# Chemistry Lecture 5 - Heat Capacity/Phase Change/Colligative Properties

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Heat Capacity
Energy used to change temperature of a substance
Two types: constant volume and constant pressure, $C_p$>$C_v$ b/c constant pressure means some PV work can be done on surroundings
*Heat capacity* = energy needed PER DEGREE so $q = C\Delta T$ (C has units J/C or J/K)
*Specific heat capacity* = energy needed PER DEGREE PER UNITS MASS so $q = mc\Delta T$
(c has units J/mol*C or J/mol*K or J/g*C or J/g*K)
Water's specific heat capacity: $1\ cal / g^{\circ}C$

Calorimeter
*Coffee cup calorimeter*: measures constant pressure b/c at atmospheric pressure
*Bomb calorimeter*: measure constant volume b/c in a steel container
IN ALL CASES: knowing energy added, change in temperature lets you calculate C or c

Phase Changes
Know what graph of temperature vs. heat added looks like: FLAT at phase changes
-> Slope = specific heat
*Heat of fusion*: energy added for solid -> liquid, or energy taken away for liquid -> solid
*Heat of vaporization*: energy added for liquid -> gas, or energy taken away for gas -> liquid
Melting/boiling are endothermic & increase S, freezing/condensing are exothermic
$q = mL$

Phase Diagram
Describes phases at different temperatures/pressure
*Triple Point*: where solid/liquid/gas meet, at that P/T the substance can be in all 3 phases
*Critical point*: if T>critical temp or P>critical pressure then you can't tell whether it's a gas or a liquid, it has properties of both
In water, the solid/liquid boundary slopes to the left (one of few substances for which this is true) -> increasing pressure will change solid to liquid b/c solid is LESS DENSE than liquid

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<u>Colligative Properties</u>: depend only on number
FOLLOWING IS FOR NONVOLATILE SOLUTES
*Vapor pressure*: $P_{actual} = \chi_{solution} P_{solution}$
*Boiling point elevation*: $\Delta T = k_b m i$
- -> *m* is molality, *i* is # of particles something will turn into when it dissolves
- -> i.e. 1 mol NaCl added to 1 kg of water will have *m=1*, *i=2*

*Freezing point depression*: $\Delta T = k_f m i$
*Osmotic pressure*: how much water wants to GO INTO a solution $\Pi = iMRT$
- -> *M* is molarity
- -> At equilibrium: osmotic pressure = hydrostatic pressure difference

$$\Pi_1 = P_1 - P_2 = \rho g h_1 - \rho g h_2$$