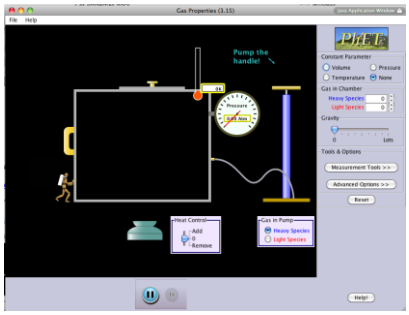
Name: _____ Period: _____

PhET: Gas Properties



Introduction: You will investigate the relationship between pressure, volume & temperature in gases.

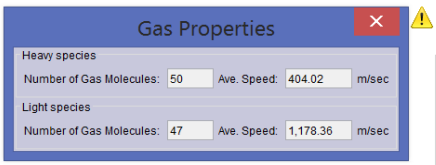
- Go to http://phet.colorado.edu/en/simulation/gas-properties
- Click “Run Now”
- This picture should appear on your screen (right):

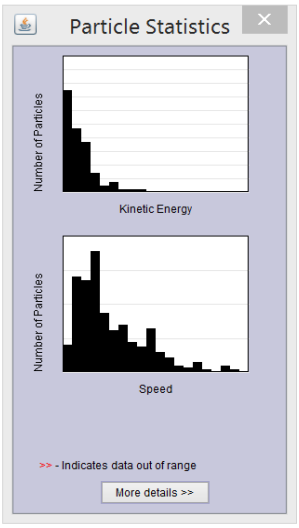
Explore:

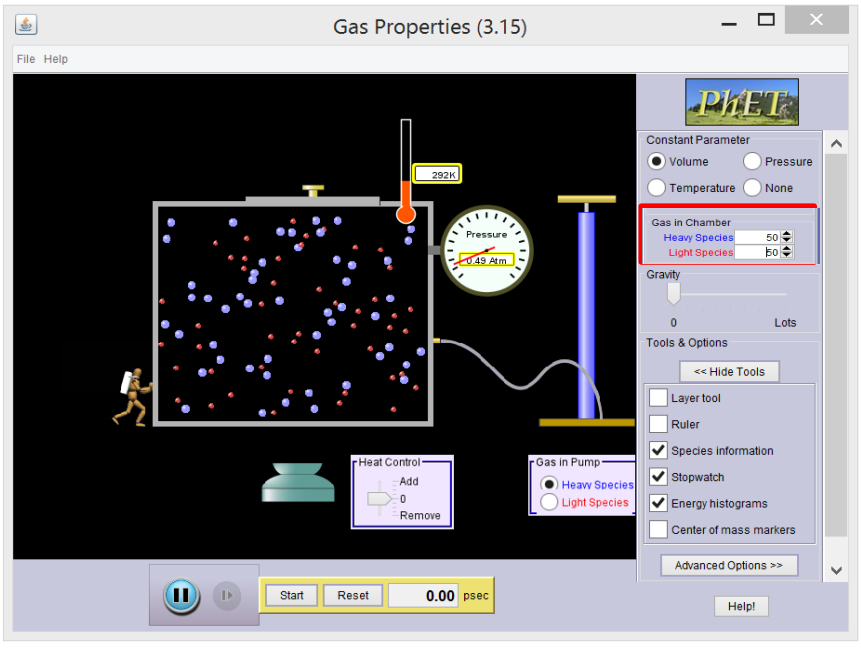
- For the next 5 minutes become familiar with the simulation. Change various features, sliders, buttons, click-and-drag items, etc.
- While you are exploring, notice how the heat control affects the gas particles.
- Next: Click “Reset All” and conduct the following investigation.

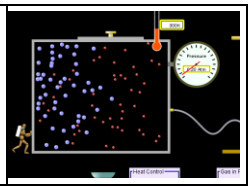
Set Up:

- Make sure the constant parameter is clicked on **volume**.
- Make sure **gravity** is set on 0.
- In the area under “Gas in Chamber” (top right) add **50 “Light Species”** and **50 “Heavy Species”** in the gas chamber.
- Next, “Tools & Options” click on “Measurement Tools” and check **“Stop Watch”** “**Species Information”** and **“Energy Histograms.”**
- Your screen should now look like the one below. Please raise your hand for help before proceeding if needed.







Activity A:	Get the PhET ready: • The starting temperature should be 300°K (On the Kelvin scale, 0 degrees is **absolute zero**, the coldest possible temperature. Absolute zero is equal to -273.15 °C or -459.67 °F)	

Question: How does temperature affect the Kinetic Energy of a gas when volume is constant?

"The **kinetic theory of matter** states that all **matter** is made of small particles that are in random motion and that have space between them. This means that no **matter** what phase **matter** is in, it is made of separate, moving particles."

1. **Observe** the motion of the particles for 10-30 seconds. From what you observed, do you agree with the definition above for the "Kinetic Theory of Matter?" **YES** **NO**

2. Using the "Heat Control" slider, "Remove" heat from the test area until the internal temperature is 0°K (or absolute zero). Observe the Kinetic Energy and Speed of particles as they change in the graph.

3. Using the "Heat Control" slider, "Add" heat to the test area until the internal temperature is 3000°K. Observe the Kinetic Energy and Speed of particles as they change in the graph.

4. _____What is happening to the pressure gauge as the temperature increases?

   A. The pressure increases
   B. The pressure decreases
   C. The pressure remains the same
   D. The pressure decreases then increases.

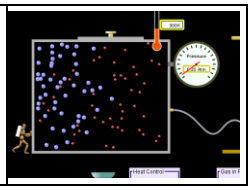
5. _____Continue to add heat to the test area until 5000-6000 °K. Watch your little guy on the side. In your opinion, what does he appear to be doing as the temperature is going up?

   A. Napping
   B. Relaxing
   C. Pushing harder and harder
   D. The whip nae nae

6. _____What event did you observe as the temperature approached 5000-6000 °K?

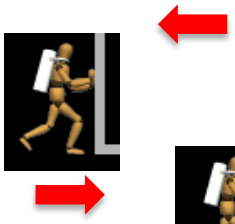
   A. The blue particles stopped moving
   B. All particles stopped moving
   C. The red particles stopped moving
   D. The lid blew off

7. _____How does temperature affect the kinetic energy in matter?
   A. As temperature goes up, energy goes up
   B. As temperature goes down, energy goes up
   C. As temperature goes up, energy remains the same
   D. Energy is not affected by the temperature of matter

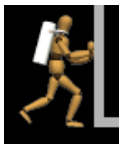
Activity B:	Get the PhET ready: • Click Reset • Add **50 "Light Species"** and **50 "Heavy Species"** • Set Constant parameter to **"None."**	

Question: How does volume affect the temperature of a gas?

1. Slide your little guy left to create a larger volume for the particles. Observe the temperature.

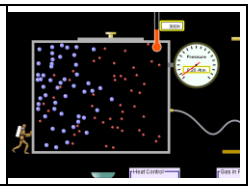


2. Slide your little guy right to create a smaller volume for the particles. Observe the temperature.



3. Write a rule that is true for all matter by filling in the space with the correct term.

- As the volume of a gas decreases, the temperature of that gas will _____
- As the volume of a gas increases, the temperature of that gas will _____

Activity C:	Get the PhET ready: • Click Reset • Add **200 "Light Species"** and **0 "Heavy Species"** • Set Constant parameter to **"None."**	

Question: How does volume affect the pressure of a gas?

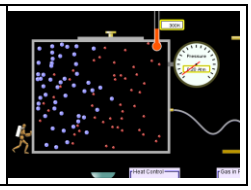
1. Add the 200 light species and let the simulation run for 5-10 seconds. Record the pressure in the table below.

2. Slide your little guy as far to the left as you can creating the largest possible volume. Let the simulation run for 5-10 seconds and record the pressure in the table below.

3. Slide your little guy as far to the right as you can creating the smallest possible volume. Let the simulation run for 5-10 seconds and record the pressure (or maximum pressure reached) in the table below.

	Pressure (Atmospheres: Atm)
#1 Starting Pressure (Middle sized volume)	
#2 Largest Volume	
#3 Smallest Volume	

4. **How does volume affect the pressure of a gas? Tell me about the pattern that you observed.**

Activity D:	Get the PhET ready: • Click Reset • Add **20 "Heavy Species"** • Set Constant parameter to **"None."**	

Application: Let's Blow this Pop Stand!

Part 1: Your mission is to blow the lid off of the test area by changing **ONLY** two variables.

Hypothesis: Check below the **TWO** variables you believe will result in the lid blowing off of the test area.

____ add heat ____ remove heat ____add light species

____ make larger volume ____ make smaller volume ____ add heavy species

____ remove heavy species

Test your hypothesis: Did you successfully blow the lid off of the test area? `**YES NO**

Data: If you answered "NO" above, make and test a new experiment before proceeding.

Data: If you answered "YES" above, please record the data from your experiment (i.e.: # light species added; temperature or pressure when lid blew etc.)

Change #1 data _____

Change #2 data _____

Part 2: Discover a second way to blow the lid off of the test area by changing **ONLY** two variables that you did not change in part 1.

Hypothesis: Check below the **TWO** variables you believe will result in the lid blowing off of the test area.

____ add heat ____ remove heat ____add light species

____ make larger volume ____ make smaller volume ____ add heavy species

____ remove heavy species

Test your hypothesis: Did you successfully blow the lid off of the test area? `**YES NO**

Data: If you answered "YES" above, please record the data from your experiment (i.e.: # light species added; temperature or pressure when lid blew etc.)

Change #1 data _____

Change #2 data _____