**Thermodynamics & Fluids (15%)**

***Please note that thermo is suggested as an independent summer study.***

Students typically do well with this topic since it builds on their knowledge of chemistry.  If you did the thermal physics portion of this topic as a summer assignment (complete with assigning UT ehwk or Quest physics problems), start with reviewing the homework.  You’ll have to teach the Carnot cycle, PV diagrams, and the fluids portion but can still trim 2 weeks off your 30 teaching weeks and buy some time! I

This is a great topic to discuss at a vertical team meeting.  Thermodynamics is present in AP Biology, AP Chemistry and AP Physics but is presented very differently in each!  Teachers of first-year chemistry need to know how students will apply thermodynamic principles in each of these courses since their course is often a prerequisite to each of the AP sciences. The AP Physics B Course objectives for this topic follow:

**Temperature and Heat (2%)**

Mechanical Equivalent of Heat

Students should understand the “mechanical equivalent of heat” so they can determine how much heat can be produced by the performance of a specified quantity of mechanical work.

Transfer and Thermal Expansion

Students should understand heat transfer and thermal expansion, so they can:  
  
(1) Calculate how the flow of heat through a slab of material is affected by changes in the thickness or area of the slab, or the temperature difference between the two faces of the slab.  
  
(2) Analyze what happens to the size and shape of an object when it is heated.  
  
(3) Analyze qualitatively the effects of conduction, radiation, and convection in thermal processes.

**Kinetic Theory and Thermodynamics (7%)**

Ideal Gases

Students should understand the kinetic theory model of an ideal gas, so they can:  
  
(1) State the assumptions of the model.  
  
(2) State the connection between temperature and mean translational kinetic energy, and apply it to determine the mean speed of gas molecules as a function of their mass and the temperature of the gas.  
  
(3) State the relationship among Avogadro’s number, Boltzmann’s constant, and the gas constant R, and express the energy of a mole of a monatomic ideal gas as a function of its temperature.  
  
(4) Explain qualitatively how the model explains the pressure of a gas in terms of collisions with the container walls, and explain how the model predicts that, for fixed volume, pressure must be proportional to temperature.

Students should know how to apply the ideal gas law and thermodynamic principles, so they can:  
  
(1) Relate the pressure and volume of a gas during an isothermal expansion or compression.  
  
(2) Relate the pressure and temperature of a gas during constant-volume heating or cooling, or the volume and temperature during constant-pressure heating or cooling.  
  
(3) Calculate the work performed on or by a gas during an expansion or compression at constant pressure.  
  
(4) Understand the process of adiabatic expansion or compression of a gas.  
  
(5) Identify or sketch on a PV diagram the curves that represent each of the above process.

Laws of Thermodynamics

Students should know how to apply the first law of thermodynamics, so they can:  
  
(1) Relate the heat absorbed by a gas, the work performed by the gas, and the internal energy change of the gas for any of the processes above.  
  
(2) Relate the work performed by a gas in a cyclic process to the area enclosed by a curve on a PV diagram.  
  
  
Students should understand the second law of thermodynamics, the concept of entropy, and heat engines and the Carnot cycle, so they can:  
  
(1) Determine whether entropy will increase, decrease, or remain the same during a particular situation.

(2) Compute the maximum possible efficiency of a heat engine operating between two given temperatures.

(3) Compute the actual efficiency of a heat engine.

(4) Relate the heats exchanged at each thermal reservoir in a Carnot cycle to the temperatures of the reservoirs.

**Fluid Mechanics (6%)**

Hydrostatic Pressure  
  
Students should understand the concept of pressure as it applies to fluids, so they can:

(1) Apply the relationship between pressure, force, and area.

(2) Apply the principle that a fluid exerts pressure in all directions.

(3) Apply the principle that a fluid at rest exerts pressure perpendicular to any surface that it contacts.

(4) Determine locations of equal pressure in a fluid.

(5) Determine the values of absolute and gauge pressure for a particular situation.

(6) Apply the relationship between pressure and depth in a liquid, *P* *g**h*

Buoyancy

Students should understand the concept of buoyancy, so they can:

(1) Determine the forces on an object immersed partly or completely in a liquid.

(2) Apply Archimedes’ principle to determine buoyant forces and densities of solids and liquids.

Fluid flow Continuity

Students should understand the equation of continuity so that they can apply it to fluids in motion.

Bernoulli’s Equation

Students should understand Bernoulli’s equation so that they can apply it to fluids in motion.