

Gas Laws & Alka-Seltzer Rockets

Area: Chemistry

Age Group: 4th and 5th grade

I. Materials:

- Film canisters with snap-on lids. Clear lids are preferred.
- Soda
- Seltzer water
- Alka-Seltzer tablets
- Safety glasses or other protective eyewear
- Paper towels
- Watch or timer

II. Objective:

To introduce students to the scientific method and experimentation. To observe and investigate the law of gases using an Alka-seltzer rocket. Students will conduct their own experiments with the Alka-Seltzer rockets to gain a better understanding of the chemistry behind the cool explosion, draw conclusions about the law of gases, and learn how to develop hypotheses, make observations, record data, and come to conclusions.

III. Background Information:

From the sodas we drink at lunch to the very air that we breathe, gases are everywhere and are part of our everyday lives. Gases exert pressure on objects.

According to the Ideal Gas Law, the pressure exerted by a gas is directly proportional to the number of gas molecules and the temperature of the environment and is inversely proportional to the volume of the container the gas is contained in. Thus, the smaller the container the greater the pressure. This is why we do not feel the pressure of the gases that surround us; the Earth is a HUGE “container.”

The Ideal Gas Law: $P = \frac{nRT}{V}$; where P is pressure (atm); n = number of moles; R = gas constant; T = temperature (K); V = volume (L).

In this experiment, we will create a buildup of carbon dioxide gases in a film canister. For the soda test flight, the carbon dioxide is produced as a result of the vigorous shaking. Carbon dioxide is present in soda and is what gives soda its bubbly quality and makes you burp. For the Alka-Seltzer rocket the carbon dioxide will be produced as a result of a chemical reaction between the water and the tablet.

IV. Procedure:

Preparation and Soda Test Flight

1. Divide the students into groups of two or three. Make sure that there is a mentor for each group of students.
2. Every student must PUT ON SAFETY GLASSES or protective eyewear!
3. Each group should get one film canister, one can of soda, and a watch/timer.
4. Fill a film canister about three-quarters of the way full with soda.
5. Before shaking the canister, ask the students what they think will happen after you shake the canister and why.
6. After getting a variety of responses, quickly place the lid on the canister and shake vigorously.
7. CAUTION: The lid may fly off at a relatively high speed. Make sure that the top of the film canister is pointed AWAY from you. Avoid aiming the canister at another student.
8. The lid should have popped off!
9. Ask the students again why they think the canister lid popped off after you shook the canister. Refer to the summary of theory for explanations.
10. Optional: You may repeat this activity with varying volumes of soda to find the volume that will produce the greatest flight of the canister lid. Write down the volume of soda that produced the biggest pop. This should introduce students to the method of trial and error and should also show that the first time may not always be the best time in science.

Student Activity:

1. Make sure that everyone has his or her safety glasses on and that the glasses remain on throughout the experiment.
2. Divide the Alka-Seltzer tablets into four equal pieces. Cutting with a knife is easiest; however, caution should be taken when using a knife.
3. Distribute 4 pieces of the Alka-Seltzer tablet (1 whole Alka-Seltzer tablet) to each group.
4. Fill the film canister about halfway full with water.
5. Ask students to predict what they think will happen after placing the Alka-Seltzer tablet into the film canister, without the canister being covered.
6. Ask one of the students to time the reaction. Press "Start" immediately after the Alka-Seltzer piece has been dropped into the water. Press "Stop" when the reaction is complete (no longer bubbling/fizzing).
7. Place one of the pieces of the Alka-Seltzer tablet in the film canister. DO NOT put the lid on.
8. Ask students to make observations.
9. Record the reaction time.
10. Were the student's predictions correct? Ask them to hypothesize about why the reaction occurred and why it stopped.
11. Empty the liquid in the film canister into a sink or a trashcan.
12. Repeat the experiment, this time putting the lid on. Ask students what they think will happen this time. Remember to time the reaction and record observations. CAUTION: the top will fly off, so make sure that the canister is aimed away from people.
13. If the lid does not fly off, try using seltzer water.

Additional Activities

1. The experiment may be repeated again with the remaining Alka-Seltzer tablets if time remains. This time use different volumes of water. Ask the students what effect they think this will have on the reaction and on the resulting lid popping. Questions to ask include -- Will the lid pop off with a greater or lesser speed? Will the reaction take longer or shorter?
2. To observe the relationship between the temperature and the extent to which the reaction between the Alka-Seltzer tablet and the water occurs and the lid pops off, gently heat the water in a microwave before filling the film canister.
3. Remember to make predictions and observations. After each experiment see if the observations matched the predictions. Try to come up with explanations to any unforeseen or unusual observations. Allow the students to draw their own conclusions to their observations.