Name: __________________________

Answer Key: Gas Pressure

Background
Pressure is caused by the number of collisions between molecules and the force of these collisions. When there are more collisions, or if the molecules collide with greater force, the pressure is higher. There are three things that can affect the number of collisions:

1) Size of the container
2) Temperature
3) Number of molecules

You will look at how these three factors affect the number of collisions and therefore affect the pressure of a gas.

Procedure
For each of the following parts, you will need a long rope and four students to hold the rope in a square shape. Each student holding the rope will count how many times “gas molecules” (about 5 student volunteers) collide with the wall of the container during a time period of one minute for each trial.

Gas molecules should remember the following:

1) Gas molecules travel in straight path until acted upon by the wall of the container or another gas molecule. They do not turn to avoid or cause a collision.
2) Gas molecules move at constant random motion. So you should not change your speed or stop during the duration of a trial.
3) Gas molecules are not attracted to or repelled by each other. So you should not change directions to hit or avoid your classmates.

PART A
Container size and pressure: Gas molecules should move at room temperature.

<table>
<thead>
<tr>
<th>Container Size</th>
<th>Number of collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial 1</td>
</tr>
<tr>
<td>Small container</td>
<td></td>
</tr>
<tr>
<td>Large container</td>
<td></td>
</tr>
</tbody>
</table>

Actual numbers will vary depending on the number and speed of students and the size of the square, but the small container should have a higher collision count than the large container.

PART B
Temperature and pressure: Gas molecules should speed walk for high temperature and walk slowly for low temperature.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Number of collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial 1</td>
</tr>
<tr>
<td>High Temperature</td>
<td></td>
</tr>
<tr>
<td>Low Temperature</td>
<td></td>
</tr>
</tbody>
</table>

Actual numbers will vary depending on the number and speed of students and the size of the square, but the high temperature container should have a higher collision count than the low temperature container.
PART C
Number of molecules and pressure

<table>
<thead>
<tr>
<th>Number of Molecules</th>
<th>Number of collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 molecules</td>
<td>Actual numbers will vary depending on the number and speed of students and the size of the square, but the container with more molecules should have a higher collision count than the container with fewer molecules.</td>
</tr>
<tr>
<td>10 molecules</td>
<td></td>
</tr>
</tbody>
</table>

Analysis
1) What two things cause pressure in gases?
   The number of collisions between gas molecules and the container walls and the force of the collisions with the walls.

2) Out of the three factors that affect pressure, which do you think would affect the pressure the most? Why?
   Answers will vary, based on how accurately students modeled gas particle behavior. Ideally, they would notice: Temperature and number of particles are both directly proportional so would cause the same change if both temperature and number of particles were changed by the same factor. Doubling temperature would have the same effect as doubling the number of particles, for instance (which would be doubling the pressure). [If students know the gas laws, they could relate this to \( P_1/T_1 = P_2/T_2 \), \( P_1/n_1 = P_2/n_2 \).] Pressure is inversely proportional to volume [gas law: \( P_1V_1 = P_2V_2 \)] and as the volume is doubled, pressure is halved, for example, so it doesn’t compare the same way.

3) As you increase the size of a container, what happens to pressure?
   Pressure decreases as container size increases because the walls are further apart and so the particles collide with them less frequently.

4) As you decrease the number of gas particles, what happens to pressure?
   Pressure decreases as the number of particles decreases because there are fewer particles to collide with the walls, so fewer collisions occur overall.

5) As you increase the temperature, what happens to pressure?
   Pressure increases as temperature increases because the particles are moving faster (temperature being a measure of average kinetic energy, energy related to movement) and will therefore collide with the walls more often. They will also hit with more force if they are moving faster, which also increases pressure.

6) As temperature decreases, what do you think would happen to the volume of the container?
   If the volume of the container were able to change, a decrease in temperature would lead to a decrease in volume, since the particles wouldn’t be colliding with the walls of the container as often, therefore pushing outward less and allowing the container size to decrease.