

Title: The effect of temperature on the volume of a gas in a closed container

Problem to be studied: How is the volume of a gas affected by temperature?

Content Standard(s): 3.4.10 A: Explain concepts about the structure and properties of matter.
3.4.10 C: Distinguish among the principles of force and motion.

Content Objective (s): SWBAT explain the motion of gas molecules in relation to temperature.

Process Standard(s): 3.1.10 A: Discriminate among the concepts of system, subsystems, feedback and control in solving technological problems.

3.1.10 C: Apply patterns as repeated processes or recurring elements in science and technology.

3.1.10 E: Describe patterns of change in nature, physical and man made systems.

3.2.10 B: Apply process knowledge and organize scientific and technological phenomena in varied ways.

3.2.10 C: Apply the elements of scientific inquiry to solve problems.

3.7.10 A: Identify and safely use a variety of tools, basic machines, materials and techniques to solve problems and answer questions.

3.7.10 B: Apply appropriate instruments and apparatus to examine a variety of objects and processes.

Process Objective(s): SWBAT measure the height of the water in the beaker; organize their data in tabular form; and construct a graph showing the relationships between their independent and dependent variable.

Assessment Strategies: (Evaluation)

Formative Evaluation: Observing the students as they record their observations in table form. Observing the students as they show the relationship between the independent and dependent variable. Observing the students as the work in a safe manner.

Summative Evaluation: The students will write a reflective paragraph about what they did, what they observed and what the observations meant.

Suggested Grade Level:

8th

Materials:

Plastic tray (at least 3 cm deep)
Water
Metric ruler
Petri dish
4 candles (approx. 10 cm tall)
Hot glue gun or modeling clay
1000 mL beaker
Aquarium gravel or small stones
Wooden matches
Lab aprons and safety goggles
100 mL beaker

Background: Students will have previously used the 4 question strategy. Appropriate safety precautions will be noted on the students paper, modeled by the teacher and on the board.

Procedures:

Engage: Prior to the start of class, the teacher will hot glue (or use modeling clay) one of the candles to the petri dish. At the beginning of the class, the teacher will demonstrate what will happen with 1 candle. Approx. 2.5 cm of water will be placed in the tray. The Petri dish and candle set up will be placed into the center of the tray. If the Petri dish and candle setup does not sit on the bottom of the tray, add aquarium gravel or small pebbles to the petri dish. Spread 1 drop of dishwashing detergent on the bottom of the beaker. (This will save lots of time during clean up.) The teacher will then ask the students to make a written inference about what they think will happen when the upside down beaker is placed on the petri dish and unlit candle and then why they think it will happen. Allowing them a minute or two to write their inference in their notebook, we will share their thoughts. Then the upside down beaker will be placed on the set up. We will observe the level of water in the beaker will be much lower than the level of the water in the tray. The students will have to explain why the two levels of water were not the same. (The air in the beaker takes up space and because the molecules are moving they exert a pressure on the water equal to the atmospheric pressure on the water in the tray.) The beaker will be carefully removed from the set up. Then the students will be asked to write what they think will happen if the teacher puts the upside down beaker on top of the lit candle. After discussing their predictions the beaker will be placed over the lit candle. ****safety notes** A few drops of water should be placed on the top of the upside down beaker. This will save you a few cracked beakers. Also, drop the lit match into the half filled 100mL beaker.** After the candle burns out the students will note that the water level inside the beaker is different than when the beaker was placed over the unlit candle. Now the problem can be posed: How can more water get into the upside down beaker?

Explore: Now the 4 question strategy will be utilized by the group.

- 1) What materials are readily available for conducting experiments on the amount of water in the beakers? (See material list)
- 2) How did the setup act? (Water went into the beaker.)
- 3) How can I change the set of materials to affect the action? (The number of candles, the amount of water in the tray)
- 4) How can I measure or describe the response of the water in the beaker to the change? (Measure the height.)

Now the students will take a response from #3 (the independent variable) and the response of #4 (the dependent variable) and write a hypothesis. The other materials will be constants for the investigation. They then will come up with a written procedure to test their hypothesis. As they are working on their procedures, the teacher will ask each group for the number of trials and how they will be changing the independent variable. Guidance will be given to increase the #of candles by 1 for each trial and to increase the amount of water by 1 cm. Another question to be asked is how will the data be recorded? The students will then test their hypothesis.

Explain: At the conclusion of the lab, the students will show the relationship between their independent and dependent variable by means of a graph. They then will write a reflective paragraph about what they did, what they observed and what their results mean.

Elaborate: A guided discussion will ensue to explain why the change occurred which will lead to the statement of Charles' Law.

Lesson Plan

Related Web Sites: <http://dbhs.wvusd.k12.ca.us/webdocs/GasLaw/Gas-Charles.html>
 <http://mtsinai.org/pulmonary/books.scuba/sectioned.htm>
 <http://iit.edu/~martcar/lesson4.html>
 <http://www.physics.emich.edu/jporter/phy100/100vlhwk15.htm>

Sources consulted in developing this lesson:

Heath Physical Science Laboratory Manual, copyright 1985 by D.C. Heath, publishers

Students and Research, Julia Cothron et.al., copyright 2000 by Kendall/Hunt Publishing Company