

## Unit 4: Thermochemistry

adapted from [http://www.phschool.com/advanced/lesson\\_plans/chem\\_brown\\_2003/index.html](http://www.phschool.com/advanced/lesson_plans/chem_brown_2003/index.html)

This lesson builds the basics of chemical thermodynamics, which will be dealt with more completely later in the course.

### Objectives:

- Understand what the *system*, the *surroundings*, and the *universe* mean.
- Be familiar with the units of energy.
- Understand what the *First Law of Thermodynamics* means.
- Be familiar with how the internal energy of a system is affected by exchanges of heat and work between the system and the surroundings.
- Understand what a *state function* is.
- Define *enthalpy*, and explain how heat transfer from or to the system at constant pressure changes it.
- Know what the sign of the enthalpy indicates about the reaction.
- Be able to sketch an enthalpy diagram for reactions given their enthalpy changes.
- Be able to calculate the amount of heat released or absorbed by a reaction, knowing the quantity of the reactants and the enthalpy of the reaction on a mole basis.
- Define *heat capacity* and *specific heat (capacity)*.
- Be able to work problems on calorimetry.
- State and apply Hess's Law of Constant Heat Summation in calculating enthalpies of reaction from enthalpies of other reactions.
- Know what the *standard state* of an element or compound is.
- Define and illustrate what is meant by *standard enthalpy of formation*.
- Calculate the enthalpy change of a reaction using a table of standard enthalpies of formation.

### Lab Objectives:

- Become familiar with the use of a calorimeter to measure the enthalpy change during a chemical reaction.
- Compare the molar enthalpy change for the neutralization of a strong and a weak acid.

### Suggested Lab:

- Heat of Neutralization

### Key Words:

Thermodynamics	heat	state function	molar heat capacity
Thermochemistry	energy	enthalpy	specific heat bomb calorimeter
potential energy	first law of thermodynamics	enthalpy of reaction calorimeter	Hess's law
kinetic energy		calorimeter	enthalpy of formation
system	internal energy	heat capacity	standard enthalpy
surroundings	endothermic	joule	standard enthalpy of formation
work	exothermic	calorie	pressure-volume work

### Tips:

- Don't spend much time on  $\Delta E$ ,  $q$ , and  $w$ .
- Spend more time on enthalpy.
- Remember that standard enthalpies of formation are molar.
- Balancing chemical reactions is essential and so are the physical states of all species in thermochemistry.

