Lesson Plan for Revised *Gas Properties* Activities

Revised for Loeblein's students who took College Physics at EHS because the students used *Gas Properties, State of Matter* & *Balloons and Buoyancy* for physics activities

Learning Goals: **Students will be able to:**

- **Describe a molecular model of gas pressure.**
- **Describe what happens to the measurable quantities if changes to a gas system are made.** *Changes can be adding/removing molecules or heat, increasing/decreasing volume or pressure.*
- **Make sense of the measurable quantities of gases by analyzing examples of macroscopic *(visible)* things that are similar.**
- **Explain using physics what is happening on a molecular level when changes are made to a gas system.** *I want them to think about N,V,P,T and force*

Lesson: I divided this lesson into 2 periods. The first was 50 minutes and we did the pre-lesson activities. I used this in the Gas unit

1. Display clicker questions, explain that they are about checking for present understanding.

2. Review pressure is force/area. $\mathbf{P}=\mathbf{F}/A$. The pressure of a gas is due to the force resulting from the change is momentum of the gas molecules that collide with the wall. $\mathbf{F}=\Delta\mathbf{p}/\Delta t = m\Delta\mathbf{v}/\Delta t$. The sum of the instantaneous normal components of the collisions forces gives rise to the average pressure on the wall. Also mention that the physics notes page may be helpful.

3. I'll have a balloon to blow up (elastic, constant pressure container). We'll talk about adding and removing molecules. I have a pressure ball to demonstrate a fixed volume and to show them what a pressure gauge looks like. We'll talk about car/bike tires and I'll use a Ziploc stuffed lightly with tissues to demonstrate a flexible but constant volume container. I'll also have a glass container (fixed volume, non-flexible) and a balloon full of tissues.

4. I'll project *Gas Properties* on a large screen. Add one pump full of molecules. 200 molecules gives about 1 atm at room temperature with *None* for *Constant Parameter*. Then I am going to display question on the overhead: Look at the animation of the particles bouncing around in the volume. Describe what visual information you can use to get a sense of the pressure that the gas particles are exerting on the walls. *I have the questions enlarged on the next page to make an overhead.*

Project question 2 and 3 : Why does the pressure reading vary with time? Get student ideas. What **visual** cues are associated with an increase in pressure? (Set temperature constant and add more molecules )

Lesson: The students will now work in pairs to complete the activity. As they are working on number 1 "Make a list of things that you think might affect pressure". Make sure they try

- Set T constant and decrease the volume.

- Make sure to try the light molecules so they get that equal # have equal pressure if V and T constant (Avogadro)
- Change temp

**Second Day of lesson:**

1. There are some clicker questions.
2. Also, for discussion, I went back over the first three questions asking how the answer changed if the container is soft. You could use the *Balloons and Buoyancy* sim to demonstrate this more clearly.

On the day after the lesson:

Other good discussion questions:

- **If you are in a building fire, you are supposed to lie on the ground. Why?**
- **If you are hiking in the mountains and find yourself short of breath, do you think if you lie on the ground you could breathe easier?**

Notes to myself about how to verify using sim for the student questions

1. Set P constant, open the top *T and V both decrease*
2. V constant, push on pump to add molecules *P and T both increase*
3. Set *None* constant, push the side of the container so the volume goes down *(P&T will rise)I was assuming the air pocket is elastic*
4. Set V constant, add heat ( *Pressure is F/A so more P means more F required)*
5. Set *None* constant, lower P by increasing V *Students will have to think about that the balloon's pressure equals the atmosphere's and that the balloon has a maximum size. I expect them to describe the whole event as they go up the mountain the outside pressure decreases and the balloon stretches until it reaches a max. The temperature does not change. Also, other users might need to know that Denver is at about 5500 ft and Evergreen about 7800 ft.*

*OR* You can use the *Balloons and Buoyancy* simulation to answer this question.

7. I tried to simulate this by having V constant, and I put in molecules to make the pressure about 2.3 and adjusted the temperature to 275. Then I changed T from 275 to 300. *I saw the pressure change very little, so the students would decide there had been a leak. 30+14.7=45(3atm)*