WELCOME TO PERIOD 6: SPECIFIC HEAT, LATENT HEAT, AND HEAT CAPACITY

Homework #5 is due today at the beginning of class.
• What is specific heat?
• What is latent heat?
• What is heat capacity?
Definitions

**Temperature:** a measure of the AVERAGE kinetic energy of the atoms and molecules of a substance.

**Thermal Energy:** a measure of the TOTAL internal energy of the atoms and molecules of a substance.

**Heat** is thermal energy in transit.

**Thermal conductivity** is a measure of how quickly a material transports thermal energy. The larger the thermal conductivity constant $K$, the more rapidly heat is conducted through the material.

**Evaporative cooling:** Cooling of a material as the molecules with the greatest kinetic energy evaporate.
Specific heat

The amount of energy needed to raise the temperature of 1 gram of a substance by 1 degree Celsius.

\[ Q = s_{heat} \times M \times \Delta T \]

- \( Q \) = heat added or subtracted (calories or joules)
- \( s_{heat} \) = specific heat (calories/gram °C or joules/gram °C)
- \( M \) = mass (grams)
- \( \Delta T \) = change in temperature = \( T_{final} - T_{initial} \) (°C)

Note: 1 milliliter of water has a mass of 1 gram.
Maximum temperature of boiling water

Water boils: 212°F  100°C

Water freezes: 32°F  0°C
Specific heat of water

Heat is measured in **calories** or **joules**

The specific heat of water is:

\[
4.186 \text{ joules/gram } ^0\text{C}
\]

or

\[
1 \text{ calorie/gram } ^0\text{C}
\]

What sources of error could occur in your experiment?
States (phases) of matter

- **In Solids**, molecules or atoms are held in a fixed position by electromagnetic bonds between the electrons and protons.  
  
  **Solids have a fixed shape and volume.**

- **In Liquids**, molecules or atoms feel an attraction to one another, but there are no fixed bonds between them.  
  
  **Liquids have a fixed volume, but not a fixed shape.**

- **In Gases**, molecules move independently of one another.  
  
  **Gases have no fixed volume or shape.**
Latent heat

The amount of energy needed to change the phase of 1 gram of a substance.

\[ Q = L_{heat} \times M \]

- \( Q \) = heat (calories or joules)
- \( L_{heat} \) = latent heat (calories/gram or joules/gram)
- \( M \) = mass (grams)

solid \( \leftrightarrow \) liquid: Latent heat of fusion of water = 80 cal/g

liquid \( \leftrightarrow \) gas: Latent heat of vaporization of water = 540 cal/g
Phase changes of ice $\rightarrow$ water $\rightarrow$ steam

Latent heat of fusion. Ice turns to water.

Latent heat of vaporization. Water turns to steam.
Heat capacity

The amount of energy needed to raise an object’s temperature by 1 degree C.

\[ Q = H_{\text{cap}} \times \Delta T \]

- \( Q \) = heat added or subtracted (calories or joules)
- \( H_{\text{cap}} \) = heat capacity (calories/°C or joules/°C)
- \( \Delta T \) = change in temperature = \( T_{\text{final}} - T_{\text{initial}} \) (°C)
Heat capacity

Heat capacity is the amount of energy needed to raise an object’s temperature by 1 degree C.

When a given amount of heat flows into or out of objects,

✓ an object with a higher heat capacity experiences less temperature change and

✓ an object with a lower heat capacity experiences a greater temperature change.
Heat capacity / specific heat / latent heat

**Heat capacity:** The amount of energy needed to raise an object’s temperature by 1 degree Celsius.

\[ Q = H_{\text{cap}} \times \Delta T \]

**Specific heat:** The amount of energy needed to raise the temperature of 1 gram of a substance by 1 degree Celsius.

\[ Q = s_{\text{heat}} \times M \times \Delta T \]

**Latent heat:** The amount of energy needed to change the phase of 1 gram of a substance.
BEFORE THE NEXT CLASS…

✓ Read textbook chapter 7.
✓ Complete Homework Exercise 6.
✓ Print out Activity Sheet 7.