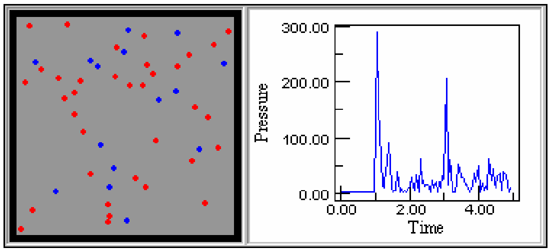
Worksheet for Exploration 20.2: Partial Pressure of Gases



In this animation N = nR (i.e., $k_B = 1$). This, then, gives the ideal gas law as PV = NT. Two particles of different masses are in the same container. The total pressure on the container is due to the collisions of both types of particles on the walls. The blue particles are more massive than the red ones (10 times more massive). How can you tell this by watching the animation? (Hint: Temperature is proportional to the average kinetic energy.) Restart.

a. What is the average pressure on the walls? Note: You need to watch the <P> number and wait until it stays around the same number (is not increasing or decreasing, but oscillating about the same number) and then estimate an approximate value. From this pressure and the temperature, use the ideal gas law (in the form PV = NT) and calculate the volume of the box the particles are in. If the dimension of the box into the computer screen is 1, what is the length of one wall? Measure the size of the container to verify your calculation.

<P>=________ T=________

V=________ L=________

Run the same animation with **only the red particles**.

b. What is the pressure on the walls? This is the partial pressure of the red particles.

P_{red}=________

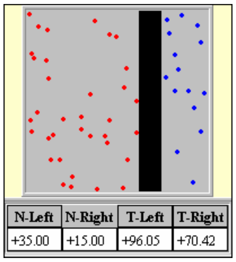
Run the animation again, but this time with **only the blue particles**.

c. What is the pressure on the walls? This is the partial pressure of blue particles.

P_{blue}=________

d. Compare the total pressure with the sum of the partial pressures.

e. The sum of the partial pressures and the total pressure should be equal. Why?



Now, **start the second animation** when the red and blue particles are in a container with a movable piston between them. The piston generally stays in a position where the pressures on both sides are essentially equal.

f. Where does the piston generally stay (right, left or in the middle)?
   i. Use the ideal gas law to predict where the piston should be. What assumptions do you make to do this?

g. Why?

h. Remembering that the blue particles have a mass 10 times the red particles, predict what the partial pressure of the red and the blue will be (in the first animation) if there are the same number of red and blue particles (25 each for a total of 50 particles).
   i. Show how you calculate these partial pressures.

$P_{red\ 25}$=_________

$P_{blue\ 25}$=_________

Try running the first animation with **equal number of red and blue particles** (after clicking, scroll back up to the first animation). Run with only **red particles**. Run with only **blue particles**.

i. Was your prediction right? Explain.

j. Predict where you expect the piston will be in the second animation if there are 25 particles on either side of the partition.

k. Try the **second animation with 25 particles** on either side of the partition. Was your prediction right? Specifically, when the temperature is the same on both sides, where is the partition on average?