Bottle Rocket Chemistry

The purpose of this lab is to allow students to explore chemical reactions, then use their knowledge to create bottle rockets.

Materials Needed:

The amounts of the following depend on how many trials the teacher wants to allow and how many students are working in a group:

For Chemistry in a Bag

- Baking soda
- Calcium chloride (Driveway Heat or other available products)
- Thermometers (2 per group)
- Water
- Sandwich bags (1 per student if working with a partner)
- Measuring spoons or graduated cylinders (2 per group)
- Safety goggles

For Bottle Rockets

- Baking soda
- Calcium chloride (Driveway Heat or other available products)
- Water
- Straws (1 per group)
- Tape
- Bamboo skewers (1 per group—available at Wal-Mart with low cost)
- 16 ounce soda or water bottles (1 per group)
- A stopwatch (one for the class or one per group as available)
- #3 Rubber stopper (1 per group)
- Kleenex or toilet tissue (small amount per group)
- Safety goggles
- Plastic garbage bags, string, masking tape, construction paper (in case students want to make a parachute and/or fins)

If calcium chloride is not available try using baking soda and vinegar instead for the rockets.

Procedure for Chemistry in a Bag:

1. Have students complete the Chemistry in a Bag activity, recording their measurements and observations. *See instruction sheet.*

2. After having completed the above, ask the students to design an experiment to test one of the questions that came up in their group as they were doing the Chemistry in a Bag. Some possible questions might be: A) *If we add more calcium chloride, will the temperature get even hotter?* B) *What would happen if we used more baking soda?* C) *How many times can we get the bag to fill up with air?* D) *What will happen to the bag if we do not "burp" it?*

Procedure for Bottle Rockets:

1. Have each group tape a plastic drinking straw (4-5 cm in length) to the outside of a 12-20 ounce plastic bottle.
2. Have each group of students dissolve 1 teaspoon (5 mL) of baking soda in 50 mL of water and pour it in the bottle.
3. Next have each group put 1 teaspoon (use a different spoon) of calcium chloride in a Kleenex or toilet tissue and roll it up in the tissue, folding up one end.
4. Take students outside in a grassy area and stick the bamboo stick in the ground. This will serve as a guide for the rocket. (*A large plastic garbage bag may be spread out on the ground and the bamboo stick stuck through it to avoid damaging the grass.)*
5. One student from each group (while wearing safety goggles) will insert the calcium chloride tissue into the bottle-folded end first. Immediately put the rubber stopper in the bottle. The stopper should be fairly snug in the bottle.
6. Shake for a few seconds to release the calcium chloride, then quickly lower the bottle rocket onto the bamboo stick via the attached straw. This will keep the bottle rocket from falling over and hitting a student. Move quickly away from the bottle rocket.
7. Once students have seen how the bottle rockets will work, they are ready to be given their Rocket Challenge. The teacher decides how much of each material the students are to be given. Emphasize that they will not receive additional materials.

Teacher Notes on Bottle Rockets

It is helpful to have the students do the above so that they have a visual understanding of what they are going to be doing. The teacher may choose to offer varying sizes of bottles from 8 ounces to 20 ounces from which the students may select. Larger size bottles do not work as well.

The investigation with the rockets should be as open-ended as possible with the students deciding what the variables are and which ones they will change. Eighth graders should be able to design their own log table as well.. To accommodate all levels of learners, for those students who ***need*** *extra assistance, the teacher may explain the variables that can influence the outcome of their rocket experiment. Those variables include: the amount and temperature of the water (cool water allows extra time to get the stopper on before the gas pressure builds up inside the bottle); type of bottle used; amount of baking soda; amount of calcium chloride used. A sample table is also included for use with those students who need the extra help of having a table designed for them.*

Chemistry in a Plastic Bag

1. Place 5 milliliters (1 teaspoon) of calcium chloride into one of the sandwich bags.
2. Find its temperature and record in the table below.
3. Clean off the thermometer and find the temperature of the water. Record in the table below.
4. Using a different spoon, place 1 teaspoon of baking soda into the second sandwich bag. Using the second thermometer, find the temperature of the baking soda. Record in the table below.
5. Carefully add 2 teaspoons (10 mL) of water to the bag of baking soda. Find its temperature using the same thermometer that you used in the baking soda. Record in the table below.
6. Carefully add 2 teaspoons of water to the bag of calcium chloride. Find its temperature using the same thermometer that you used in the calcium chloride. Record in the table below.
7. Carefully pour the contents of one sandwich bag into the other. Quickly squeeze the air out of the bag with the combined substances and seal it. Gently shake and observe, feeling the solutions through the bag. If the bag gets tight due to pressure, open the seal to release the pressure, then reseal it.

Water Temperature (In Celsius)	**Dry Baking Soda Temperature (In Celsius)**	**Baking Soda in Water Temp. (In Celsius)**	**Dry Calcium Chloride Temp. (In Celsius)**	**Calcium Chloride in Water Temp. (In Celsius)**

Did a chemical reaction take place? How do you know?

When did an endothermic reaction occur?

When did an exothermic reaction occur?

Choose one question that came up during this activity to investigate. Design an experiment to help answer your question. Be sure to record and analyze your data in the space provided or in your scientist notebook.

Question: _____

Hypothesis: _____

Experimental Procedure:

Data and Data Analysis:

Conclusion:

Rocket Challenge

You are part of a team whose company is trying to win a contract with NASA to build a new rocket that is powered by an alternative energy source. NASA will award the contract to the company whose prototype stays in the air the longest with the alternative fuel source. Your team must design a prototype of a rocket to demonstrate to NASA. Remember that you want your rocket to stay in the air as long as possible. Your company has given your team a limited budget. Keep this in mind as you experiment. Your budget will not allow you to get extra fuel or rocket materials. Using the materials and "fuel" provided by your teacher, design your rocket. Keep a log of your trials. Remember to save enough fuel for your flight demonstration to NASA. You may use the space below to record your data.

Log for Rocket Trials

Remember to change only one variable at a time.

Trial	Type of Bottle Used	Amount of Water Used	Amount of Baking Soda Used	Amount of Calcium chloride Used	Temperature of Water	Time the Rocket Remained in the Air
1						
2						
3						
4						
5						

Rubric for Rocket Challenge

Score	Log	Rocket Launch	Team Work	Safety
6	At least 3 trials. Log filled out completely. Only 1 variable was changed per trial.	2.5 sec or more	Every team member contributed. Team worked well together. Disagreements solved in an amiable manner.	Lab safety rules were all followed.
5	2 trials. Log filled out completely. Only 1 variable changed per trial.	2.0-2.49 sec	Every team member contributed. Some minor unresolved issues while working together.	Major lab safety rules were followed. A few of the minor ones were not.
4	At least 3 trials. Log has a few missing parts.. Only 1 variable changed per trial.	1.5-1.99 sec	Most team members contributed. Those contributing worked well together. Disagreements solved in an amiable manner.	Not all major lab safety rules were followed.
3	At least 2 trials. Log incomplete. Only 1 variable tested at a time	1.0-1.49 sec	Most team members contributed. Some minor unresolved issues while working together.	Only about half of the lab safety rules were followed.
2	3 or less trials. Log incomplete. More than 1 variable tested at a time.	0.05-0.99 sec	Only a few team members contributed. Some unresolved issues.	Only a few lab safety rules were followed.
1	2 or less trials. Log incomplete. More than 1 variable tested at a time.	0.00-0.49 sec	One person did all or most of the work. Some unresolved issues.	Only 1 or 2 lab safety rules were followed.