Learning Objectives for
Thermochemistry: Energy Flow and Chemical Change

- To describe the thermochemical "universe" as a sum of the "system" and the "surroundings".
- To describe “internal energy”.
- To describe two ways that a chemical system can change its internal energy.
- To describe “heat” and “work”.
- To describe the two kinds of work normally associated with chemical reactions.
- To describe the sign conventions for changes in internal energy of the system when work is done by, or on, the system and/or heat is gained, or lost, by the system.
- To describe the First Law of Thermodynamics in terms of changes in internal energy of the universe, system and surroundings.
- To describe a “state function” and list several examples of state functions.
- To describe enthalpy, and its relationship to heat flow at constant pressure.
- To distinguish “exothermic” and “endothermic” processes.
- To describe each of the following types of enthalpy change:
  - heat of reaction ($\Delta H_{rxn}$)
  - heat of combustion ($\Delta H_{comb}$)
  - heat of formation ($\Delta H_f$)
  - heat of fusion ($\Delta H_{fus}$)
  - heat of vaporization ($\Delta H_{vap}$)
- To describe why the heat of vaporization for a substance is usually larger in magnitude than the heat of fusion for the substance.
- To describe how the value for $\Delta H$ is experimentally determined.
- To describe heat capacity, specific heat capacity and molar heat capacity.
- To describe the chemical source(s) of $\Delta H$.
- To calculate $\Delta H$ by using:
  - bond energies
  - Hess’s law of heat summation
  - standard heats of formation
- To describe “homolytic” and “heterolytic” bond dissociation energies and the difference(s) between them.
- To describe (list) the limitation(s), if any, of using (1) bond dissociation energies, (2) Hess’s Law and (3) standard heats of formation for calculating $\Delta H$.
- To describe “standard state” conditions and why they are needed in thermochemistry.
- To describe why many compounds have negative standard heats of formation.