



### Science Objectives

- Use a Gas Pressure Sensor and a gas syringe to measure the pressure of an air sample at several different volumes.
- Determine the relationship between gas pressure and volume.
- Use the results to predict the pressure at other volumes.

### Math Objectives

- Mathematically describe the relationship between gas pressure and volume.
- Evaluate an inverse mathematical relationship.
- Generate and analyze a power regression model.
- Linearize an inverse relation.

### Materials Needed

- Vernier® EasyLink™
- Vernier Gas Pressure Sensor
- 20 ml syringe

### Vocabulary

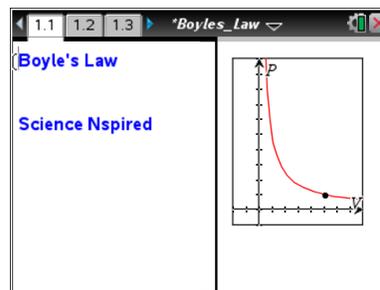
- pressure
- volume
- inverse

### About the Lesson

- This activity makes use of the Gas Pressure Sensor in an inquiry activity that enables the student to understand Boyle's Law through experimentation and data collection.
- As a result, students will:
  - Built a mathematical model to show the inverse relationship between gas pressure and gas volume.
  - Analyze that mathematical model, and make predictions from the model through interpolation and extrapolation.
  - Apply Boyle's Law to the real-life situation of human respiration.

### TI-Nspire™ Navigator™ System

- Screen Capture to monitor student progress.
- Live Presenter allows students to show their graphs to the class.



### TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Entering and graphing data
- Tracing and interpolating

### Tech Tip:

Access free tutorials at

<http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials>

### Lesson Files:

*Student Activity*

- Boyles\_Law\_Student.pdf
- Boyles\_Law\_Student.doc

*TI-Nspire document*

- Boyles\_Law.tns



### Activity Overview

- Please print the student worksheet and make available to students before beginning the lab. Lab background information as well as lab procedures are included only in the student worksheet. Always remember to review any safety precautions thoroughly with your students prior to starting the lab.
- Students may answer the questions posed in the .tns file and submit for grading with TI-Nspire Navigator (optional) or students may answer directly on the student worksheet
- Ensure that students collect data on the 5 known substances and look at the graph before they actually measure the absorbance of the unknown solution. This will allow them to make predictions and to look at the graph of the data first.

### Discussion Points and Possible Answers

#### TI-Nspire Navigator Opportunity

Use the TI-Nspire Navigator System to monitor student progress using screen capture.

#### Pre-lab Information and Questions.

Have students read the background information on pages 1.2 – 1.5. Then, they should answer the pre-lab question on page 1.6.

Q1. As volume increases, pressure \_\_\_\_\_.

**Answer:** decreases

#### Lab Procedure.

The lab procedure is in the student worksheet and is not duplicated here. Please refer to the student handout.

#### Boyles Law Lab.tns

Have students move to pages 2.3 – 2.5 and answer the questions in the .tns file or on the worksheet.

Q2. Which variable is considered to remain constant during a Boyle's Law experiment?

**Answer:** temperature

Q3. When a quantity of gas is compressed, the pressure of the gas is expected to \_\_\_\_\_.

**Answer:** increase



Q4. The expected mathematical relationship between pressure and volume is \_\_\_\_\_.

**Answer:** inverse

Q5. If the volume is doubled from 5 to 10 mL, what does the data show happens to the pressure?

**Answer:** cut in half

Q6. If the volume is halved from 20 to 10 mL, what does the data show happens to the pressure?

**Answer:** cut by one-third

Q7. Based on the data, what would be expected to happen to the pressure if the volume in the syringe were increased from 10 to 40 mL?

**Answer:** doubles

Q8. From the answers to the above three questions and from the shape of the curve of the plot, of pressure vs. volume, what is the relationship between the pressure and volume of a confined gas?

**Answer:** inverse

Q9. What two experimental factors are assumed to be constant during this experiment?  
(select two)

**Answer:** moles of gas and temperature

Q10. Using P, V, and k, write an equation representing Boyle's Law.

**Answer:**  $P = k/V$

Q11. Which of the following produced a constant value?

**Answer:** pressure times volume



Q12. Summarize what you have learned about the relationship between pressure and volume.

**Answer:** Answers will vary. Students should indicate the inverse relationship between pressure and volume

Q13. When the temperature is doubled, how does the pressure change?

**Answer:** The pressure doubles.

Q14. At a higher temperature, the relationship between pressure and volume is a(an) \_\_\_\_\_ relationship.

**Answer:** inverse (same as before)

<p><b>TI-Nspire Navigator Opportunity: <i>Screen Capture</i></b> <b>See Note 1 at the end of this lesson.</b></p>
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## **Wrap Up**

Use Boyle's Law to offer a practical application such as human breathing.

## **Assessment**

Formative assessment will consist of questions embedded in the pre-lab TI-Nspire document. Summative assessment questions are found in the lab and post-lab TI-Nspire document. The questions will be graded when the TI-Nspire documents are retrieved. The Slide Show can be utilized to give students immediate feedback on their assessment.

## **TI-Nspire Navigator Notes**

### **Note 1 Screen Capture**

Screen Capture can be used to monitor students.