

Civil Air Patrol's ACE Program

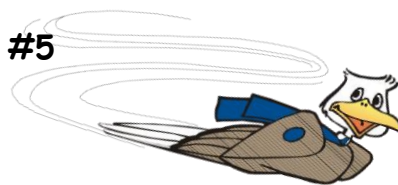
Fizzy Rocket

Grade 5 Academic Lesson #5

Topics: rockets, Newton's laws of motion, matter (science, math)

Length of Lesson: 45-60 minutes

Lesson Reference: ["Build a Bubble-Powered Rocket"](#)

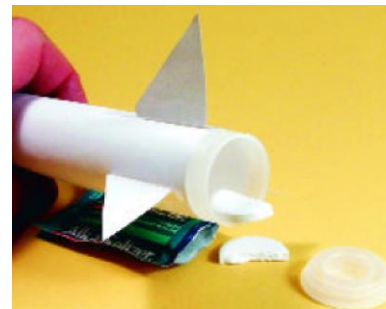


Objectives:

- Students will construct and launch a rocket.
- Students will explain and apply Newton's laws of motion.
- Students will identify a solid, liquid, and gas.
- Students will demonstrate a chemical reaction.

Next Generation Science Standards:

- Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. (3-5-ETS1-3)
- Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (5-PS1-4)



CCSS ELA:

- SL 5.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

CCSS Math:

- 5.MD.2 - Represent and interpret data.
- 5.NBT.6 - Perform operations with multi-digit whole numbers and with decimals to hundredths.

Background Information:

The lesson, which demonstrates rocketry and Newton's laws of motion, will take longer than thirty minutes if each step is followed. If time is an issue, you do NOT need to have students make the film canister look like a rocket. You may skip step 4 in this lesson plan. If this is your plan, have the film canisters already filled about 1/3 full of water. Distribute the prepared film canisters to students along with an effervescent tablet to use with either the "Fizzy Rocket Data Sheet" or "Fizzy Rocket Experiment Form."

Materials:

- plastic 35 mm film canisters (Keep and use them each year.)
The film canister must have an internal-sealing lid, like many Fuji and translucent canisters. The canister **MUST** have a cap that snaps **INSIDE** the rim instead of over the outside of the rim. Photo shops and labs will be happy to save and donate some for educational purposes; however, these types of canisters are becoming difficult to find.
They are available for purchase at the following online sites:
TeacherSource.com
ScienceBobStore
SteveSpanglerScience
- effervescent antacid tablet, such as Alka Seltzer
- paper (copy paper or construction paper)
- Fizzy Rocket Data Sheet **OR** Fizzy Rocket Experiment Form
- tape
- scissors
- paper towels
- water
- bucket or pitcher
- eye protection
- index cards (for fins)

NOTE: We suggest allowing students to work in pairs or groups of three for this activity. Determine what is appropriate for the students in your classroom. Also, determine which Fizzy Rocket data sheet you will use for this activity. (See step 8 below for more info.)

Consider watching the video available at [Steve SpanglerScience](http://SteveSpanglerScience). Unlike examples in the video, this lesson plan asks the participants to flip the canister upside down after sealing the lid.

Other videos include: [Sci-Tech Labs: Alka Seltzer Rocket](#) or this demo - [Kevin Delaney and Jimmy Fallon Launch 1,000 Alka-Seltzer Rockets](#).

Lesson Presentation:

1. Show a film canister and ask students to record ideas on how to make it fly.
2. Discuss student ideas. Remind students that according to Newton's third law of motion, there must be some action to result in a reaction. Also, tell them that Newton's first law of motion says that an object at rest will stay at rest unless there is some force that disrupts its rest. The opposite is also true. An object in motion will remain in motion unless there is some other force or forces that cause it to stop its motion. For example, a kickball on the ground stays there resting until a force causes it to move. Ask students what would cause the kickball to move. (the force of the moving leg that strikes it) Ask students what force(s) will cause the kickball to, if it flies up, come back down and stop moving. (gravity and friction, if they have studied friction) Tell students that they should remember these concepts as they prepare a film canister to rocket upwards away from Earth.
3. Distribute a canister for each student (or group of students).

4. Distribute materials (paper, scissors, index cards, Fizzy Rocket Template, tape) to make the canister look like rocket. If time is an issue, you may omit this step.

- Remove the lid from the film canister and put it in a safe spot so it will not get lost.
- Cut out the body tube template for the rocket.
- Wrap and **tape** the body tube of paper around the film canister without covering the open end!

Open end →



Open end →



- Using the template, cut and tape fins to your rocket.
- Construct a nosecone for the top of the "rocket" and tape the cone to the top (closed end) of the canister. To create a nosecone, cut out the partial circle in the template. Overlap and twist the open ends of the circle to create a cone. Tape and cut as needed.
- Have students clean their work area.



5. It is EXTREMELY important to demonstrate how to correctly put the lid on the film canister. Tell students they should hear a "snap" sound. If they do not hear a "snap" sound when putting the lid on the canister, the lid is not on, and the canister will NOT launch correctly. With students seated, have each student or pair of students practice snapping the lid on and off of the canister. Tell them that they should hear a "snap" sound that lets them know the lid is on tight. It is very important to have the lid on correctly for the rocket to launch.
6. While students are practicing correctly opening and closing the canister, make sure you have a bucket or pitcher of water. Lay out a garbage bag or some type of drop cloth for a launch pad.
7. Demonstrate how the students will launch their rocket. Put on eye protection. Fill the film canister about 1/3 full of water (or about 10 ml). (You may choose to have students use a graduated cylinder to measure water, or you may have a plastic cup marked with the correct amount of water to pour into the canister. If students are measuring amounts of water used during the experiment, it is easy for them to see and test water as a variable for launching the fizzy rockets - if time allows for additional experimentation.) Place the half-sized seltzer tablet into the canister and quickly snap the lid shut. Quickly place the canister with "snap" side down on the launch pad. (The top has to be put on quickly to be able to produce the desired pressure inside the canister. The canister has to be placed quickly in its position for launch, as well.)

Count how many seconds it takes for the rocket to launch and how many seconds the rocket stays in the air before hitting the ground. Record the times on the board.

8. Distribute either the "Fizzy Rocket Launch Data Sheet" or the "Fizzy Rocket Experiment Form," depending on which you prefer for your students. Use the "Fizzy Rocket Experiment Form" if students are using a combination of $\frac{1}{4}$, $\frac{1}{2}$, and whole tablets. Go over the directions for the sheet that you have selected for your class.
9. Tell students that they will go outside to launch their rockets. Prior to launch, if students are in groups of three, they should rotate among the following tasks for each launch: (1) set up the canister to launch, (2) count how many seconds it takes to launch after the rocket is placed in launch position, (3) count how many seconds the rocket stays in the air before it hits the ground. The students should record the times on their data sheet.
10. Prior to the first launch, ask a volunteer to explain the steps they will follow to launch the rockets. (Put on eye goggles. Fill the canister about $\frac{1}{3}$ full of water (or 10 ml). Put the tablet in. Make sure the lid snaps on. Place the canister in launch position. Count to see how many seconds it takes to launch and how many seconds it stays in the air. Record the results of both counts.)
11. Distribute the effervescent tablets. Take the water and students outside and allow the students to conduct their launches.
12. Once the students have launched the rockets and completed their information, have students clean up the area and assemble together in the classroom. If the "Fizzy Rocket Launch Data Sheet" was used, allow students time to figure out the average launch and flight times.
13. Discuss how Newton's three laws of motion were at work in this activity.
 - Law #1 (Inertia): The rocket lifts off due to a force acting upon it. That force is the pressure that has built up inside the canister and escaped.
 - Law #2 ($F=ma$): The amount of force created is directly proportional to the mass and acceleration of the water and gas expelled from the canister.
 - Law #3 (Action/Reaction): The top is forced off the canister due to the pressure produced by the fizzy gas. That fizzy gas is actually carbon dioxide. Ask students if they know what caused that gas to occur. The carbon dioxide is a result of the chemical reaction that took place when the fizzy tablet was added to the water. A result of the chemical reaction is the accumulating pressure due to the buildup of gas inside the canister. The pressure of the carbon dioxide bubbles builds up so much that it finds the weakest structural point in the canister through which to escape. The weakest structural

point is the area where the lid snaps onto the canister. The action of the high pressure escaping out of the canister causes the reaction of the canister being propelled into the air.

14. Allow students to discuss the results of their data sheet and what they feel they have learned from the experiment.

Summarization:

Ask students what might account for some differences in the number of seconds to launch and land. (Some students may have counted faster or slower. Some students may have had a little bit more or less water in their canister. Some students may have had a little bit more or less of the effervescent tablet. Part of the tablet may have been protruding out from the water when the canister was placed in launch position.)

Ask students to identify the liquid in their experiment. (water) Ask students to identify the solids in the experiment. (canister, tablet) Ask students to explain what created the gas in their experiment. (a chemical reaction: the tablet reacting in the water produced gas bubbles) Ask the students to explain what made the rocket canister "explode" and allow the rocket to launch. (Newton's Laws of Motion)

When the fizzy tablet is placed in water, many little bubbles of gas escape. The bubbles go up, instead of down, because they weigh less than water. When the bubbles get to the surface of the water, they break open. All that gas that has escaped from the bubbles pushes on the sides of the canister.

Now when you blow up a balloon, the air makes the balloon stretch bigger and bigger. But the little film canister doesn't stretch and all this gas has to go somewhere!

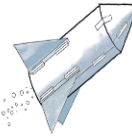
Eventually, something has to give! So the canister pops its top (which is really its bottom, since it's upside down). All the water and gas rush down and out, pushing the canister up and up, along with the rocket attached to it.

*Real rockets work kind of the same way. But instead of using tablets that fizz in water, they use rocket fuel. The **action** is the gas rushing out of the rocket. The **reaction** is the rocket taking off in the other direction. In other words, for every action there is an equal and opposite reaction. The rocket goes in the opposite direction from the gas, and the faster the gas leaves the rocket, the faster the rocket gets pushed the other way.*

Character Connection: Tell students that the fizzy rocket should remind us of something we do not want to do in life: "pop-off." Sometimes, we feel ourselves getting very upset. It feels like the pressure building up inside that small canister and builds until we want to explode. We are not rockets. We must find other ways to deal with bad pressure. Have students name ways they can prevent "popping their lid." When we find alternative ways to handle frustration and anger, we gain control in our lives. We become our own directional fins able to travel steadily through life.

Assessment:

- teacher observation
- constructed rocket
- data sheet
- student answers to class discussion questions
- "Fizzy Rocket Reflections" worksheet (optional)



Additional activity ideas to enrich and extend the primary lesson (optional):

- Have students complete the "Fizzy Rocket Reflection" worksheet. **Answers:** 1) water 2) tablet 3) pressure, gas, or chemical reaction 4&5) answers will vary
Bonus: chemical reaction
- Find the mean, median, and mode of a list of launch times and flight times.
- Experiment with the launch performance of canisters with and without fins and with and without nosecones. Real rockets have nosecones to reduce drag, and they have fins to create stability.
- Write an expository paragraph explaining how to make a film canister fly.
- Help students gain a better understanding and an appreciation for rockets that deliver payload (e.g., satellite, rover, humans) by having them participate in this **"Rocket to Mars" design challenge**.

Room set up: Place three 50 cm circles (Mars - destination) in three separate places with masking tape on the floor. Place a line of tape (Earth - launch site) 3 meters from each circle. Have extra balloons on hand as students re-launch their rockets!

Materials per team of 3 students: 1 toilet paper tube, 1 drinking straw, 1 wooden skewer (with ends cut off or blunted), 1 balloon, 1 ping pong ball

- Additional materials available to all: construction paper, aluminum foil, and a variety of tape (duct tape, scotch tape, masking tape, etc.)

Instructions:

1. Explain/demonstrate the difficulty of hitting a moving target. Lead into challenges of launching a spacecraft or satellite from a moving Earth to land on another moving target, such as the International Space Station (ISS) or Mars.
2. Explain the design challenge to the students: Each team must use the items to create a rocket that can deliver the ping pong ball (the payload) to Mars (represented by the circles on the floor) from Earth (tape lines). To make things easier, the targets are not moving. The teams have 50 minutes to design and test their vehicles. If they are unsuccessful, they may make modifications and try again (waiting their turn at one of the 3 stations). The "propulsion system" for their rocket is the balloon. Each team will slide its straw over the skewer to create a "launch pad" that can be adjusted to the team's desired angle of launch by the person holding the skewer. The straw should

be secured to the team's rocket design. To succeed, the rocket must land in the circle, not slide into it. Teams who succeed may make additional modifications to try to reach a target that is farther away.

Closing: This is a real challenge, and few teams will succeed. Emphasize that the students were trying to land a rocket and its payload on a non-moving target. Mars, Earth, and the International Space Station are all in motion, which means designing is even more challenging! Students probably came to the realization that weight was a factor in their launch vehicle. Rockets that were the simplest (no extra decorations and lightest weight tape) traveled the farthest.

Fizzy Rocket Template

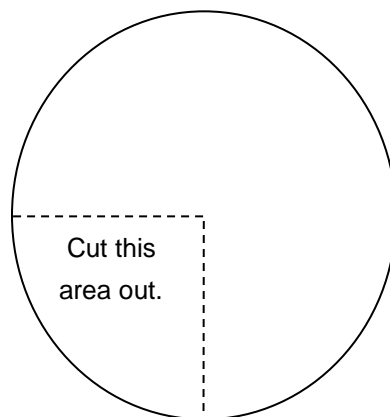
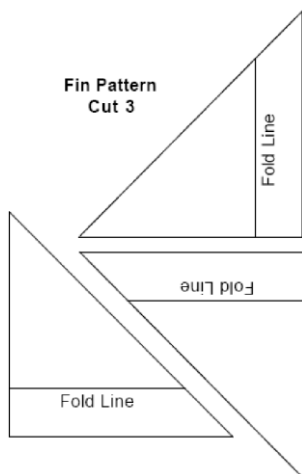


Cut this area out.
Cut out to make
nosecone.
for body tube

Cut out the square. Use
tape to attach one edge



Fin Pattern
Cut 3

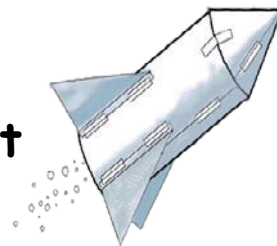


Cut out to make
nosecone.





Fizzy Rocket Launch Data Sheet



Name(s): _____

What size tablet are you using for your 3 launches? _____

Fizzy Rocket Launches	Launch 1	Launch 2	Launch 3	Average Add all three launch times and divide by 3; Add all three flight times and divide by 3.
Launch Time (in seconds) from the time the canister is placed in launch position to launch				
Flight Time (in seconds) time in the air from launch to landing				

Enrichment: If your teacher has extra supplies and time, try additional launch experiments and complete the following chart, or obtain your own film canister and try this at home. Remember to wear eye protection!

Fizzy Rocket Launches	Draw and indicate size of tablet. ($\frac{1}{4}$, $\frac{1}{2}$, etc.)	How much water?	Launch Time (in seconds) from the time the canister is placed in launch position to launch	Flight Time (in seconds) time in the air from launch to landing
Launch 1				
Launch 2				
Launch 3				

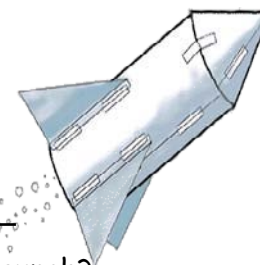
What can you conclude from your experiments? (Use the back of this paper if you need more room to answer.)

NAMES: _____

Tablet Size	Launch Time (in seconds)	Flight Time (in seconds)
$\frac{1}{4}$ tablet (quarter)	_____seconds	_____seconds
$\frac{1}{2}$ tablet (half)	_____seconds	_____seconds
1 tablet (whole)	_____seconds	_____seconds



Fizzy Rocket Experiment Form



- Which tablet size launched the fastest?

- Which tablet size took the most time to launch?

- Which tablet size stayed in the air the longest?

- Why do you think the tablet that launched in the

shortest amount of time (fewest seconds to launch) did so?

5) Were you surprised by any of the results? If so, name something that surprised you and try to explain why you think this "surprise" result occurred.

6) What do you feel you have learned from this activity? (Use the back of this paper to answer if you need more room.)

ENRICHMENT: Conduct your own experiments!

Tablet Size	Amount of Water	Launch Time (in seconds)	Flight Time (in seconds)
		_____ seconds	_____ seconds
		_____ seconds	_____ seconds
		_____ seconds	_____ seconds

What do you feel you learned from
your experiments?



FIZZY ROCKET REFLECTION

NAME _____



1. Name the liquid that was used in your fizzy rocket experiment. _____

2. What was the solid fuel that was used during your fizzy rocket experiment?

3. What was produced when the tablet was added to the water? _____

4. Explain one of Newton's laws of motion.

5. Explain why the canister launched into the air. (Your answer must include more than just, "Newton's 3rd Law of Motion.") Use the back of this paper if you need more room.

BONUS: What type of change caused the gas to form inside the canister?
