

BIOLOGICAL FRAMEWORKS FOR ENGINEERS

Session #15 [Cellular Energetics]

General Objectives:

- ✓ Discuss the importance of energy to the body and metabolism
- ✓ Discuss cellular respiration in detail and compare with known systems

Central Framework:

- ✓ Cellular energetics involves the complex transformation of chemical bonds into free energy for the cell to utilize; nature's storage and handling of energy may provide insight into our engineering of energy solutions

Interactive Activity:

- ✓ Discussions on cellular processes to produce energy efficiently.

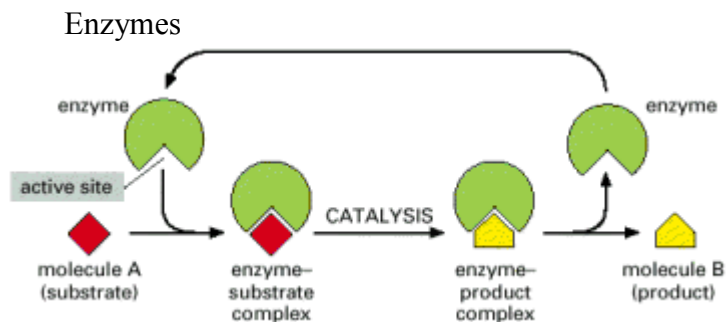
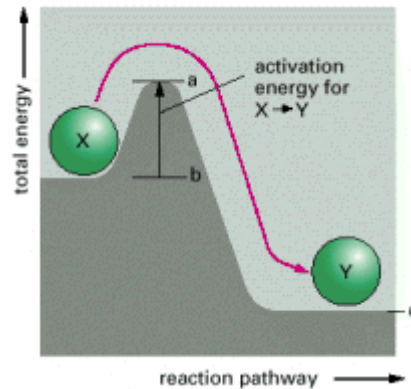
Session Outline:

A. Basics of Energy

1. Thermodynamics – the science of energy transformations (Including within a single cell and an entire ecosystem)

2. Energy Conversion

Fuels (such as hydrocarbons – gasoline, wood, etc.)
Burned to release heat (chemical energy is converted to heat)
Heat is then converted into useful energy (e.g. electricity)



B. Energy in Biologic Systems

1. Cellular Activity Requiring Energy (Why do we need energy?)

- a. Mechanical work – cells can change their physical location or shape and move structures within.
- b. Transport work – cells need to pump substances across the membrane
- c. Chemical work – endergonic process of polymerization (making proteins)
- d. Organization –

2. Metabolism –a collection of chemical reactions by which cells convert what they have (food, raw materials) into what they need (energy - ATP).

Fuel (carbohydrates, fats, etc.) “burned,” but energy is recaptured in the form of other high-energy chemical compounds (e.g., ATP). These compounds then donate their energy to endothermic processes

3. ATP (adenosine triphosphate) – “energy currency” of the cell

4. Cellular Respiration (breakdown of food and synthesis of ATP)

<u>Fuel</u>	<u>Pathways used to break it down</u>
Carbohydrate (glucose)	glycolysis / Citric Acid (Krebs) cycle / e ⁻ transport
Fat (fatty acid)	oxidation / Citric Acid (Krebs) cycle / e ⁻ transport

