

## Chapter 2: Bioenergetics

- ♥ Thermodynamics, energetics – science that studies the principles limiting energy exchange
- ♥ Bioenergetics – science that involves studies of energetic events in the biological world

### Describing energy in the body:

- ♥ Energy is not created; it is acquired in one form and converted to another
- ♥ Conversion process is inefficient, and much of the energy released is in a no usable form – heat.

### Important terms:

- ♥ Energy – capacity to do work
- ♥ Work – product of a given force acting through a given distance
- ♥ Power – rate of work production
- ♥ System – organized, functional unit
- ♥ Surroundings – after you define a system, all else is the surroundings
- ♥ Universe – system and surroundings
- ♥ Turnover – rate of renewal; in a steady state of metabolism means that the rate of use equals the rate of restoration (renewal).
- ♥ Thermodynamics – physical science dealing with energy exchange
  - More appropriate term is energetics
  - 6 principal forms of energy: thermal, chemical, mechanical, electrical, radiant, and atomic
  - Bioenergetics – branch of science that deals with energy exchanges in living things

Biological engines cannot convert heat energy to other forms.

- ♥ Heat is released as a essential but useless component of reactions in which other forms of work are accomplished

### 2 characteristics of biological systems:

1. Temperature dependence
  - a. Sensitive to small increments in temperature
2. The rates of biological or enzymatic reactions are sensitive to temperature

### First Law of Thermodynamics – energy can be neither created nor destroyed.

- ♥ Whenever there is an exchange of energy or matter between a system and its surroundings, the total energy content in the universe remains constant.

### Second Law of Thermodynamics – processes always go in the direction of randomness, or disorder

- ♥ Entropy – quantitative measure of disorder
  - As a result of the 2<sup>nd</sup> law, entropy always increases
  - Energy is exchanged, the efficiency of the exchange will be imperfect and some energy will escape – usually in the form of heat – thus increasing entropy in the universe
  - When one biological process moves some product toward a higher level of organization, it is driven by at least one “linked” or “coupled” entropic reaction.

### Exergonic and Endergonic Reactions

- ♥ Exergonic reaction – one that gives up energy