

# AM Atomic Microscope

## Objective

In this computer based lab, the objective is (1) to use the simulation software *Atomic Microscope*, by Stark Design, Inc. to examine the molecular-level behavior of gases, liquids, and solids and (2) to perform simple animations demonstrating the underlying basis of the gas laws, phase changes, diffusion, osmosis, and other processes.

## Getting Started

Atomic Microscope does not come with instructions or a users guide. The company expect us to learn how to use the software simply by playing with it (which actually is an okay suggestion). The software has four tabs to help the user get around:

<i>Home Screen Tab</i>	Essentially, a table of contents
<i>Controls Tab</i>	Explains the various control buttons, bars, etc.
<i>Information Tab</i>	Brief explanation and often a list of pre-set experiments
<i>Services Tab</i>	More background information.

Check out each of screens the above tabs display. Spend time with the Controls Tab screen until you know what each of the controls does. (You may want to avoid the Quick Tour.) The Information tab gives you different information depending on what experiment you chose on the Home Screen.

A few commands to help you get started are:

Space bar	pause or resume simulation
Y	interaction on or off ( normally want to make sure this is on)
U	notation is off or on
I	clear experiment screen
Arrows	up or down for temperature increase or decrease

## Activities

### Activity 1

Select *2-D* and *Diffusion*. Select the *Info Tab*. Select the *He Kr Diffusion* experiment. Carry out this activity until you "understand it". What does one learn from this activity?

### Activity 2

Select *2-D* and *Diffusion*. Select the *Info Tab*. Now select the *Osmotic Pressure* activity. Run this activity. What does one learn from this "experiment"?

### Activity 3

Select *2-D* and *Pressure Number of Atoms*. Put 10 atoms in the box and wait for the pressure to stabilize. Hit the *Pause* control, add 10 more atoms, and un-do *Pause*. Wait for the pressure to stabilize. Repeat these steps until you have 50 atoms present. What does one learn from this activity (make sure you describe the graph that is generated)?

### Activity 4

Select *3-D Plus* and *Sodium Chloride*. Select the *Info Tab* and *216 Atom Crystal*. Use the mouse to start the cube rotating slowly. Are the various crystal planes visible? Raise the temperature until you see a noticeable change. At the maximum temperature, what state is the NaCl found in (solid, liquid, or gas)? What does one learn from this activity?

### Activity 5

Select *3-D Plus*. Select *Free Play*. Select *Info Tab* and *172 Kr Crystal*. Use the mouse to start the cube rotating slowly. Does this structure exhibit closest packing? Raise the temperature until you see a noticeable change. By raising the temperature, is it possible to bring about melting? Is it possible to turn Kr into a gas by raising the temperature to the maximum value?

Turn off the attractive forces and examine the sample at maximum, medium, and minimum temperatures. What state is the sample in at each of these temperatures?

With the temperature at a medium setting, turn attractive forces back on. What do you see happening? Define "nucleation". (Hint: Atkins has an index.) Are you seeing nucleation happen?

Lower the temperature close to the minimum. Define "solidification". Are you seeing it happen? Does the sample revert to closest packing?

### Activity 6

Select *3-D Plus*. Select *LeChatelier's Principle*. Adjust the temperature and generate a graph of #bonds versus temperature. What does one learn from this activity.

### Activity 7

Do 3-D Pressure Volume activity with *Atomic Microscope*. Draw a picture of the P vs  $1/V$  and P vs V plots. If you replace one set of atoms with a different type do the above plots change. Why or why not?

### Activity 8

Select 3-D Effusion. Start with some number of atoms for several different types and repeat an effusion experiment. Count how many atoms effuse (pass through hole) during given time period for these different types of atoms. How is rate of effusion affected by the change of atom type.

### Activity 9

Select 3-D Maxwell Boltzmann. How does change in molecule affect curves you observe? How does change in temperature affect curves?

**Activity 10**

Can you construct an experiment that more closely models osmotic pressure in which you have solvent only on one side of a membrane and solute and solvent on the other side? Explain what you did and what you observed?

**Report**

Your report will have a normal cover page but then the report is an answer to questions about activities 1 – 10 above. You do not need to be verbose, but make sure you are specific about your activity set-up, observation, and interpretation or conclusion.