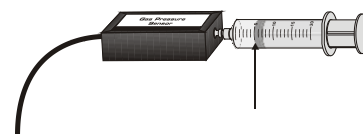


In this activity, you will use a Gas Pressure Sensor to measure the pressure of an air sample inside a syringe. Using graphs, you will apply your results to real-world examples.

What is the mathematical relation between volume and pressure for a confined gas? To answer this question, you will perform an experiment with air in a syringe connected to a Gas Pressure Sensor. You will be measuring the pressure in the syringe, as you change the volume of air in the syringe. Pressure and volume will be calculated during this experiment and then analyzed. Using the data and the graph, the type of mathematical relationship between pressure and volume of the confined gas can be determined. Historically, this relationship was first established by Robert Boyle in 1662 and has since been known as Boyle's law.

### **Directions:**

1. With the syringe disconnected from the Gas Pressure Sensor, move the piston of the syringe until the front edge of the inside black ring (indicated by the arrow in the picture to the right) is positioned at the 15 mL mark.
2. Turn on your TI-Nspire handheld, and close any documents that are open.
3. Attach the syringe to the probe as shown to the right. (Do not twist too tightly—the syringe just needs to be secure.)
4. Plug the EasyLink into the USB port in the top of the handheld. The DataQuest APP should open automatically.
5. Select **MENU > Experiment > Collection Mode > Events with Entry**.
6. Type in **Volume** for Name, press , and type **mL** for Units. Check the box next to **Average over 10s**. Press .
7. Time to collect pressure and volume data. It is best for one person to take care of the syringe and for another to operate the handheld. Click the play  button to start data collection.
8. To collect your first data reading, click on the keep  button to save the data. After 10 seconds, enter a value of 15, since you set the syringe at 15 mL earlier. Click on OK, or press .
9. Depress and **HOLD** the plunger to the 14 mL mark. Click on the keep  button, after 10 seconds type in 14, and press .
10. Continue this procedure, collecting data at 13, 12, 11, and 10 mL. Don't forget to move the plunger and **HOLD** it in place **BEFORE** hitting the . After you have collected data for 10 mL, click on the stop  button. Unplug the EasyLink™, remove the syringe, and bring equipment back to the front of the room.



Q1. When a quantity of gas is compressed, the pressure of the gas is expected to \_\_\_\_\_.

- A. decrease    B. remain the same    C. increase    D. double

Q2. Based on the graph of pressure vs. volume, the expected mathematical relationship between pressure and volume is \_\_\_\_\_.

- A. direct    B. inverse    C. indirect    D. impossible to determine

11. While on the DataQuest app page, select **MENU > Send To > List & Spreadsheet**

Q3. Rename column A: **x** and column B: **y**. Do NOT press .

What do x and y represent in this experiment? (go back to page 1.1 (DataQuest app page if needed)

x axis = \_\_\_\_\_    y axis = \_\_\_\_\_

12. Label column C: **k**, and press . In the = row, press .

If the data represents a direct variation, type  $y/x$  and press .

If the data represents an inverse variation, type  $x*y$ , press .

When prompted, choose Variable Reference.

13. Add a Calculator page. Type **mean(k)** and press .

Q4. Use your calculated mean(k) to write a model relating x and y.

14. Go back to page 1.1 (DataQuest app page), select **MENU > Send To > Data & Statistics**.

15. Press **MENU > Analyze > Plot Function**, and enter your equation from Q4.

Q5. How well does your equation fit your data? If it does not fit well, recollect your data.

Q6. Use your equation to determine the pressure if the volume is 20 mL.

Q7. Use your equation to determine the pressure if the volume is 5 mL.

Q8. What would be expected to happen to the pressure if the volume in the syringe were decreased from 40 mL to 10 mL? (Circle all that apply.)

- A. increase    B. decrease    C. quadruple    D. double    E. cut to 1/4    F. cut to 1/2