Chapter 15: Energy and Chemical Change
Section 1: Energy

Energy: the ability to do work or produce heat

- Exists in 2 basic forms:
  - Potential energy
    - Energy due to the composition or position of an object
  - Kinetic energy
    - Energy of motion
    - As temperature increases, the motion of particles increases

Law of conservation of energy: states that in any chemical reaction or physical process, energy can be converted from one form to another, but it is neither created nor destroyed.

- 1st Law of Thermodynamics

Chemical potential energy: the energy that is stored in a substance because of its composition

- Plays an important role in chemical reactions

Heat (q): energy that is in the process of flowing from a warmer object to a cooler object

- When a warmer object loses energy, the temperature decreases
- When a cooler object absorbs energy, the temperature rises

calorie (cal): the amount of energy required to raise the temperature of one gram of pure water by one degree Celsius

- When the body breaks down sugars and fats to form carbon dioxide and water, this generates heat that is measured in Calories
  - Note the difference in Calories and calories

- We measure our food in Calories (capital C) or a nutritional Calorie
- 1 Calorie = 1000 calorie = 1 kcal

Joule (J): the SI unit of energy and of heat

- 1 J = 0.2390 cal
- 1 cal = 4.184 J

Specific heat (c): the amount of heat required to raise the temperature of 1 gram of that substance by 1 degree Celsius

- Each substance has its own specific heat

Calculating heat:

- $q = c \times m \times \Delta T$
  - q = heat absorbed or released
    - measured in J (sometimes kJ)
  - c = specific heat of a substance
    - measured in J/(g*ºC)
  - m = mass
    - measured in grams
  - ΔT = change in temperature
    - measured in ºC

Example:

1. Calculate the heat absorbed in 5000. grams of water if the temperature changed from 25.0 ºC to 31.0 ºC. The specific heat of water is 4.184 J/(g*ºC)

   $q = c \times m \times \Delta T$
   $q = (4.184\ J/(g*^oC)) * (5000.\ g) * (31.0-25.0\ ^oC)$
   $q = 125{,}000$ J (or 125 kJ)
   *Note the positive for heat absorbed.

2. Calculate the heat released in 5000. grams of concrete if the temperature changed from 74.0 ^{o}C during the day and cooled to 40.0 ^{o}C at night. The specific heat of concrete is 0.84 J/(g*^{o}C).

$q = c \times m \times \Delta T$

$q = (0.84\ J/(g*^{o}C)) * (5000.\ g) * (40.0-74.0\ ^{o}C)$

$q = -143{,}000\ J$ (or -143 kJ)

*Note the negative for heat released.