Materials Resources

Pitsco Straw Rocket Launcher
You can purchase the Pitsco Straw Launcher at:
Pitsco, Inc.
P.O Box 1708
Pittsburg, KS 66762-1708
www.pitsco.com

Precision Straws
You can purchase the precision straws at:
Pitsco, Inc. (See the contact information above)
Note: Any straw with a ¼ inch diameter would work with this investigation.

Pitsco Straw Rocket Video DVD
You can purchase the straw rocket video at:
Pitsco, Inc. (See the contact information above.)

Vinyl Balloons
Alibaba.com
Shopzilla.com
4imprint.com

Foil Balloons
Birthday.direct.com

Plastic Balloons
Target
Birthdayexpress.com

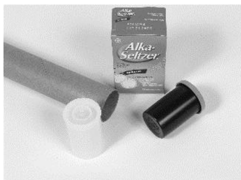
Lesson Materials

Film Canister Rockets

As a preview to the straw rocket unit, I have the students build a simple rocket using a film canister.

Materials:

Film canister, antacid tablets, water, tape, scissors, construction paper, colored markers, and safety goggles



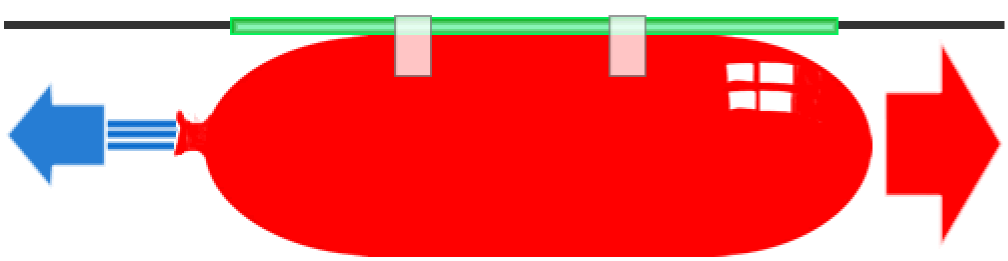
Directions:

1. Obtain an empty film canister with a lid that snaps on.
2. Make a paper nose cone and attach it to the bottom of the film canister. If the students prefer, they may decorate the nose cone using colored markers.
3. Fill the canister about ¼ full of water. Once all of the rockets are built, bring the class outside for the launching.
4. Put on your safety goggles. Add a fizzing antacid tablet to the film canister and quickly snap it shut. 
5. Place the canister on the ground with the lid down and stand back. If everything goes according to plan, the "rocket" will lift off and shoot between 2 and 5 meters into the air.

Conclusion:

Gas pressure builds up inside the canister as a result of the reaction of the antacid and water. The pressure will continue to build until the lid of the canister is blown off and the "rocket" is launched.

Balloon Rockets



From www.sciencebob.com

Materials:

1. One balloon- The round ones will generally work quite well, but the longer “airship” balloons may perform better.
2. One long piece of kite string about 10–15 ft. long
3. One plastic straw
4. A clear plastic bag that can hold a blown up balloon
5. Tape
6. Safety goggles
7. Balloon Pump (optional)

Directions:
1. Tie one end of the string to a chair or another support.
2. Put the other end of the string through the straw.
3. Pull the string so that it is tight and straight and tie it to another support in the room.
4. Tape the plastic bag to the straw so that the straw is resting on top of the bag.
5. Before you begin blowing up the balloon, move the straw and plastic bag all the way down to one end. Untie that end of the string and have a student hold it up so that it is at the same level as the support that is holding the string on the other end. For protection, have the students put on their safety goggles.
6. Place the balloon inside of the plastic bag as you are blowing up the balloon. Note: A balloon pump can make this step much easier to perform.
6. After the balloon fills up the space in the plastic bag, do not tie it. Instead, pinch the end of the balloon.
7. You are now ready for the launch. Let go of the balloon and watch the balloon inside of the plastic bag fly across the room.

Straw Rockets

Name:____Class:___________________

Question: How can I design a straw rocket to travel the farthest distance?

Hypothesis: ____

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Materials:
1. Precision straw with a ¼-inch diameter
2. Transparent tape
3. Heavy paper or index cards
4. Modeling clay
5. Scissors
6. Rulers
7. Pencil
8. Straw Rocket Launcher

9. Clipboards
10. Wind up metric tape measure
11. Triple beam balance or a double pan balance
12. Safely goggles

Directions:
1. On a piece of paper, plan and draw your straw rocket. Be sure you include how many fins you will be attaching to the rocket.
2. The straw is going to be the body of the rocket. It can be a minimum length of 10 cm and a maximum length of 20 cm.
3. You may use the index cards to make between 2 and 5 fins. Attach the fins to the precision straw using transparent tape.
4. Take the modeling clay and mold a ball that is 2 cm or less in diameter. The clay ball will be used to construct a nose cone.
5. The clay nose should go ½ cm into the top of the straw. The straw should be centered and the opening of the straw should be completely covered.
6. Find the mass of the new rocket. Use a triple beam balance or double pan balance to calculate how many grams the rocket weighs.

My rocket's mass is: ________________________________

7. Find the total length of the rocket.

The length of the rocket is: _____________________________

8. Find the diameter of the base. Be sure you include the fins in your calculations. I am using ________________fins.

The diameter of the base is: ____________________________

Rocket	**Launch Angle in Degrees**	**Launch Rod Calibration Mark**	**Distance Traveled in Meters and cm**

Analyze the Data:

My rocket traveled the farthest when the launch angle was at ________________________degrees.

My rocket traveled the least when the launch angle was at __________________________degrees.

Conclusion:

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Now that you have tested your first rocket, you will have a chance to make another rocket to see if you could make it travel further and higher.

Describe the changes you will make to your next rocket to help it travel further and higher.

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Rocket Specifications

Name of the Rocket	Length of the Straw in cm	Mass of the Rocket in Grams	Number and Shape of Fins	Diameter of the Nose Cone in cm

Straw Rocket Launch
Manipulated Variable #1
Length of the Straw Rocket

Group Name	**10 cm Straw and Distance It Traveled (m and cm)**	**15cm Straw and Distance It Traveled (m and cm)**	**20cm Straw and Distance It Traveled (m and cm)**	**Conclusion: Which Straw Length Enabled the Rocket to Fly the Maximum Distance?**

Straw Rocket Launch
Manipulated Variable #2
Number of Fins

Group Name	**2 Fins on the Rocket and Distance Traveled**	**3 Fins on the Rocket and Distance Traveled**	**4 Fins on the Rocket and Distance Traveled**	**5 Fins on the Rocket and Distance Traveled**	**Conclusion: How Many Fins is the Ideal Number to Let your Rocket Fly the Maximum Distance?**

Straw Rocket Launch
Manipulated Variable #3
Size of the Nose Cone

Group Name	**1cm Diameter Nose Cone and the Distance the Rocket Traveled**	**1 ½ cm Diameter Nose Cone and the Distance the Rocket Traveled**	**2 cm Diameter Nose Cone and the Distance the Rocket Traveled**	**Conclusion: Which Size Nose Cone Enabled the Rocket to Travel the Farthest?**

Designing the Straw Rocket

Manipulated Variable #1

Length of the Straw

Name:______________________ Class:_____________

Question: Which straw length—10 cm, 15 cm, or 20 cm—would enable the straw rocket to fly the maximum distance?

Hypothesis:____

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Materials:

1. Precision straws with a ¼ inch diameter
2. Transparent tape
3. Heavy paper or index cards
4. Modeling clay
5. Scissors
6. Rulers
7. Paper
8. Pencil
9. Straw rocket launcher
10. Triple beam balance or double pan balance
11. Safety goggles

Directions:

1. For this first straw rocket lab, you will be working with one manipulated variable: the size of the straw. You will be making three separate rockets. One rocket should be 10 cm long, the second rocket should be 15cm long, and the final rocket should be 20 cm long.
2. The rest of the variables must be controlled in order to test the rocket's flight in a systematic manner.
   a) All of the fins must have the exact same size and shape and be attached to the rocket in the same spot. Use the same number of fins for each rocket.
   b) The nose cone needs to be the same size on all three rockets.
   c) The launch angle must remain at 45 degrees for each flight.
   d) The launch rod should be lifted to its maximum height.

3. Find the mass of each rocket. Use a triple beam balance or double pan balance to calculate how many grams the rocket weighs.

   The 10 cm long rocket's mass is _______________________

   The 15 cm long rocket's mass is _______________________

The 20 cm long rocket's mass is ______________________

4. Find the diameter of the base. Be sure you include the fins in your calculations. I am using ________________ fins.

5. The diameter of the base is: ___________________

6. The size of the nose cone is:____________________

Manipulated Variable #1
Length of the Straw
Recording Sheet

Group's Name:_______________________ Class:_____________

Name of Rocket	Distance Traveled at 45 Degrees
10 cm Rocket Length	
15 cm Rocket Length	
20 cm Rocket Length	

<u>Manipulated Variable #1</u>
Length of the Straw
Analysis of Data and Conclusion

Name:___________________________ Class:______________

Analysis of the Date:

1. Which straw length enabled the rocket to fly the maximum distance?

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2. Conclusion: Why was the rocket able to fly the best when it was that length?

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Designing the Straw Rocket
Manipulated Variable #2
The Number of the Fins

Group's Name:____________________ Class:______________

Question: How many fins would be ideal for allowing your rocket to fly the maximum distance?

Hypothesis:____

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Materials:
1. Precision Straws with a ¼ inch diameter
2. Transparent tape
3. Heavy paper or index cards
4. Modeling clay
5. Scissors
6. Rulers
7. Paper
8. Pencil
9. Straw Rocket Launcher
10. Triple beam balance or double pan balance
11. Safety goggles

Directions:

1. For your second rocket design, the manipulated variable will be the number of fins you decide to place on your rocket. On one rocket there should be 2 fins, on the second rocket there should be 3 fins. On the third rocket there should be 4 fins, and on the final rocket there can be 5 fins.
2. The rest of the variables must be controlled in order to test the rocket's flight in a systematic manner.
   a) The style and size of the fins must be the same.
   b) The fins must be placed at the same spot on your rocket.
   c) The length of the straw must be the same in all of the rockets.
   d) The size of the nose cone must be the same diameter in all of the rockets.
   e) The launch angle must remain at 45 degrees for each flight.
   f) The launch rod should be lifted to its maximum height.

3. Find the mass of each rocket. Use a triple beam balance or double pan balance to calculate how many grams the rocket weighs.

   The 2 finned rocket's mass is ______________________

The 3 finned rocket's mass is ______________________

The 4 finned rocket's mass is ______________________

The 5 finned rocket's mass is ______________________

4. Find the diameter of the base.

The diameter of the base is: ___________________

Manipulated Variable #2
Number of Fins
Recording Sheet

Group's Name:________________________ Class:______________

Name of Rocket	Distance It Traveled at 45 Degrees
2 Finned Rocket	
3 Finned Rocket	
4 Finned Rocket	
5 Finned Rocket	

Manipulated Variable #2
Number of Fins
Analysis of Data and Conclusion

Name:____________________________ Class:______________

Analysis of the Date:

1. What was the ideal number of fins that enabled the rocket to fly the maximum distance?

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2. Conclusion: Why was the rocket able to fly the best when it contained that number of fins?

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Designing the Straw Rocket
Manipulated Variable #3
Size of the Nose Cone

Name:______________________ Class:____________

Question: Which nose cone diameter- 1cm, 1 1/2cm, or 2cm would enable the straw rocket to fly the maximum distance?

Hypothesis: ____

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Materials:
1. Precision Straws with a ¼ inch diameter
2. Transparent tape
3. Heavy paper or index cards
4. Modeling clay
5. Scissors
6. Rulers
7. Paper
8. Pencil
9. Straw Rocket Launcher
10. Triple beam balance or double pan balance
11. Safety goggles

Directions:
1. For this straw rocket lab, you will be working with one manipulated variable: the size of the nose cone's diameter. You will be making three separate rockets. On one rocket, the nose cone's diameter should be 1cm. On a second straw rocket, the nose cone's diameter should be 1 1/2 cm. On the third rocket, the nose cone's diameter should be 2 cm.
2. The rest of the variables must be controlled in order to test the rocket's flight in a systematic manner.
   a) All of the fins must have the exact same size and shape and be attached to the rocket in the same spot. Use the same number of fins for each rocket.
   b) The length of the straw must be the same in all of the rockets.
   c) The launch angle must remain at 45 degrees for each flight.
   d) The launch rod should be lifted to its maximum height.

3. Find the mass of each rocket. Use a triple beam balance or double pan balance to calculate how many grams the rocket weighs.

The 1cm nose cone rocket's mass is ______________________

The 1 1/2cm nose cone rocket's mass is ___________________

The 2cm nose cone rocket's mass is ______________________

4. Find the diameter of the base.

The diameter of the base is: ___________________

Manipulated Variable #3
Size of the Nose Cone
Recording Sheet

Group's Name:________________________ Class:______________

Name of Rocket	Distance It Traveled at 45 Degrees
1cm Nose Cone	
1 1/2cm Nose Cone	
2cm Nose Cone	

Manipulated Variable #3
Size of the Nose Cone
Analysis of Data and Conclusion

Name:___________________________ Class:_____________

Analysis of the Date:

1. What was the ideal size of the nose cone that enabled the rocket to fly the maximum distance?

2. Conclusion: Why was the rocket able to fly the best when it contained that size nose cone?

Rubric for the Straw Rocket Investigation

Category	Poor	Fair	Good	Excellent
Straw Rocket Construction (ETS1.A)	The rocket's fins are not uniform in size and they are poorly attached. The nose cone does not stay attached to the top of the straw	The rocket's fins are generally uniform in size, but they are not securely attached. The nose cone does not always stay attached to the top of the straw.	The rocket's fins are uniform in size and stay attached to the straw's body. The nose cone is attached to the top of the straw.	The fins are securely attached to the straw's body, and the fin's design provides the straw with stability to help give it a smoother and longer flight. The nose cone is attached to the top of the straw and is tapered to help improve the straw rocket's flight.
Use of Measurement Tools MP.4: Common Core State Standards Connection (3-5 ETS1-3)	The student does not use the triple beam balance accurately to find the mass of the rocket. The student does not accurately measure the size of the rocket using a metric ruler.	The student generally uses the triple beam balance correctly, but the rocket's mass is not accurately recorded. The student uses the metric ruler correctly, but has difficulty noting the precise measurement of the straw rocket.	The student uses the triple beam balance with some guidance to note the accurate mass of their rocket. The student accurately uses the metric ruler to find the length of their straw rocket.	The student uses the triple beam balance independently and with skill in recording the mass of their rocket. The student accurately measures the length of the straw rocket using a metric ruler.
Investigation Performance	The student does not use the straw	The student correctly uses the	The student correctly uses the	The student correctly used

(ETS1.B)	rocket launcher correctly and cannot comprehend why the investigation did not work.	rocket launcher, but is unable to comprehend how the angle of launch affected the distance the rocket flew.	rocket launcher and is able to explain only in simple terms how the angle of launch affected the flight of the rocket.	the rocket launcher and is able to explain in detail what happens when you change the angle that the straw rocket is launched.
Analysis of Data and Writing Conclusions (ETS1-C)	The student is unable to analyze the results of the investigation and write a clear conclusion based on the data collected.	The student is able to analyze some of the data collected during the investigation but needs guidance when writing the conclusion.	The student is able to analyze the data collected and write a conclusion based on the results of the investigation.	The student is able to analyze the data collected and write a clear conclusion based on the based on the results of the investigation. The student is able to plan an additional investigation to test other variables used in the initial investigation.