Boyle's Law

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1. **Measure the change in pressure relative to the volume of a gas and explain their relationship.**

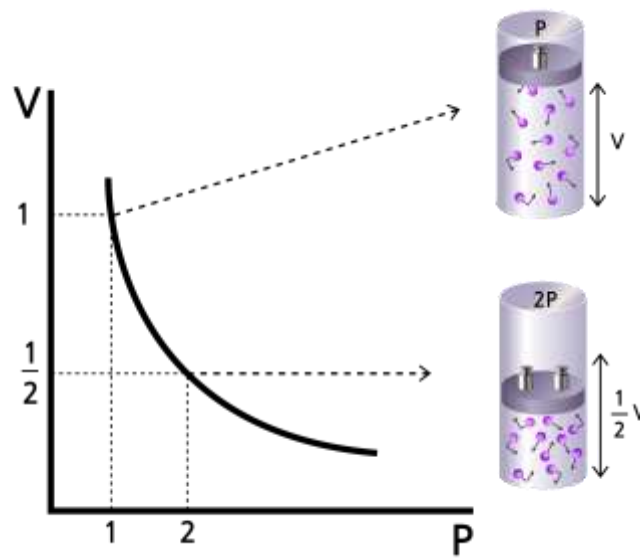2. **Identify and explain phenomena where Boyle's Law is applicable.**

Fundamental Concept

1. Boyle's Law

   At constant temperature, the volume of a given amount of gas is inversely proportional to its pressure.

   $$PV = constant \rightarrow P_1V_1 = P_2V_2 \rightarrow P \propto \frac{1}{V}$$

   (Temperature: T , Initial pressure: P_1 , Initial volume: V_1, Final pressure: P_2, Final volume: V_2)

[Graph Interpretation]

(1) Pressure (P) and Volume (V) are inversely proportional   PV= constant

(2) The product of Pressure (P) and Volume (V) is always constant $P_1V_1=P_2V_2$

2. Phenomena Related to Boyle's Law

Pressing the lid of a thermos causes water to come out.	Air bubbles in water expand as they rise to the surface.	PET bottles become more rigid at higher altitudes.	Balloons expand and burst as they rise into the sky.	Blocking the syringe tip and pressing the plunger reduces the volume of air inside

Experiment

Materials Needed

Interface, Science# program, Gas pressure sensor (A), Syringe (20 mL)

Preparing the Experiment Setup

1. Set the syringe to the 20 mL mark.
2. Attach the syringe to the gas pressure sensor (A).

Gas pressure sensor (A)

Interface Setup

1. ![icon] Run the Science# program.
2. Connect the gas pressure sensor (A) to the interface.
3. ![icon] Press to zero the sensor.
4. Press ![icon] to set up the experiment environment as shown below or press ![icon] for automatic setup.

Automatic Setup

Data Collection

1. Press to start data collection.

2. Position the syringe at the 20 mL mark and press .

3. Enter '20' as the volume of the syringe in the input field.

4. Using the same method, reduce the volume of the syringe by 1 mL increments, measure the pressure, and input the volume values until 6 mL.

5. Press to end the experiment.

Data Analysis

Recording Data

1. Draw a graph showing the pressure inside the syringe as the volume changes.

2. Explain the relationship between volume and pressure based on the graph.

3. Predict how the pressure of the gas inside a balloon would change if its volume is doubled or halved (assuming constant temperature).

   1) When the volume is doubled

   2) When the volume is halved

Data Application and Extension Activity

1. The following is a setup where a cylinder is sealed to prevent air leakage, and a single weight is placed on it. Draw the molecules inside the cylinder when two weights are placed on it and explain the expected change in gas pressure (assuming constant temperature inside the cylinder).
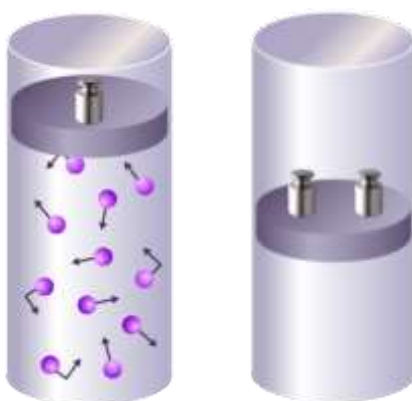
2. The following table shows the volume change of a gas at constant temperature as the pressure changes. Fill in the appropriate values in the blank spaces.

Pressure (atm)	1.0		2.5	4.0	
Volume (ml)		25.0			10.0
Pressure x Volume (atm*ml)			50.0		

Report
(For Students)

Report
(For Teachers)