

Week 3 – Energy and Enzymes (part I) and Cell respiration (part II)

Part I

Learning Goal: Appreciate how the laws of thermodynamics relate to the function of cells and how enzymes modulate the rate of chemical reaction to regulate cellular processes.

After the pre-class assignments you should be able to:

- Define and differentiate the terms metabolism, anabolism, and catabolism
- Define the terms kinetic energy and potential energy
- Explain the first and second laws of thermodynamics
- Define and relate the terms free energy, enthalpy, entropy, exergonic, and endergonic
- Discuss how an endergonic reaction can be “coupled” to an exergonic reaction
- Define and relate the terms substrate, active site, activation energy, transition state, and reaction rate
- Describe in general terms how enzymes are able to alter the rate of chemical reactions
- Explain how small molecules (e.g., drugs or regulatory molecules, are able to increase or decrease the activity of an enzyme

By the time you take the first midterm you should also be able to:

- Predict whether a reaction will be exergonic or endergonic based on ΔH and ΔS
- Determine whether two reactions can be successfully coupled based on their changes in free energy (ΔG)
- Evaluate how changing cellular conditions will change the free energy of a reversible reaction
- Interpret graphs of free energy vs. progress of reaction to determine the thermodynamic favorability, likelihood of coupling, and relative rates of reactions for different chemical reactions
- Interpret data to assess changes in enzyme function and predict the effects (i.e., activating or inhibiting) of regulatory molecules
- Evaluate the effect of regulatory molecules (e.g., feedback inhibitors) on metabolic pathways
- Relate the pH scale to the concentration of hydrogen ions (aka H^+ or “protons”) in a solution
- Evaluate environmental effects (e.g., pH, temperature) on enzyme catalyzed reactions rates

Part II – Cellular respiration

Learning Goal: Understand how the process of cellular respiration allows energy stored in molecules (food) to be transformed into another form, primarily chemical energy stored in ATP.

After the pre-class assignments you should be able to:

- Define and relate the terms oxidation and reduction as they relate to chemical reactions
- Describe the energy changes associated with oxidation-reduction (redox) reactions
- Discuss what happens to matter and energy through the overall process of cellular respiration
- Identify where the different stages of cellular respiration occur in the eukaryotic cell
- Discuss what happens to matter and energy through the process of glycolysis

By the time you take the first midterm you should also be able to:

- Connect redox reactions to the energy transformations that occur throughout cellular respiration