Solar System Activity Bag

Rockets! *Engineering Challenge:* Student Activity Guide

In this activity, we will work the way NASA engineers do to build a rocket that can deliver a payload to a specific altitude in as few launches as possible. In the process of sending things into space, NASA has developed technologies that are useful on Earth. After launching your payload, you will explore these different technologies.

These directions will get you started. Your teacher will be in contact to guide you and provide information.

Materials From The Bag

- 1 Plastic Tube With Cushion (rocket body and payload)
- 2 Small Plastic Caps (launch cap)
- 1 Plastic Cup (launch cup)
- 1 Graduated Medicine Cup
- 6 Effervescent Tablets
- 1 Space Spinoff Product Sheet

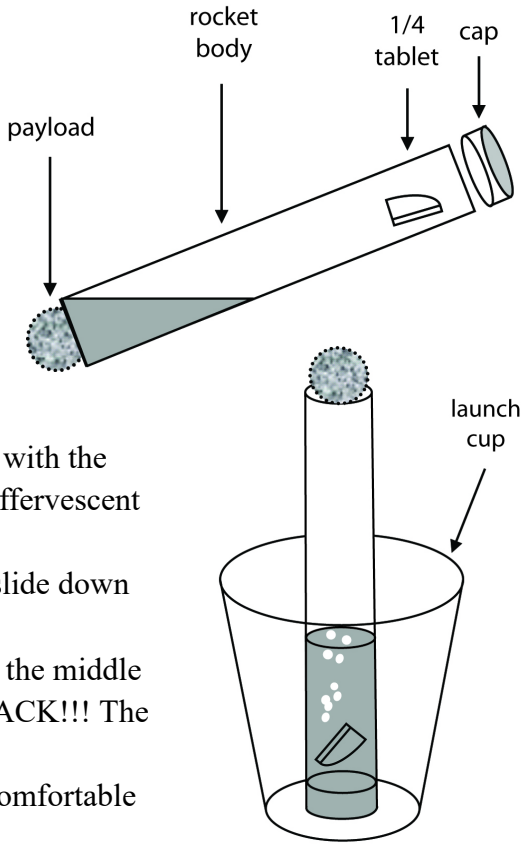
You Will Supply These Materials

- Water

Part 1: Launching the Rocket

First, we will launch a rocket safely.

1. From the bag, grab the rocket body with payload, small plastic cap, plastic cup, and effervescent tablets.
2. Put the plastic cup on the floor where no one will run into it and where it's easy to clean up spills.
3. Open one package of effervescent tablets and break a tablet into 4 equal parts.
4. Use the graduated medicine cup to measure out 7.5 mL of water and pour it into the rocket body.
5. Hold the tube at an angle as shown in the diagram to the right with the payload angled down and the mouth up. Place a piece of the effervescent tablet just inside the mouth so that it doesn't touch the water.
6. Place the cap carefully on the tube so that the tablet does not slide down into the water.
7. Look at the diagram to the right. Place the rocket on its cap in the middle of the launch cup. The tablet will fall into the water. STEP BACK!!! The rocket will launch in 3-5 seconds.
8. Use the rest of your tablet to launch a few more times to get comfortable with the launch process.



Part 2: Deliver the Payload

Now that we know how to launch a rocket, it's time to make it go to a certain height and deliver its payload. Using the rocket, determine how much water and effervescent tablet you need to deliver a payload into "outer space."

1. You have been hired by NASA to complete this challenge. Each test launch costs a lot of money, so fewer launches is better.

   Rules:

   - Launch only from the launching cup and use only the original rocket materials: a tube with the payload, launching cap, water, and part of an effervescent tablet.
   - The payload is the pom-pom on top of the rocket.
   - The payload must reach 80 inches or 203cm, the height of most interior doors. Place your cup on the floor inside the door frame and try to hit the top. Use your measuring tape to confirm the height.

2. Make a table to record how much water and effervescent tablet you used in each test launch. Before placing the effervescent tablet in the mouth of the tube, record the amount by tracing the piece you used in your data table. Also, record the height of each launch.
3. When a test launch reaches 80 inches, record how many launches it took to complete the challenge.

Part 3: How High Can You Fly?

1. Continue to change the amount of water and effervescent tablet and see how high you can launch the rocket.
2. Show how you measured the height your rocket flew.

Part 4: Space Spinoffs

Many modern technologies have resulted from the NASA space program. Let's explore some of the different products that were developed as NASA explored space.

1. Read through each of the five space spinoff products on the space spinoff product sheet.
2. Below are five problems NASA engineers faced that resulted in one of the space spinoff products. As you read, think about which space spinoff product came from the space problem.
   a. **How to measure a planet's temperature** - To take temperatures of space objects such as planets or stars, scientists launched an "Infrared Astronomical Satellite." Onboard was an instrument that looks at distant objects and exactly measures their heat waves. The key component is a sensor that precisely changes the amount of electricity that passes through it according to the energy of heat waves that strike it.
   b. **Protecting astronauts from impact and g-forces** - The problem was to protect astronauts while launching, re-entering the atmosphere, and plummeting into the ocean. Also, in a crash, passengers in airplanes needed a better form of padding. For all of these applications, they needed something that could absorb a high-energy impact and still feel soft.
   c. **Protecting a heat-seeking missile's antenna** - Heat-seeking missiles use an antenna to track heat from jet engines that are their targets. This antenna needs protection in order to work while flying on a missile. It has to be covered by a clear material that can be easily formed over the antenna, yet is hard. To do this NASA developed a special transparent ceramic material.
   d. **Stronger parachute straps** - When NASA recovered Apollo 15 after it returned to Earth in 1971, they found that some of the straps connecting it to its parachute were missing. They could not allow this to happen on Mars landing. To land safely, the parachute straps had to be much stronger than those on Apollo 15. NASA's problem was to find a new material to make those straps stronger than steel.
   e. **Lightweight parts** - systems that move parts on wings to control flight can be heavy. To make them lighter, NASA wanted parts that did not move but simply changed shape. To do that, they needed metals that change shape when heated or cooled, and return to their original shape when the temperature changes back, a property called "shape memory."

   Which product do you think came from the space problem? Explain your reasoning.
3. Your teacher will share with you the correct answers.