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# Boyle's Law <br> 14012 

## Warning:

- Not a toy; use only
in a laboratory or educational setting.
- California Proposition 65 Warning: This product

can expose you to chemicals including lead, nickel, DEHP, and acrylonitrile which are known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.



## Introduction

Gas pressure is a measurement of the amount of force the moving gas particles cause on a unit of area. Several factors can affect the pressure of gas. Increasing the temperature of a gas causes the particles to move faster, increasing the pressure. Faster moving particles can each exert a larger force when they collide with a surface. Decreasing a gas's volume causes the particles to move faster, which in turn increases the pressure they exert.

## Background

Boyle's Law was named after Robert Boyle, who was an Anglo-Irish philosopher, chemist, physicist, and inventor. He made this discovery in 1662. Boyle's law states that at a constant temperature and mass, the pressure of a gas increases as its (container) volume decreases. This law is also referred to as Mariotte's Law or the Boyle-Mariotte Law because French physicist, Edme Mariotte independently discovered the same law in 1679.

## How it works

A smaller more economical version gives better and more accurate quantitative results for the pressure/volume relationship of air at constant temperature. A graduated $(0-300) \mathrm{cm}^{3}$ cylinder with a closely fitting piston is connected to a pressure gauge by a narrow tube to minimize the dead volume, it is fitted on two side supports. The cylinder is made of transparent material to see the working process inside it. We can adjust the pressure inside the cylinder by rotating the knob connected to the piston via a threaded shaft. A gas tap allows the cylinder to communicate with the outside air to adjust the mass of the air enclosed. The pressure can directly read out from a big size pressure gauge circular dial, graduated in (0-3.4) x 105 Pa .

## Equation

Basic form: $\quad \mathrm{PV}=\mathrm{k}$
Therefore when the temperature is held constant,

$$
P_{1} V_{1}=P_{2} V_{2}
$$

## Experiment

1. Open the valve to the outside atmosphere
2. Turn the piston so that the gasket is at a high volume
3. Close the valve
4. Record the initial volume and pressure
5. Turn the piston clockwise to decrease the volume by at least 5 ml . Record new volume and pressure
*With this apparatus, it is assumed that the temperature is constant.

You will be able to observe that the calculated relationship between the variables was constant for each trial. If you were to graph this relationship, it would come out to a straight line. You may wish to experiment with increasing the volume from the starting value. Predict what will happen and test your idea.

## Observations:

| Trial | Pressure (P) | Volume (V) | $\frac{1}{V}$ |
| :--- | :--- | :--- | :--- |
| 1. |  |  |  |
| 2. |  |  |  |
| 3. |  |  |  |
| 4. |  |  |  |
| 5. |  |  |  |
| 6. |  |  |  |
| 7. |  |  |  |
| 8. |  |  |  |

