

**Chapter 8 Metabolism,  
Thermodynamics, ATP and  
Enzymes**  
Overhead Notes

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**I. Energy**

- Energy = The capacity to do work.
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**I. Energy**

- First Law of Thermodynamics – Energy can be neither created or destroyed; however, it can be changed from one form to another.
- Second Law of Thermodynamics- Energy can not be changed from one form to another without the loss of usable energy.

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## II. An Organism's Metabolism

- Metabolism

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## II. An Organism's Metabolism

- Catabolic and Anabolic Pathways

Catabolic reactions	Anabolic Reactions
Break down complex molecules into simpler ones	Building complex molecules from simpler ones.
Hydrolysis reactions	Condensation reaction

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## II. An Organism's Metabolism

- Energy Requirements for Catabolic and Anabolic Pathways

Catabolic reactions	Anabolic reactions
•NET release of energy into the surroundings	•Needs a NET input of energy from the surroundings
•Spontaneous process	•NON-Spontaneous
•Exergonic	•Endergonic
• $\Delta G = (-)$ value	• $\Delta G = (+)$ value

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## II. An Organism's Metabolism

- Typical energy profile for a catabolic reaction.

$$\Delta G = G_{\text{final state}} - G_{\text{starting state}}$$

$$\Delta G = \Delta H - T\Delta S$$

↑                      ↙  
Enthalpy            Temperature + Entropy

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### Question 8.1

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## III. Free energy and metabolism

- If a chemical process is exergonic, the reverse process is endergonic.

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### III. Free Energy and Metabolism

- Chemical Equilibrium = the reaction is still going on but there is no net change in the concentration of reactants and products.

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### III. Free Energy and Metabolism

- When a reaction is at equilibrium,  $\Delta G = 0$ .
- No net change in the system.
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### III. Free Energy and Metabolism

Living systems are open systems. They exchange energy and matter with their surroundings.

- 1.
- 2.
- 3.

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IV. ATP Drives Cellular Work

- **ATP (adenosine triphosphate) = Currency of the Cell**
- **ATP allows endergonic reactions to take place in the cell.**
- (2 slides)

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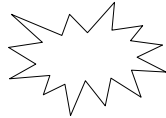
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IV. ATP Drives Cellular Work

- **Structure = ATP is a nucleotide**
- **Hydrolysis = releases -7.3 kcal/mol of energy**
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IV. ATP Drives Cellular Work

- **Why is ATP so unstable?**
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V. How does ATP Drive Cellular Reactions?

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VI. Regeneration of ATP

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Question 8.2

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VII. Enzymes Speed up Metabolic Reactions

- **Thermodynamics =**
- **Kinetics =**
- **Enzyme Kinetics =**

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VII. Enzymes Speed up Metabolic Reactions

- **An Enzyme is a Biological Catalyst – it speeds up a chemical reaction without getting consumed in the process.**

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VIII. The Activation Barrier

- **Every chemical reaction between molecules**

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### VIII. The Activation Barrier

- The activation energy,  $E_A$ 
  - Is the initial amount of energy needed to start a chemical reaction
  - Is often supplied in the form of heat from the surroundings in a system

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### VIII. The Activation Barrier

- How do you speed up a chemical reaction?
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### IX. How Enzymes Lower the $E_A$ Barrier

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## X. Substrate Specificity of Enzymes

- **Substrate = reactant acted upon by an enzyme.**
- **Enzymes are substrate specific.**
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## XI. Enzyme's Active Site

- **Active Site =**
- **= Bringing chemical groups of the active site into positions that enhance their ability to catalyze the chemical reaction**

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## XII. Effects of Temperature and pH

- **Each enzyme**

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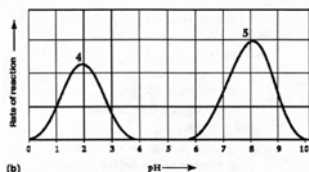
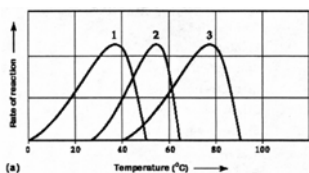
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### Question 8.3



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### XIII. Enzyme Inhibitors

- **Competitive inhibitors bind to the active site of an enzyme, competing with the substrate.**

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### XIV. Enzyme Inhibitors

- **Noncompetitive inhibitors bind to another part of an enzyme, changing**

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XV. Feedback Inhibition

- Feedback Inhibition =

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Question 8.4

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