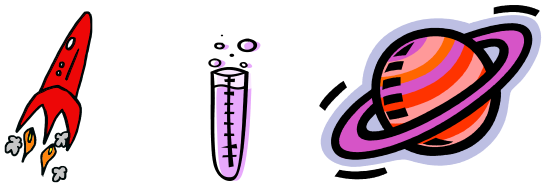
raft®
RESOURCE AREA FOR TEACHING

FIZZY ROCKETS

Have a blast with this gas-powered flyer!



Curriculum topics:

- Air pressure
- Chemical reactions
- Forces
- Momentum
- Motion
- Newton's laws

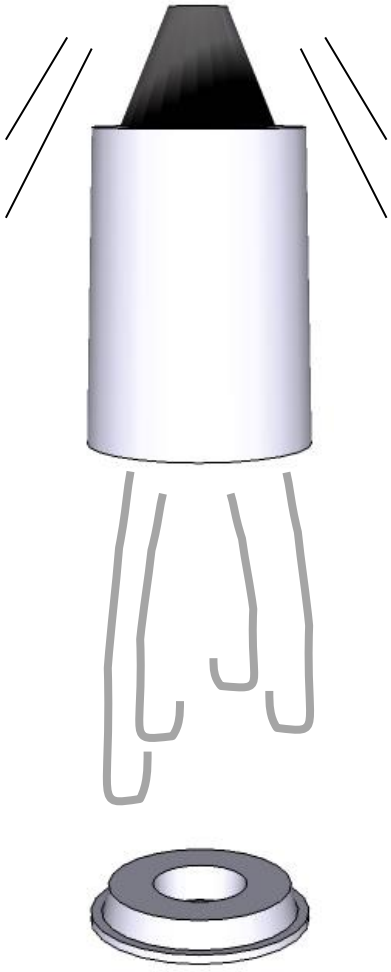
Subjects:

Earth/Space Science,

Physical Science

Grade range: 4 – 12

These rockets enable students to use design thinking and are effective demonstrations of Newton's laws of motion. The liftoff power of the rocket is produced by a common acid/base chemical reaction that creates carbon dioxide gas; making this activity an ideal tool for teaching students about chemical reactions and how pressure can do work on objects.



Who we are:

Resource Area for Teaching (RAFT) helps educators transform the learning experience through affordable "hands-on" activities that engage students and inspire the joy and discovery of learning.

For more ideas and to see RAFT Locations

https://raft.net

Materials required

Safety note: Never create a rocket out of glass or other material which can shatter.

Per rocket:

- Film can, plastic, w/ tight fitting, dimpled lid
- Effervescent tablet, cut into fourths
- Foam cylinder, adhesive
- Water
- Eye protection
- Optional: paper or cardstock, conical cups or funnels
- Optional: watch or timer
- Optional: catch basin or tray

Teaching tip: The strength of effervescent tablets may vary – especially internationally. If not familiar with a type of tablet, use a sample to test the strength of the reaction before using.

Design Challenge Introduction

Have students come up with a design for the rocket and then let students explore and build the rockets. The students can test how best to fly the rockets - experimenting to find the best ratio of air, water, and effervescent tablets to use". The students can explore how the mass of the rocket, placement of the rocket parts on the film can, and the rocket dimensions affect its flight. Students can make the rockets look realistic using cardstock or paper for the rocket body and cone-like objects for nosepieces.

How to build it

Figure 1

1 Secure the adhesive foam onto the flat bottom of the film can. See figure 1.

2 Use scissors to trim the foam into a cone-like shape to look like a rocket's nose cone. See figure 2.

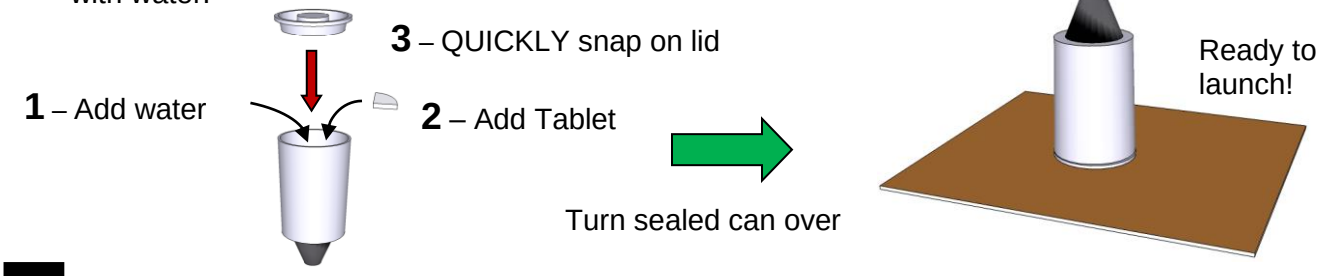
Figure 2

To do and notice

Launch Guidelines:

- Conduct the experiment outdoors or in a large space.
- Wear eye protection while waiting for rocket to lift off.
- Everyone should stand away from loaded rockets. Make sure that rockets are aimed away people, animals, and objects.
- It may take 15 seconds or more to build up enough pressure to launch the rocket. If the film can does not launch, wait at least 60 seconds before approaching. Suggestion: toss a towel over the un-launched can.

1 Hold film can in one hand with the nose cone pointing down. Fill the film can 1/8 to 1/4 full with water.



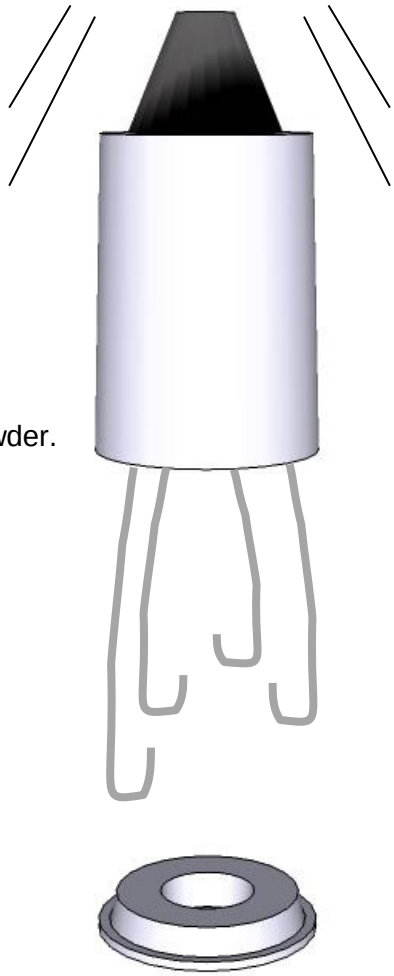
2 Working quickly, drop a piece of effervescent tablet into the can, snap the lid on the film can, turn the can over – place on a flat surface and step back. Optional – use a catch basin under the "rocket".

3 Start the timer, look at a watch, note the time, or count the seconds.

4 Determine how long it takes for "blast off" to occur.
Estimate how high the rocket flies and note where it lands.

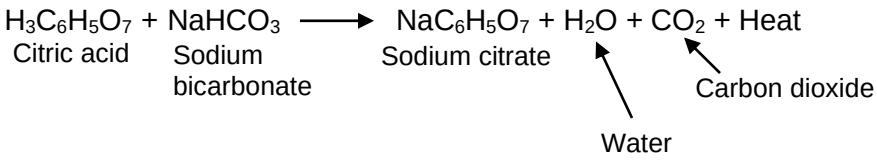
5 Rinse and dry off the lid and rocket. Crush a piece of the tablet into a powder. Repeat steps 1 to 4 above using the crushed tablet piece and the same amount of water. Does it take more, less, or the same amount of time for blast off to occur?

6 Launch the rocket again using remaining water and tablet pieces, varying the amounts of both. Observe any differences in the blast off times and/or landing sites.



The science behind the activity

Effervescent tablets contain sodium bicarbonate and citric acid. When the tablet is exposed to water it begins to dissolve and the sodium bicarbonate and citric acid then react with each other and produce sodium citrate, water, and carbon dioxide gas. It is the carbon dioxide gas that builds pressure inside the film can and eventually pops the seal between the can and lid. The reaction shown below is **exothermic** (meaning that heat is released as the products are formed). This heat increases the pressure exerted on the film can by the gas.



When the gas pressure reaches the lid sealing pressure the lid blows off and the rocket is acted upon by an unbalanced force. This is Newton's 1st law of motion. The force propelling the rocket upward is equal and opposite the downward force acting on the lid, water, and gas (Newton's 3rd law). The magnitude, or strength, of the upward force on the rocket depends on the mass and velocity of the gas being expelled from the rocket. This is Newton's second law (F=ma). Therefore, different amounts of water and/or effervescent material should yield observable differences in take-off time and altitude. Another factor that affects take-off time is the surface area of the effervescent material exposed to the water. Crushing the tablet into a powder increases its exposed surface area that can immediately dissolve in the water. The chemical reaction will occur faster reducing that the time required for the carbon dioxide gas to build pressure. This does not mean the rocket will reach a higher altitude! The limiting factor on altitude is the mechanical sealing pressure required to snap the lid onto the film can, which sets an upper limit on the CO_2 pressure that can build in the can. Have students conducted a **controlled experiment** (see **Learn more**) to further investigate the impact of varying the amounts of the reactants.

Curriculum Standards:

Forces & Motion (Next Generation Science Standards: Middle School, Physical Science, 2-2; High School, Physical Science, 2-1)

Energy (Next Generation Science Standards: Grade 4, Physical Science, 3-1 & 3-4)

Gravity (Next Generation Science Standards: Grade 5, Physical Science, 2-1)

Structure of matter (Next Generation Science Standards: Grade 5, Physical Science, 1-1)

Mixtures (Next Generation Science Standards: Grade 5, Physical Science, 1-4)

Science and Engineering Practices (Next Generation Science Standards Grades 4 – 12)

Additional standards at: http://www.raft.net/raft-idea?isid=680

Learn more

- Create and conduct a **controlled experiment** to investigate the effect of varying the amount of water and other reactants. In a controlled experiment only one variable is changed a time. For example, time the flights and measure the paths of two rocket launches – both with the same amount of water – one with a ¼ tablet and the other with two ¼ tablets.
- Replace the water with vinegar and note any changes in flight/take-off
- Put the rocket on an incline and note the shape of its flight path.
- Compare in-flight behavior before and after adding fins to the rocket
- Build a paper cylinder body for the rocket and observe lift-off and/or in-flight behavior

Visit **https://raft.net/resources-2/** to view the following related activities!

Air – A Pressing Matter
Air Pressure –Feel It!
Flat Bag! Cold Bag! Puffy Bag!
Cabbage Patch Indicator
Puff Rockets
Foam Tipped Stomp Rocket

Resources

See these websites for more information on the following topics:

- **Acid-base reactions** – http://www.chem4kids.com/files/react_acidbase.html
- **Hands-on rocket activities from NASA** – exploration.grc.nasa.gov/education/rocket/TRCRocket/RocketActivitiesHome2.html
- **Videos on Balanced and unbalanced forces from the Khan Academy:** https://www.khanacademy.org/science/physics/forces-newtons-laws/balanced-unbalanced-forces/v/balanced-and-unbalanced-forces