Balloons in a Sunny Window or Out in the Cold

Background Information

A balloon can serve as a handy, flexible-sized container for a sample of air or other gas. Balloons will change in size in response to changes in temperature, according to the simplified gas law PV=kT, where P is the pressure of the gas, V is its volume, k is a constant multiplier to make the units turn out correct, and T is the temperature of the sample of gas. P, V, and T are the variables in this equation and in our experiment. In our experimental design, we are keeping the pressure constant, because the balloons are all expanding against air pressure, which can be assumed to be the same whether over the teacher's desk, in the refrigerator in the teacher's lounge, or outside on the playground in the sun.

You can see from the algebra that there is a direct relationship between volume and temperature. When the temperature increases, the volume increases, as long as the pressure remains the same. When the temperature decreases, the volume decreases proportionately. The elasticity of the balloon allows the sample of gas inside to change its volume without appreciable changes in pressure.

Prior to this activity, students should understand the need to keep all variables, except those being studied, constant during an experiment.

Materials Needed

2 dark-colored balloons for each lab groupAccess to a warm place (over a radiator or out in the sunshine)Access to a cold place (refrigerator or out in the snow)Measuring equipment: string, rulers, measuring tapes, thermometers

Procedure

Students in their lab groups will need to decide on a procedure for ensuring that the two balloons are initially inflated identically. You may ask students to record the initial dimensions of their balloons.

One balloon of each pair should be left in a room temperature setting. The other should be put in a colder (in a refrigerator or snow bank) or hotter (in a sunny place or over a radiator) setting.

You may want students to measure and record the temperatures of each setting.

After the balloons have time to be affected by the temperature, students should again determine whether or not they are identical in size.

As a class, share results and discuss possible reasons for any differences found.

This is an experiment that is easily repeated at home. Involving family and friends can be very energizing for middle school students. Encourage your students to duplicate or extend in-class work at home as often as possible. You may want to send home a sealed bag containing two identical balloons, a short sheet of directions, and a paper for collecting data.

Additional Learning Opportunities

Encourage students to repeat the experiment at home. Ask for reports to the class the following day. Emphasize differences in techniques and similarities in results.

Try the same experiment using a freezer instead of a refrigerator.

Determine the mathematics needed in a contest to see who can create the greatest size change without breakingthe balloon.Discover whether helium-filled balloons act in similar manner.Experiment with different colors, shapes, and composition of balloons.