

Gases: Properties and Laws

Learning Objectives:

Define four important properties of gases- pressure, temperature, volume, and amount of a substance. Graphically analyze the relationships between the properties and define their proportional relationship. Apply gas properties and laws to real life.

Assignment:

Tire pressures, sinus headaches, cabin pressure in airplanes, even hairspray bottles- all find their explanation in the properties and laws of gas molecules. Four important properties of gases- pressure, temperature, volume, and amount (in moles)- are used to define the behaviors of gas molecules. Using the **Gas Properties** simulation from the pHet program, you and your partner will first define each property and then compare the properties to one another.

1. Open the **Gas Properties** simulation on the University of Colorado's pHet website:
phet.colorado.edu/en/simulation/gas-properties
2. "Pump the Handle" to place gas molecules into the box.
3. Play around with the simulation and list the four things in the simulation you can change below.
4. Using the "Constant Parameter" section to the right of the simulation. Hold first volume constant. Adjust the amount of gas molecules and the temperature and observe what is happening to the pressure of the system.
5. Repeat the process above with "temperature" held constant.
6. Based on your observations, define the first property of gas molecules- *pressure*.
7. Repeat Steps 4-6, holding pressure and temperature constant and defining *volume*.
8. Repeat Steps 4-6, holding pressure and volume constant and defining *temperature*.
9. How does the amount of gas molecules present affect the three properties above (pressure, volume, temperature)?

10. Using your observations and the simulation, predict by drawing a graph of the relationship between temperature and pressure.

11. Hold volume constant in the “constant parameter” section to the right.

12. Add heat to the system and record your new temperature and pressure in the chart below.

13. Repeat step twelve three more times recording your new temperature and pressure each time.

Pressure (atm)	Temperature (K)

14. Using your observations and the simulation, predict by drawing a graph of the relationship between volume and pressure.

15. Now hold temperature constant.

16. Adjust the volume by moving the man. Calculate your new volume by clicking on the “Measuring Tools” and checking the “Ruler” and “Layering tool” box. (Assume the width of the box is 10 nm).

17. Record your new volume and pressure in the chart below.

18. Repeat steps 16-17 three more times.

Pressure (atm)	Volume (nm³)

19. Using your observations and the simulation, predict by drawing a graph of the relationship between temperature and volume.

20. Now hold pressure constant.

21. Choose to either add or remove heat. Calculate the new volume and record the new temperature and volume in the chart below.

22. Repeat step 21 three more times.

Volume (nm³)	Temperature (K)

23. Create three graphs using the three data tables above.

24. Do your graphs support your three predictions made in steps 10, 14, and 19? If not why?

25. Using your knowledge of everyday life, the book, and the internet, provide three real-world situations that describe the relationships you discovered for:

a.) pressure and temperature

b.) volume and pressure

c.) temperature and volume

26. Is it possible to make the top blow off the container by adding just one “heavy species” to the container? If possible, how? If not possible, why not?