Kinetic theory of matter – Ideal Gases laws

Ideal gas definition(Duke LeTran, 2014)

1. Particles have no intermolecular forces.
2. Particles have no volume so the size of the molecules does not matter.

**What causes pressure?**

Pressure is caused by the collisions of particles with their container. It is dependent on both:

* *The number of collisions*
* *The force of the collisions*

Ideal Gas law biographies.

Robert **Boyle**

<http://www.famousscientists.org/robert-boyle/>

<http://www.robertboyle.info/3.php>

Edme **Mariotte**

<http://www.encyclopedia.com/topic/Edme_Mariotte.aspx>

Joseph Louis **Gay-Lussac**

<http://www.1902encyclopedia.com/G/GAY/joseph-louis-gay-lussac.html>

[Jacques Alexandre César](http://en.wikisource.org/wiki/1911_Encyclop%C3%A6dia_Britannica/Charles%2C_Jacques_Alexandre_C%C3%A9sar) **Charles**

<http://www.encyclopedia.com/doc/1G2-2830900865.html>

**Activity**

Download the Ideal gases simulation: <https://phet.colorado.edu/en/simulation/gas-properties>

(Barbera, Dubson & MasterLE, 2014)

**Learning Goals:**

* Design experiments to measure the relationships between pressure, volume, and temperature.
* Create graphs based on predictions and observations.
* Make qualitative statements about the relationships between pressure, volume and temperature using molecular models.

**Predictions:** Make a chart like the one below. Without using the simulation, sketch what you think the graphs would look like. **Note: Be sure to label your x and y axes.**

|  |  |
| --- | --- |
| 1. Volume-Pressure graph

xy | Explain your reasoning for the graph’s appearance |
| 1. Volume-Temperature graph

xy | Explain your reasoning for the graph’s appearance |
| 1. Temperature-Pressure graph

xy | Explain your reasoning for the graph’s appearance |
| 1. Number of particles – Volume

xy | Explain your reasoning for the graph’s appearance |

**Experiments:**

1. For each case, I-IV, use the simulation to collect 7 measurements for each relationship. Make an Excel spreadsheet for each, make a graph and add a line of best fit. *Some helpful hints* – if you set a parameter like temperature constant, then make a change, you may have to watch the temperature adjust and not record your data until the temperature is back to the original setting. These experiments would be difficult in a real situation because it is complicated to isolate parameters like you can in the *sim*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Experiment I** | **Experiment II** | **Experiment III** | **Experiment IV** |
| Independent Variable |  |  |  |  |
| Dependent Variable |  |  |  |  |
| Controlled Variable(s) |  |  |  |  |

1. After you have made your graphs in Excel, check your predictions, and see if any need correction. If necessary, make corrections in a different colour including corrections to your reasoning.
2. Complete this table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Relationship | Direct or inverse? | Constant parameters | Whose Law? | Briefly, why according to particle model. |
| V vs P |  |  |  |  |
| V vs T |  |  |  |  |
| T vs P |  |  |  |  |
| Moles vs V |  |  |  |  |

1. Using your results, explain each of the following scenarios. Make sure to refer to which graph can be used as evidence for your answer.
2. Explain why bicycle tires seem more flat in the winter than in summer.
3. Explain why a can of soda pop explodes if left in the hot sun.
4. A rigid container filled with a gas is placed in ice. What will happen to the pressure of the gas? What do you think will happen to the volume eventually?



Bibliography

Barbera, J., Dubson, M., & MasterLE, R. (2014). *Gas Properties*. *PhET*. Retrieved 28 October 2014, from <http://phet.colorado.edu/en/simulation/gas-properties>

Duke LeTran, D. (2014). *The Ideal Gas Law - Chemwiki*. *Chemwiki.ucdavis.edu*. Retrieved 27 October 2014, from <http://chemwiki.ucdavis.edu/Physical_Chemistry/Physical_Properties_of_Matter/Phases_of_Matter/Gases/The_Id>

Thanks to [Sarah Borenstein’s lesson](http://phet.colorado.edu/en/contributions/view/3010) on PhET Teacher’s Activity Database