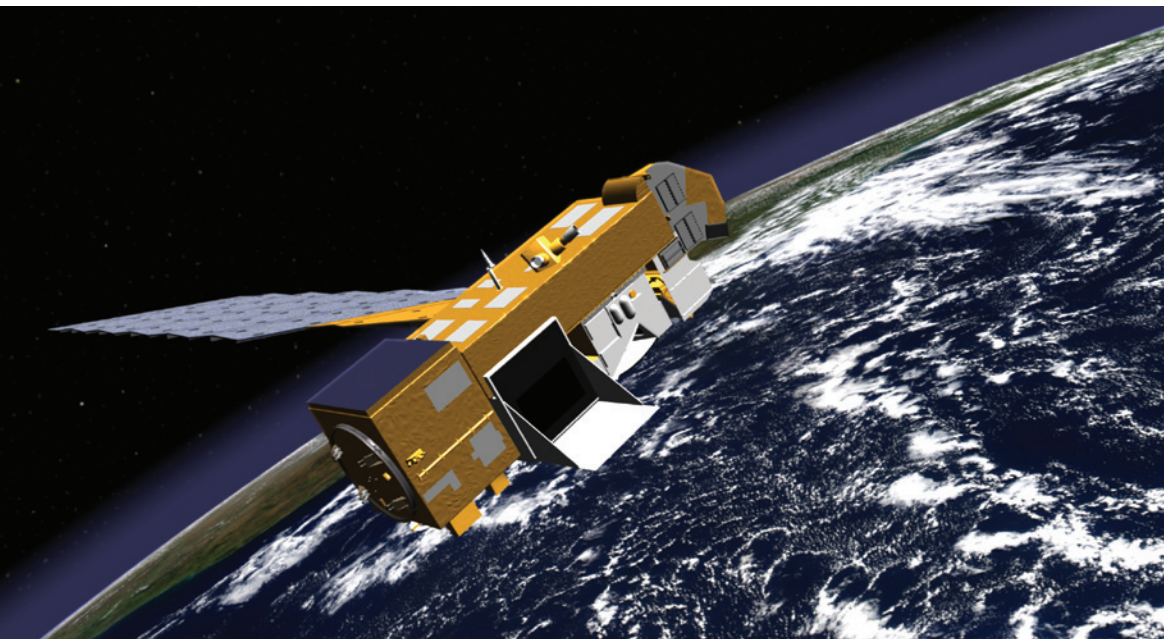
Launch Your Satellite



DESIGN challenge

To design a balloon rocket to launch the satellite that was built in the last activity. The goal is to get the satellite to go as far as possible.

launch your satellite

OBJECTIVE

To demonstrate an understanding of the Engineering Design Process while utilizing each stage to successfully complete a team challenge.

PROCESS SKILLS

Observing, communicating, measuring, collecting data, inferring, predicting, making models

MATERIALS

Satellite model from previous activity

General building supplies

Rulers or meter sticks

Binder clips or clothes pins

Balloons (several per group)

Straws

5-meter fishing line set-up strung between two tables

STUDENT PAGES

Design Challenge

Ask, Imagine and Plan

Experiment and Record

Quality Assurance Form

Fun with Engineering at Home

PRE-ACTIVITY SET-UP

The fishing line apparatus should be at least 5 meters in length. Clamp or tie one end at table or chair height and stretch the line across the space to another table/ chair at the same level. Holding the free end of the line taut for each trial enables easy restringing of the successive balloon rockets. The line must be very taut for best results. Shoot the rockets toward the tied end. Two fishing line set-ups should be sufficient for most clubs. *Note: Use clips or clothes pins to hold filled balloon shut before launch. If the opening in the balloons tends to stick, try putting a little hand lotion inside the opening.*

MOTIVATE

- Show the video of a recent rocket launch, titled, "Liftoff…To the Moon!"

  http://lunar.gsfc.nasa.gov/launch.html

SET THE STAGE:

ASK IMAGINE
& PLAN

- Share the Design Challenge with the students and ask students to retrieve their satellites from last session.
- Demonstrate how a balloon rocket works by sending a balloon connected to a straw up the fishing line. Do not model how best to attach the satellite or how best to power the rocket, other than releasing the air by using your fingers.
- Ask the students, "How can we use this setup to launch your satellite?" Remind students that one end of the line is the launch pad and the other end is the Moon.
- Have students take the time to imagine a solution for a balloon rocket design and then draw their ideas. All drawings should be approved before building begins.

CREATE

- Challenge the teams to build their rockets based on their plans. In addition, teams will need to design a system to attach their satellites to the launch set up. Remind students to keep within specifications.

EXPERIMENT

- Send teams to their assigned launch sites to test their rockets, completing the data table as they conduct each trial launch.

IMPROVE

- After the first set of trials, allow teams to make adjustments to their rockets.
- Teams re-launch satellites and record their data.
- Teams discuss how far their rocket traveled and which combination of variables gave the best results.

CHALLENGE CLOSURE

Engage the students in the following questions:

- *What was the greatest challenge for your team today?*
- *Why is the balloon forced along the string?*
- *How did changing the straw length/number of balloons affect how far the rocket travelled on the fishing line?*

PREVIEWING NEXT SESSION

Ask teams to think about how humans navigate robotic rovers on a distant planet or moon. How are they programmed? How do the rovers receive messages from a team on Earth?

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Launch Your Satellite
Teacher page

3, 2, 1 . . . We have lift-off!

NASA launches several rockets each year. There are actually several launch facilities around the United States. You probably know of the launch pad at Kennedy Space Center in Florida, but did you know there is a launch facility at Vandenberg Air Force Base in California, one at Wallops Flight Facility in Virginia, and another at White Sands Missile Range in New Mexico? A rocket is just the launch vehicle that carries a payload into space. A payload is the load, or package or set of instruments, that needs to be delivered to a destination. When you watched the video for this session, you saw an Atlas V rocket carry a payload, the LRO and LCROSS satellites, to a destination: an orbit around the Moon.

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Launch Your Satellite
Student page

THE CHALLENGE:

Your mission is to design and build a launch vehicle to send a payload to the Moon. Your payload is the satellite you built at the last session. The launch vehicle is a balloon rocket assembly. Your team must also determine how to attach your satellite to the balloon assembly and then launch it down a fishing wire. The design constraints are:

1. *Between trials, you must change the length of the straw on your rocket.*
2. *Once you have selected an appropriate straw length, select one other rocket element for your design and modify only that element during your remaining trials. The rocket elements are:*
   a. *number of balloons*
   b. *type of balloon(s): long or round (if time and materials permit)*

ASK IMAGINE &PLAN

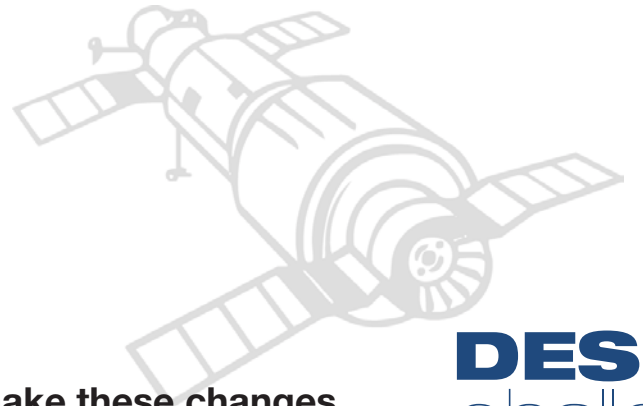
What questions do you have about today's challenge?

How will you choose what lengths to make the straw?

Predict how the effect of the length of the straw on the launch assembly might change the launch distance of your satellite.

Explain how you think changing the straw length changes how far the rocket travels?

What is the next rocket element (or variable) that you plan to test? How are you going to test it?



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Student page

Predict what will happen when you make these changes.

_____

_____

Draw your balloon rocket assembly and include your satellite:

Approved by: _____

Experiment & Record

Experiment 1. Select the number and shape of balloons you want to use. This is your control. Only modify the length of straw for each trial.

	Trial 1	Trial 2	Trial 3
Straw Length (cm)			
Distance Traveled (cm)			

Number of Balloons?	Balloon shape?

Experiment 2. Change the number of balloons for each trial, but keep the straw length and shape of balloons constant.

	Trial 1	Trial 2	Trial 3
Number of Balloons			
Distance Traveled (cm)			

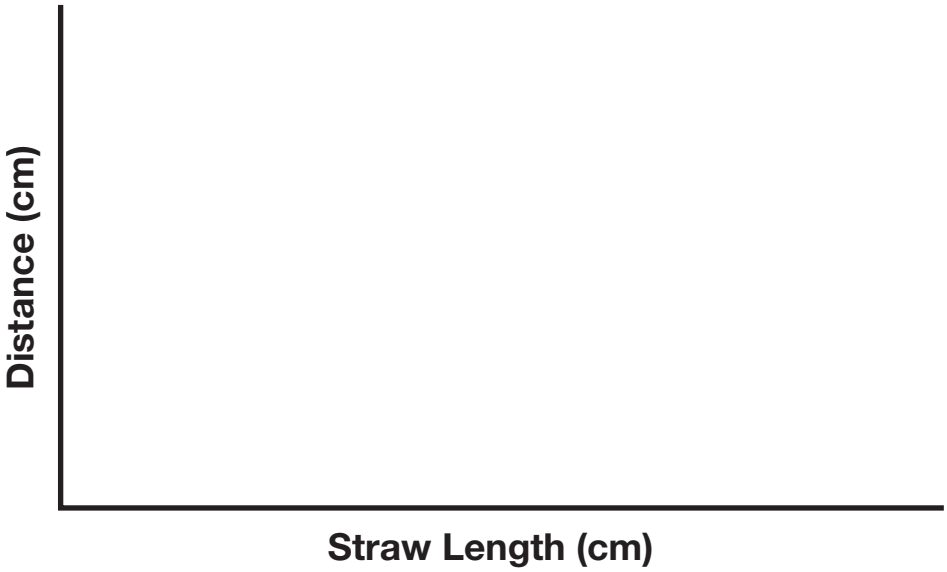
Length of Straw?	Balloon shape?

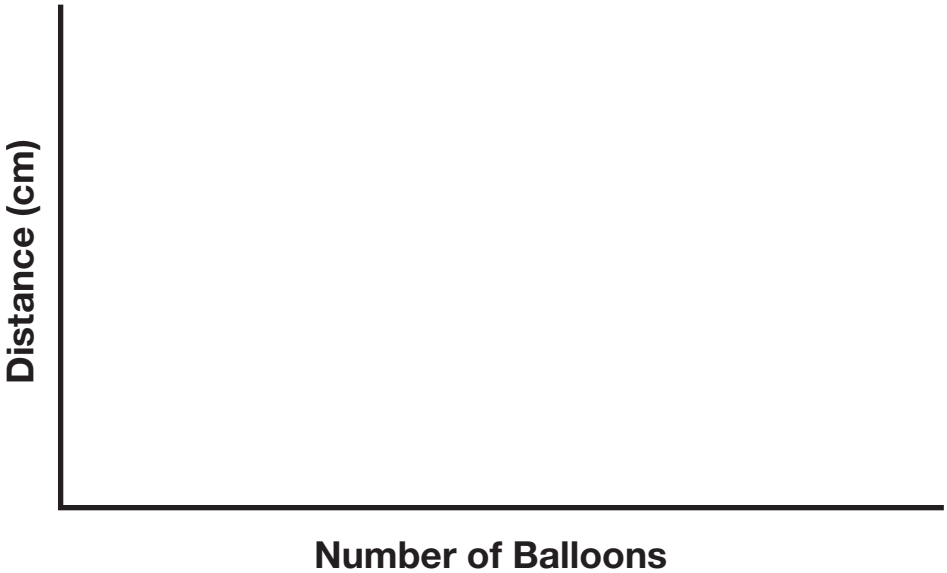
Experiment 3. (if time and materials permit). Select different shapes of balloons for each trial but keep the straw length and number of balloons constant.

	Trial 1	Trial 2	Trial 3
Shape of Balloon(s)			
Distance Traveled (cm)			

Length of Straw?	Number of Balloons?

Plot the data from your tables into the graphs below.





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QUALITY ASSURANCE FORM

Each team is to review another team's design and model, then answer the following questions.

Name of team reviewed: _____

What was the farthest distance the rocket travelled?_____ cm

What design components were on the rocket that made it travel this far?

Straw Length?	
Number of Balloons?	
Balloon Shape?	

List the specific strengths of the design.

List the specific weaknesses of the design:

How would you improve the design?

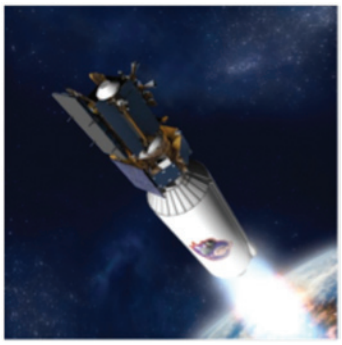
Inspected by: _____

_____

_____

_____

Fun with Engineering at Home



Today you designed and built a balloon rocket to send your lunar satellite to the Moon. By creating a model using simple classroom supplies, you still used the same process that engineers use when they build a rocket assembly to put satellites in space. While at home, see what you can learn about rockets: how they work, what they are used for, and what types of fuel are used to get them into space.

American rocketry was pioneered by Dr. Robert Goddard. NASA's Goddard Space Flight Center is named after him. For further reading about Dr. Goddard:

www.nasa.gov/centers/goddard/about/dr_goddard.html

To read about the Ares V rocket, check out this link:

www.nasa.gov/mission_pages/constellation/ares/rocket_science.html

NASA's Marshall Space Flight Center studies propulsion and manages the Michoud Facility in New Orleans.

www.nasa.gov/centers/marshall/about/index.html

CHALLENGE:

What kinds of rockets carry satellites into space? Are these the same kind of rockets that carry astronauts into space? Ask your family members to help you investigate!

DESIGN challenge

To design and build a satellite that falls within certain size and weight constraints. It will have to carry a combination of cameras, gravity probes, and heat sensors to investigate the Moon's surface. The satellite will need to pass a 1-meter Drop Test without any parts falling off of it.

Launch Your Satellite
Student page

launch your challenge