Lesson plan for *States of Matter* : Phase Changes and Diagrams

Time for activity 60 minutes Also could use *Atomic Interactions* a sim that was posted in 2009

Learning Goals: Students will be able to: (2 levels of goals listed)

A. Identifying and Describing Particle behavior as it relates to phase.

1. Describe differences and similarities between monatomic, diatomic, and polyatomic particle behavior.
2. Describe how the vapor pressure of a liquid or solid is measured.
3. Describe how changing the pressure or temperature can change the state of matter.
4. Given the position on a phase diagram from which the labels are all removed, identify the phase present and determine the microscopic behavior of molecules. And vice versa.

B. Explaining behavior using Bonding

5. Develop ideas about why there is variation in inter-particle forces (other references will be needed)
6. Differentiate between non-polar and polar molecular behavior as it relates to phase
7. Relate changes in the strength of the inter-particle bonding to changes in the phase diagram, vapor pressure, and transition temperatures.

Background:

My students did an activity using Gas Properties and Microwaves last year in Physics to help them construct and understanding of KMT. We have also studied Thermodynamics, so the students have already demonstrated several of the learning goals that you would find listed under the first tab.

States of Matter **Introduction:**

This is the first time that my students have used the sim, but I did not demonstrate anything.

States of Matter **Teaching tips:** The sim has Ne Ar O_2 and H_2O and a Custom particle that you can adjust the inter-particle attraction. Basically, the students should be able to see that the larger Ar has more Dispersion forces and that O_2 has even more. Then they can explore varying the force of attraction which varies from very low London Dispersion (Van Der Waals) to just below the strength of the water dipole force.

Lesson:

Have the students use the lab sheet for guidance. The activity took my College chemistry students about 60 minutes. I encouraged some groups to try looking at heteronuclear molecules using the *Atomic Interactions* sim, but I did not have this in the written directions and will probably revisit this activity before next year.