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## Film Canister Rockets

CAN-300, 310, 330

Building a simple rocket with a film canister, a seltzer tablet and water is a memorable, hands-on lesson that teaches students about Newton's Second and Third Laws of Motion. Adding a sheet of goldenrod paper will make the lesson even more unforgettable.

### How does it work?

When you combine a seltzer tablet and water, a chemical reaction occurs that produces carbon dioxide. As the CO<sub>2</sub> builds up, the pressure inside the canister increases and eventually provides enough force to break the seal of the canister's cap. This is what provides the force—or push—that launches the rocket.

### Newton's Laws

The force provided by the rapidly expanding CO<sub>2</sub> causes the rocket to accelerate upwards, as described by **Newton's Second Law of Motion**.

**Newton's Third Law of Motion** states that for every action there is an equal and opposite reaction. What is the equal and opposite reaction to the movement of the rocket?

The rocket pushes against the Earth with force  $F$ , and the Earth exerts a force of the same magnitude on the rocket—but in the opposite direction.

Since the mass of the Earth is enormous compared to that of the rocket; its acceleration away from the rocket is infinitesimally small. As a result, the rocket accelerates up, up, and away!

$$F = ma$$

$F$  = the net force on an object  
 $m$  = the mass of the object  
 $a$  = acceleration, the rate of change of the object's velocity over time ( $dv/dt$ )

### Watch a "how-to" video:

Our YouTube channel includes a video explaining how to build your own film canister rocket:



[www.youtube.com/watch?t=294&v=iL3CiGNY12k](http://www.youtube.com/watch?t=294&v=iL3CiGNY12k)

# NGSS Correlations

Our Film Canister Rockets and these lesson ideas will support your students' understanding of these Next Generation Science Standards (NGSS):

## Elementary

### K-PS2-2

The Rocket Film Canister can be loaded with baking soda and vinegar or Alka-Seltzer tablets and water to investigate movement. Students can analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

### 2-PS1-2

The canisters can be loaded with baking soda and vinegar or Alka-Seltzer tablets and water to investigate movement. Students can analyze data obtained from testing different materials to determine which ones have properties best suited for an intended purpose.

### 3-PS2-2

The canister can be loaded with baking soda and vinegar or Alka-Seltzer tablets and water to investigate motion. Students can make measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

## Suggested Science Idea(s)

### K-PS2-2

When the film canisters are loaded with various reactive chemicals that produce a gas, students can run trials to determine which variable gives the best lift off or push of the canister.

### 2-PS1-2

When the film canisters are loaded with various reactive chemicals that produce a gas, students can run trials to determine with variable gives the best lift off or movement of the canister.

### 3-PS2-2

The Rocket Film Canister can be loaded with baking soda and vinegar or Alka-Seltzer tablets and water to investigate motion. Students can plan an investigation with variables; make observation and/or measurements of the canister's motion to find pattern that can be used to predict future motion.

### HS-PS1-4

The Rocket Film Canister can be loaded with baking soda and vinegar or Alka-Seltzer tablets and water to create a simple rocket or to explore chemical reactions.

### MS-PS2-2

The Rocket Film Canister can be loaded with baking soda and vinegar or Alka-Seltzer tablets and water to investigate movement. Students can plan an investigation with variables that test and provide evidence that the change in an object's motion is related to the sum of the forces on the object and the mass of the object.

### MS-LS1-6

The Rocket Film Canister can be filled with water and a piece of aquatic plant, and placed in the direct sunlight. Students can observe the build-up of gas and growth of the plant.

## Middle School

### MS-PS2-2

The canister can be loaded with baking soda and vinegar or Alka-Seltzer tablets and water to investigate movement. Students can plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

### MS-LS1-6

The canister can be filled with water and a piece of aquatic plant and placed in the direct sunlight. Students can construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

## High School

### HS-PS1-4

The canister can be loaded with baking soda and vinegar or Alka-Seltzer tablets and water as a model to illustrate that the release or absorption of energy from a chemical reaction system depends on the changes in total bond energy.



# Making Your Own Film Canister Rocket

For each student (or pair of students), you will need:

- ✓ 1 empty, uncapped film canister
- ✓ 1 film canister cap
- ✓ scissors
- ✓ pipette
- ✓ broken seltzer tablets
- ✓ 1 sheet of 8.5" x 11" paper (any color)
- ✓ 1 sheet of goldenrod paper
- ✓ 1 copy of the Film Canister Rocket Template

For each student, distribute a sheet of 8.5" x 11" paper, scissors, and a film canister (uncapped). Have tape, pipettes, water, broken seltzer tablets and goldenrod paper available.

1. Instruct your students to uncap their film canisters. Using the uncapped canister as a guide, they should roll the paper around the canister to create the cylindrical rocket body.

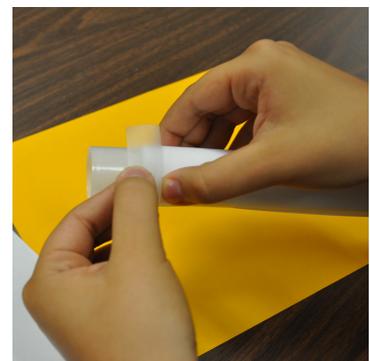
**NOTE:** *It doesn't matter if students roll their tube in the long or short direction—this is one of the many variables they can explore.*

2. Next, students must tape the paper cylinder closed along the edges. Again, let students decide how much (or how little) tape they choose to use.

3. After the rocket's body is created, the film canister must be removed from the cylinder. The easiest way is to blow into one end of the rolled cylinder, forcing the canister out the other end.

4. The film canister should be taped to the cylinder with the open end extending far enough from the end of the cylinder so that no tape overlaps the canister's opening.

**NOTE:** *If any tape extends over the opening, the lid will not form a complete seal. Without a complete seal, sufficient pressure may not build up and the rocket may not launch.*



# Making Your Own Film Canister Rocket

*continued*

- Using the *Film Canister Rocket Template* on page 5, student should cut out the nose cone and fin shapes. The nose cone is made by cutting away the pie-shaped area and curling the paper so the edges of the missing pie piece begin to overlap forming a cone shape.
- Tape the nose cone to the end of the rocket opposite the film canister. Students can add tail fins to their rocket as long as they do not block access to the film canister. Here, too, let your students decide how many fins to use or what size to make the nose cone.
- If you have goldenrod paper available, distribute a piece to each student. They should lay their goldenrod paper flat on the desk in front of them.
- Now distribute  $\frac{1}{4}$  pieces of seltzer tablets, pipettes and water.
- Instruct students to turn the rocket upside down, holding it carefully in the area of the film canister in order to avoid crushing the hollow cylinder.
- They should fill a pipette with water and add a squirt or two into the film canister. The amount of water is not critical—point out that it is yet another variable.
- Explain this step clearly to students before allowing them to proceed. Remind them to put on safety glasses, if they have not already done so. Students should insert the tablet piece into the canister and tightly secure it with a lid.



## WHAT'S HAPPENING?

*Once the seltzer tablet is added to the water in the film canister, it will begin to fizz and give off carbon dioxide gas.*

*The total release of gas will continue for more than a minute which allows plenty of time for the student to secure the cap onto the film canister.*



# Making Your Own Film Canister Rocket

*continued*

- 12.** Caution them to cap their film canister calmly, without rushing. Remember to grip the rocket around the film canister and NOT the paper cylinder. Now place the rocket right side up onto the goldenrod paper (if available)... and wait!

## WHAT'S HAPPENING?

*Inside the closed film canister, pressure continues to build until the lid can no longer contain it. At this point, the lid separates from the canister.*

*Since the lid is unable to move with the table behind it, the rocket is propelled upward with a loud popping noise.*

*Since Goldenrod paper is an indicator for bases, students will notice the launch pattern that is left behind on their launch pad!*



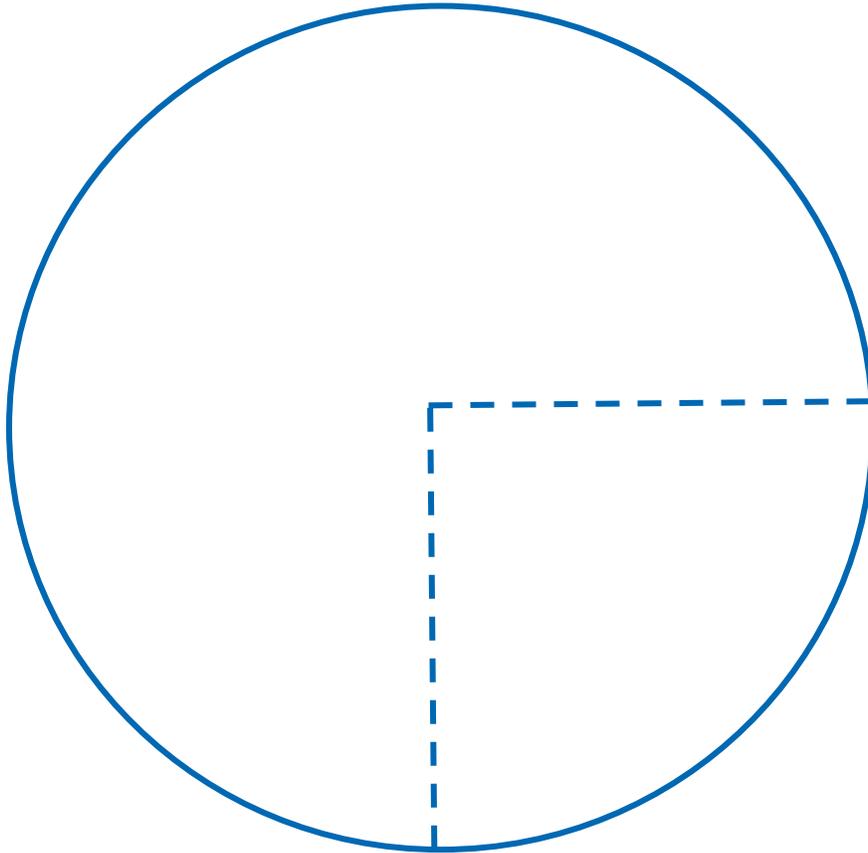
After the activity is over students will note with interest which rockets flew the highest. This is when the true lesson begins! Here is the opportunity to identify the many variables and the effects of each variable on the rockets' flight characteristics. Examples will include the width of the nose cone, the length of the cylinder, whether any excess paper from the cylinder was trimmed and discarded, and the amount of tape that was added to the rocket during construction.



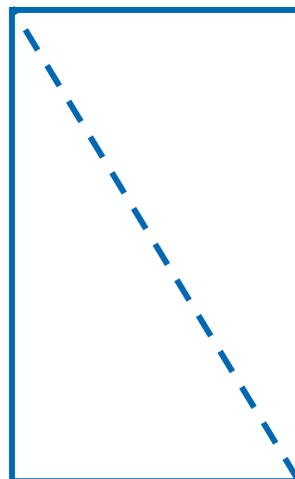
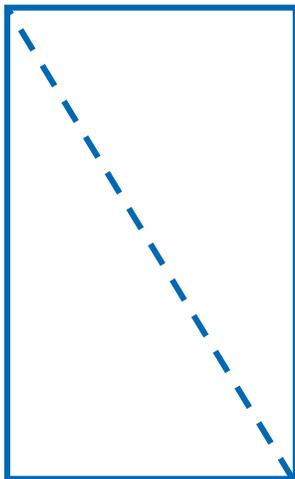
## Film Canister Rocket Template

CAN-300, 310, 330

**NOSE CONE**



**FINS**



# More Uses for Film Canisters

Aside from making film canister rockets, there are many other things you can do with our film canisters. For instance:

- ✓ **Storing Devices:** Film canisters make great storing devices. Use these canisters for liquid or solid samples. For a hands-on homework assignment, distribute the canisters and have your students collect water samples from a local river or pond. These canisters will seal tightly enough to prevent spilling, but will open easily again for classroom use. Equip your students with a microscope, and they'll be amazed to observe all the microscopic life in their water samples.
- ✓ **Sensory Exploration:** Explore sensory perception by using film canisters to store interesting smells. Soak a cotton ball in a strongly smelling liquid, like vanilla extract or vinegar, and place it in a canister. The tightly-sealed lids will prevent the odors from leaking out until the canister is opened. Very young students will be interested in identifying the unknown smells.

With older students, you can discuss diffusion in air. Open a canister at the front of a classroom and ask students to raise their hands when they can smell the liquid of your choice. Have your students make observations on who raises their hands first and last. This will demonstrate how quickly different smells spread from their origin (the film canister) out into the air.

- ✓ **Make a Hovercraft:** Consult our “[Look Mom, No Wheels!](#)” blog for step-by-step instructions your students can follow to make their own hovercraft using a balloon, film canister and a few other simple materials. Go to <http://blog.teachersource.com/2013/02/25/look-mom-no-wheels/>

A video explaining the steps can be viewed on our YouTube channel here:

[www.youtube.com/watch?v=eQpRAb80k2E](http://www.youtube.com/watch?v=eQpRAb80k2E)

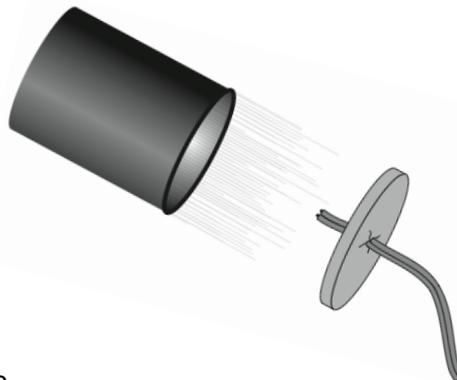


NOTE: If you'd prefer to purchase everything you need to make 12 hovercrafts, please consider our [Hovercraft Class Kit](#) (AIR-520).

# More Uses for Film Canisters

*continued*

- ✓ **Advanced Science:** For more fun with film canisters, try Educational Innovations' **Piezo Popper Kit** (HS-2A). Using a few drops of an alcohol (perfume will work) for fuel, these amazing poppers will launch over 20 feet! The amazing piezoelectric device generates a spark of a few thousand volts at the touch of a button. It can be used as a safety lesson to demonstrate the flammability of alcohol or perfume. Safety glasses and adult supervision required.



- ✓ **Film Can Capacitor (Leyden Jar):** ... On Educational Innovations' blog (<http://blog.teachersource.com/2013/03/01/film-canister-capacitors/>) you will find step-by-step instructions for building a homemade Leyden Jar. The only materials needed are a film canister, a small strip of aluminum foil, a paper clip, a small section of PVC pipe, a cloth or piece of fur to rub on the pipe and a small amount of water.

To review a brief video that describes the process, go to:

<http://blog.teachersource.com/2009/02/26/film-canister-leyden-jars-with-video/>



# Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons. For us, “*Teachers Serving Teachers*” isn’t just a slogan—it’s our promise to you!

Please visit our website  
for more lesson ideas:

[www.TeacherSource.com](http://www.TeacherSource.com)

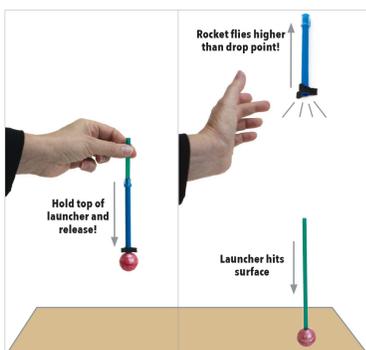
Check our blog for classroom-tested  
teaching plans on dozens of topics:

<http://blog.TeacherSource.com>

To extend your lesson, consider these Educational Innovations products:

## Goldenrod Paper (SM-925)

True goldenrod paper is made from a dye which is an acid-base indicator. This paper turns bright red in bases such as ammonia, baking soda or washing soda and returns to bright yellow in acids such as vinegar or lemon juice. Make your own indicator paper or use to preserve fingerprints. Instructions included. Color-changing goldenrod paper has become very difficult to find. Ours is guaranteed to be color-changing.



## Reaction Rocket (RKT-625)

Five, four, three, two, one, LIFT OFF!! This cleverly designed rocket with nose cone and fins will travel 20 to 30 feet into the air. Simply pour in water, drop in a seltzer tablet, replace the end cap, and the rocket is prepared for launch. To activate, simply invert the rocket, place it on a flat surface and move away. The rocket is 10 cm (4 in.) long. Adult supervision and eye protection required. Not for indoor use. Four seltzer tablets included with single rocket. Teacher Pack includes ten seltzer tablets.

## Rocket Balloons (RKT-165/170/175/180)

A great way to demonstrate basic principles of Newton’s Laws to students. In order for a rocket to be stable, the center of gravity must be forward of the center of pressure. Balloons are inherently unstable, which is why they swirl around in every direction when you allow the air to escape. Rocket balloons are properly weighted to create stability. For safety and hygiene, the package of 85 Rocket Balloons includes a pump so there is no need for the balloons to contact the mouth.

