by living things to do metabolic work.
  - Potential Energy: stored energy
    - Work done against force of gravity
    - Chemical Bonds: non polar high potential energy and polar low potential energy
    - Systems tend toward lower potential energy
  - Entropy: disorder, disorganization
    - Tendency of energy to spread out
    - Systems tend toward greater entropy
- Entropy and potential energy contribute to the total energy available for transfer, which is known as the Gibbs Free Energy.
  - A chemical reaction will tend to occur spontaneously if there is an overall loss in free energy ( $G$ ).
  - $\Delta G$  negative: reaction EXERGONIC, spontaneous
  - $\Delta G$  positive: reaction ENDERGONIC, non-spontaneous
  - A chemical reaction will tend to occur spontaneously if products have LOWER potential energy and HIGHER entropy compared to the reactants.
  - Even exergonic reactions require activation energy, to pass through unstable intermediate transition state.
- Enzymes: proteins that catalyze (facilitate) chemical reactions
  - Most cellular reactions require specific enzymes to occur efficiently.
  - The substrate/reactants fit in enzyme's active site, with each other to form product.
  - Enzymes bring together and orient the reactants favorably, so that less energy is needed to
  - Enzymes lower the activation energy of a reaction.
  - Enzyme function depends on temperature and pH. Sensitivity
  - Enzymes reduce the energy required to pass through the intermediate transition state of the reaction.
  - Enzymes do not affect the overall difference in free energy between products and reactants.
- ATP transfers energy to reactants, powering an endergonic reaction.

- Energy released from exergonic ATP hydrolysis provides energy to drive a coupled endergonic reaction.
- Coupling of endergonic reaction with a more strongly exergonic one.
- Competitive Inhibitors: bind to active site, blocking substrate's access
- Non-Competitive Inhibitors: bind to an allosteric site on enzyme, changing conformation of active site. (= allosteric inhibition)
- Feedback Inhibition: a process creates the conditions that shuts itself off
  - end product acts as allosteric inhibitor of an enzyme involved in its production
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