Energy and Chemistry

- Energy is the capacity to do work
- Kinetic versus Potential energy
  - In compounds, potential energy is stored in bonds and other interactions
- Heat: energy flowing from a hotter to a colder object
  - Enthalpy
  - Exothermic vs endothermic processes
- Focus on energy <u>changes</u>

Table 15.2 Some Examples of Potential and Kinetic Energy

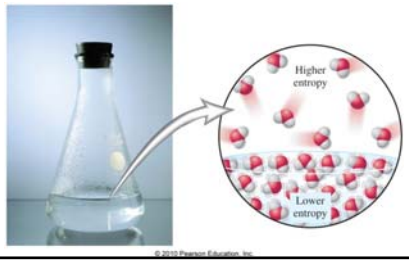
Potential Energy	
Energy stored by position	Water at the top of a waterfall (hydroelectric power; Section 15.15)
	A child at the top of a slide
	A skier poised at the top of a mountain slope
	A swimmer ready to dive
	A baseball player poised to swing his bat
Energy stored in chemical bonds	Fuel (coal, gasoline, natural gas; Sections 15.6–15.8)
	Food (carbohydrates, fats, proteins; Chapter 17)
	Explosives (nitroglycerin)
Energy stored in bound nuclear particles	Nuclear energy (power plants, bombs; Section 15.10)
Energy stored by compression	A compressed spring
	A squeezed rubber ball
Kinetic Energy	
Energy of any moving object	A rolling freight train
	A spinning water turbine (hydroelectric power; Section 15.15)
	A rolling bowling ball
	A moving molecule
	A sailboat skimming across a lake
	A baseball hurtling toward home plate
	The eruption of a volcano

Thermodynamics and Kinetics

- Any process has two components
  - Thermodynamics – dealing with energy or tendency
  - Kinetics – dealing with rate
- Thermodynamic parameters are **state functions**. Only concerned with starting and ending states
- Kinetics deals with what happens in between, the **mechanism** of the process.
  - Where you start, where you end, but not how you get there.

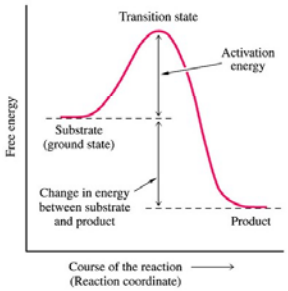
Laws of Thermodynamics

- Key terms: system, surroundings and universe
- First Law: Energy is neither created or destroyed
  - "Law of conservation of energy"
  - You can't win, you can only break even
  - More useful forms of energy are constantly being degraded into less useful forms
- Second Law: The entropy of the universe is increasing OR Heat cannot be converted to work without making some changes to the universe OR energy does not flow spontaneously from a cold object to a hot one.
  - You can't break even
  - What is entropy
  - Spontaneous vs nonspontaneous



Chemical Energy

- Often stored in bonds
- Typically costs energy to break bonds, energy is released when bonds are made
  - Think stability
- Energy **<u>can</u>** be released or absorbed as heat
  - Amount of energy depends on reaction and on the quantities of reactants/products used
    - Heat of reaction
    - Heat of combustion
    - Units?
- Bond Energy: Energy required to break bond
- Consider "Free Energy"
- Energy's role in kinetics
  - Activation energy
  - Kinetic energy of molecules as a function of temperature



http://www4.nau.edu/meteorite/meteorite/Images/EnergyDiagram.jpg