





Study Guide

Key Ideas about Transformations of ENERGY and MATTER in Living Systems

1. Energy and Matter/Mass cannot be created (made) or destroyed (used), but rather they get transformed (changed) into different forms. 
2. The purpose of PHOTOSYNTHESIS is to capture sunlight energy and store it as chemical energy in the bonds of sugars built from carbon dioxide molecules from the air, making food for all living things. 
3. The purpose of CELLULAR RESPIRATION is to transform energy from the chemical bonds of food into energy in the chemical bonds of the small molecule ATP. 
4. All living things – plants, animals, bacteria, fungi – do cellular respiration to transfer energy from food to ATP, and in the process release mass in the form of carbon dioxide. 






Energy

What:

- Defined as the ability to do work, or to create some kind of change.

Forms

- Energy exists in different forms

 Mechanical Energy
 Electrical Energy
 Light Energy
 Thermal Energy
 Sound Energy

Forms
of
Energy

<http://www.slideshare.net/Cristinam0626/types-of-energy-10076124>

Types of Energy

Potential Energy

- Stored energy – due to location/structure

Kinetic Energy

- Energy associated with objects in motion
- Heat: energy transferred from one system to another that isn't work


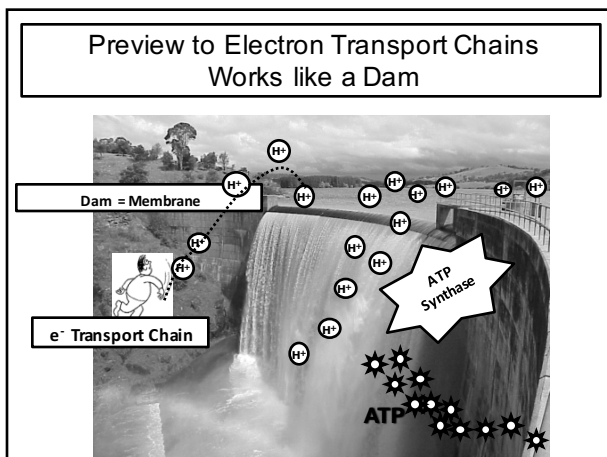
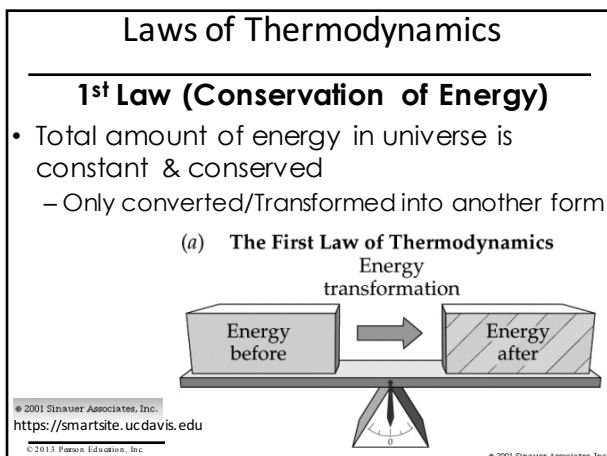
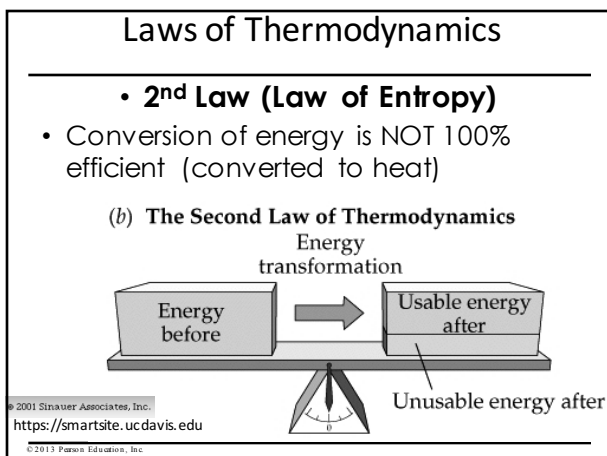


Figure 4.5





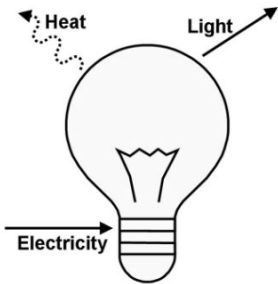


Heat Energy

- Thermodynamically, **heat energy** is defined as the energy transferred from one system to another that is not work.

Example:

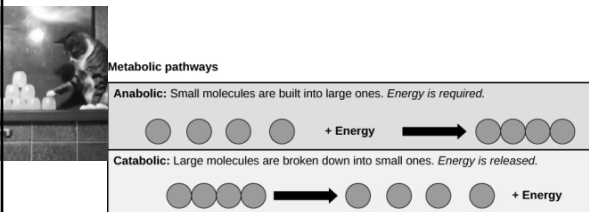
- When a light bulb is turned on, some of the energy being converted from electrical energy into light energy is lost as heat energy.



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Chemical reactions are used to do work

<p>Oxidation Reactions</p> <ul style="list-style-type: none"> Results from the loss of an electron & typically results in the RELEASE of energy, but require activation energy AKA: Catabolic, Exergonic, "Downhill" 	<p>Reduction Reactions</p> <ul style="list-style-type: none"> Gains an electron & typically requires E AKA: Anabolic, Endergonic, "Uphill"
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Metabolic pathways

Anabolic: Small molecules are built into large ones. *Energy is required.*

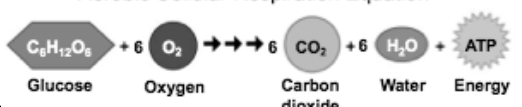
Catabolic: Large molecules are broken down into small ones. *Energy is released.*

CELLULAR RESPIRATION: AEROBIC HARVEST OF FOOD ENERGY

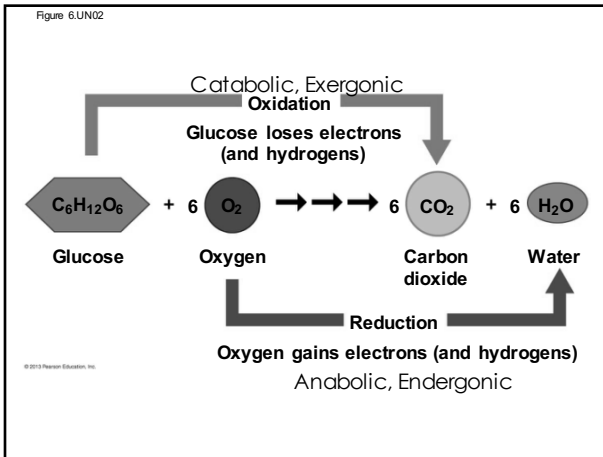
– **Cellular respiration** is

- Breakdown of chemical bonds in food molecules to release *stored* energy.
- Make ATP
 - * **aerobic** process—requires oxygen

Aerobic Cellular Respiration Equation



$C_6H_{12}O_6 + 6 O_2 \rightarrow 6 CO_2 + 6 H_2O + ATP$
 Glucose Oxygen Carbon dioxide Water Energy



ATP AND CELLULAR WORK

- **ATP**
 - Primary energy currency of cell
 - Powers the majority of cellular reactions

ENERGY!

Gamma phosphate group

Alpha phosphate group

Beta phosphate group

Adenine

Ribose

Energy used for ACTIVE TRANSPORT

ENERGY!

ATP AND CELLULAR WORK

- ATP**
 - Recycled via the ATP cycle

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ATP AND CELLULAR WORK

- ATP**
 - A working muscle cell spends and recycles up to 10 million ATP molecules per second.

Giphy

Before we begin, some advice

How to study this topic:

- Memorize the summary equation

$$\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{ATP}$$

Glucose
Oxygen
Carbon dioxide
Water
Energy

- Memorize names of the 3 steps
- Memorize where each step occurs in the cell
- Describe the function of each step in your own words
- Memorize reactants and products for each step
- Describe the process of each step in your own words
