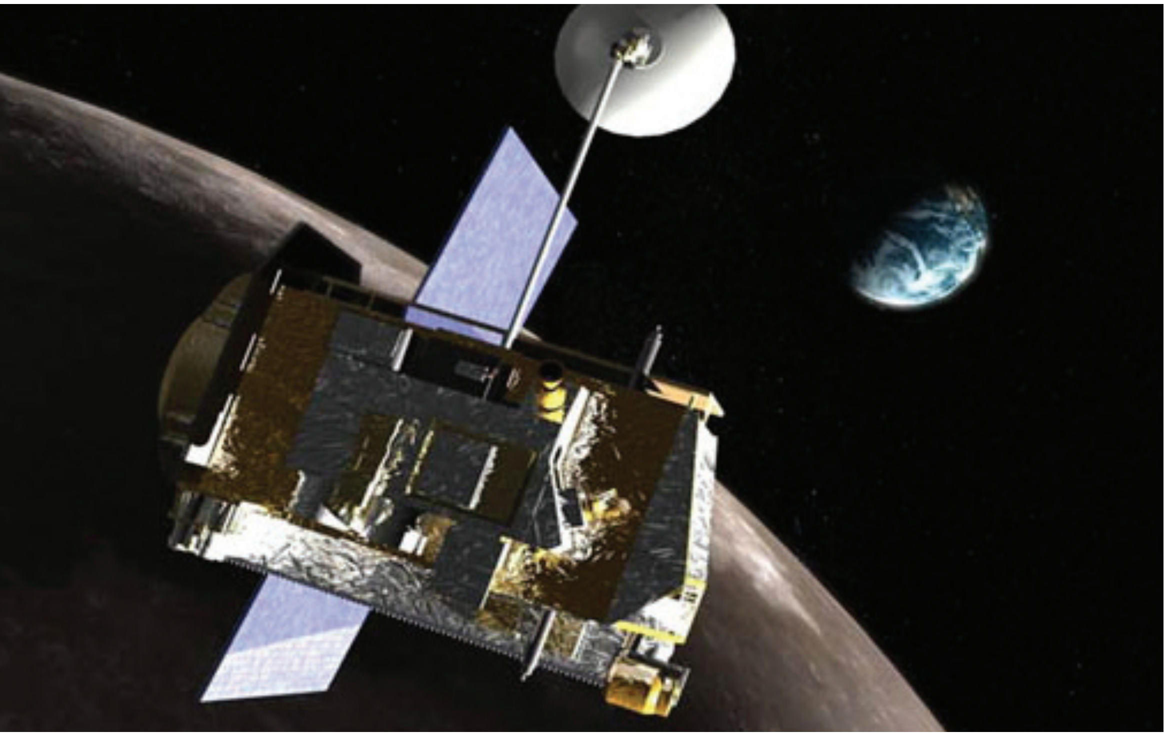
Build a Satellite to Orbit the Moon



DESIGN challenge

To design and build a satellite that meets specific size and mass constraints. It must 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.

satellite

OBJECTIVE

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

PROCESS SKILLS

Measuring, calculating, designing, evaluating

MATERIALS

General building supplies

Bag of various sized buttons

1 Mailing tube, oatmeal canister or other container (used as a size constraint)

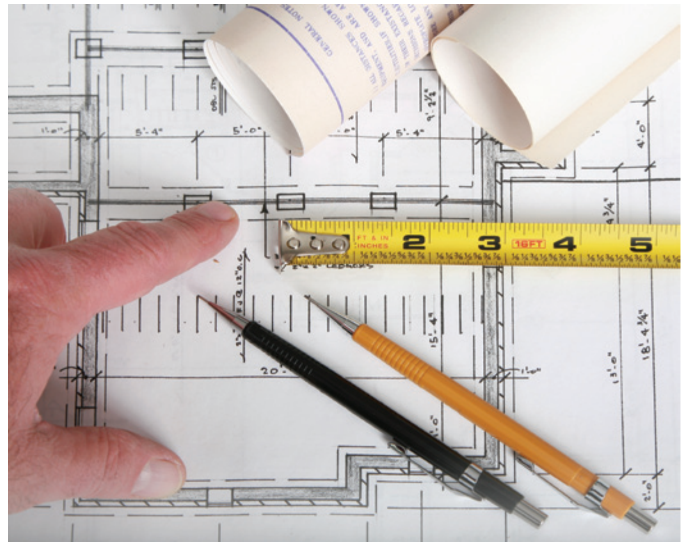
STUDENT PAGES

Design Challenge

Ask, Imagine and Plan

Experiment and Record

MOTIVATE



- Spend a few minutes asking students if they know what engineers do, then show the NASA's BEST Students video titled, "What is Engineering":

  http://svs.gsfc.nasa.gov/goto?10515

- Using the *Engineering Design Process (EDP)* graphic on the previous page, discuss the EDP with your students:
  - **Ask** a question about the goal.
  - **Imagine** a possible solution.
  - **Plan out** a design and draw your ideas.
  - **Create** and construct a working model.
  - **Experiment** and test that model.
  - **Improve** and try to revise that model.

SET THE STAGE:
ASK IMAGINE & PLAN

- Share the *Design Challenge* orally with the students (see next page).
- Have students ask questions and brainstorm ideas as a group, then break into teams to create a drawing of their satellite. All drawings should be approved before building begins.

CREATE

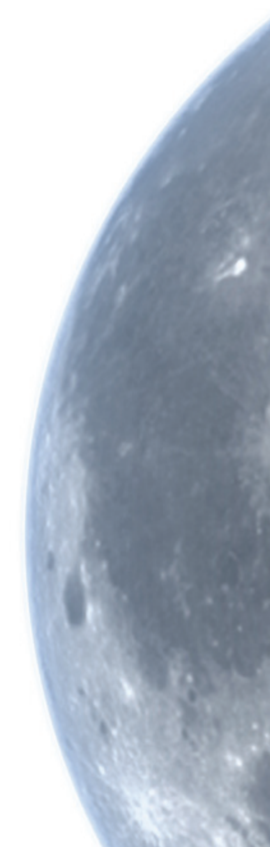
- Distribute materials for students to build their satellites based on their designs and specifications.
- Ask teams to double check mathematical calculations, designs and models. Visit each team to make sure their model can fit within the size specification of the cylinder or box you are using.

EXPERIMENT

- Have student test their satellites by dropping them from a 1-meter height and to record their observations.

IMPROVE

- Have students inspect their satellite after the drop and rework their design if needed.



CHALLENGE CLOSURE

Engage the students in a discussion with the following questions:

- *List two things you learned about what engineers do through building your satellite today.*
- *What was the greatest difficulty you encountered while trying to complete this satellite challenge? How did your team solve this problem?*

PREVIEWING NEXT SESSION

Ask teams to bring back their satellite model for use at the next session. You may want to store them in the classroom or have one of the club facilitators be responsible for their safe return.

DESIGN
challenge

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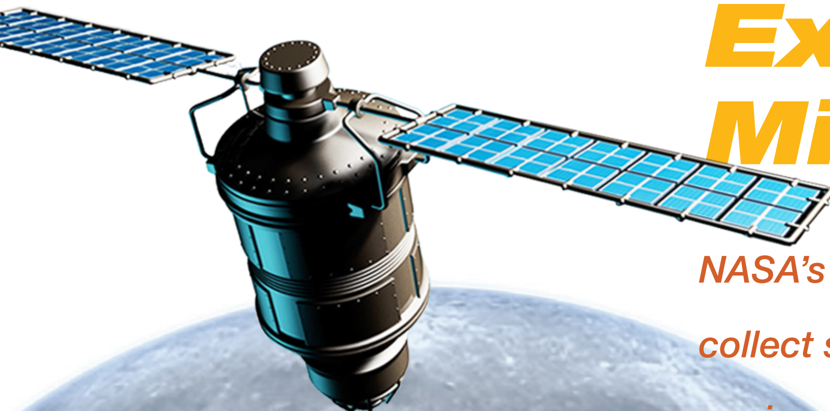
Build a Satellite
Teacher page

satellite

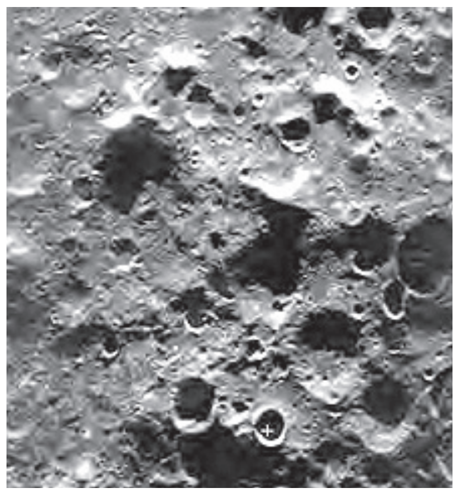
NASA's Lunar Exploration Missions



NASA's lunar exploration missions will collect scientific data to help scientists and engineers better understand the Moon's features and environment. These missions will ultimately help NASA determine the best locations for future human exploration and lunar bases.

SATELLITE INSTRUMENTS

The information gathered by lunar exploration missions will add to information collected during earlier missions. Some of these missions gathered data that caused scientists to have more questions — questions they hope to solve with new instruments on new satellites. For example, NASA has recently sent a satellite to look for water ice on the Moon. Thus, that satellite carried instruments (sometimes called "detectors" or "sensors") to look for the ice. Other instruments will help collect data to make exact maps of the Moon's surface and make careful measurements of the radiation falling on the lunar surface for the safety of future lunar explorers.



TEAMWORK IS IMPORTANT

The different instruments are designed, tested, and assembled by different teams of engineers and scientists. The separate teams must work together to ensure instruments are the right mass, fit correctly, and make proper measurements. Working together is an important skill for *everyone* to practice.

DESIGN
challenge

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THE CHALLENGE:

Your mission is to build a model of a lunar exploration satellite with the general building supplies provided. Use different shape and sizes of buttons or beads to represent the various instruments. The design constraints are:

DESIGN challenge

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Design a Satellite
Student page

1. *Using the data on the Ask, Imagine, and Plan worksheets, calculate the total mass of the instruments. The total mass, including detectors, probes, sensors and solar cells, can be no greater than 10 grams.*
2. *The entire satellite must fit within **the _________ (i.e. mailing tube, oatmeal canister).** This item is a size constraint. The satellite is not to be stored in this or launched from this item.*
3. *The satellite must withstand a 1-meter Drop Test without any pieces falling off.*

ASK IMAGINE &PLAN

What questions do you have about today's challenge?

The objective of this activity is to design your own satellite. These are the instruments you may choose to use put on your satellite:

Camera
Total Mass = 2.5 g

Gravity Probe
Total Mass = 2 g

Heat Sensor
Total Mass = 1 g

Each of these instruments requires a certain number of solar cells to operate on your satellite. A solar cell collects energy from the sun to power the instruments. Each solar cell has a mass of 0.5 g.
A camera requires 3 solar cells to operate. A gravity probe requires 2 solar cells to operate. A heat sensor requires 1 solar cell to operate.

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Build a Satelliite
Student page

If you were to build a satellite with two (2) cameras and one (1) heat sensor, how many solar cells would you need? Write the number sentence below for this problem:

____

____

If you were to build a satellite with two (2) cameras and one (1) heat sensor, would the total mass be greater or less than the mass limit for the challenge? Write the number sentence below for this problem:

____

____

Now draw your own satellite. Include the correct number of solar cells it will need and label each instrument.

Approved by: ______________________

Experiment & Record

1. Write a hypothesis. Complete the following statement:
When our team's satellite is dropped from a height of one (1) meter, it will:

____

____

____

2. Record your observations.
Describe what happened during your satellite's drop from a height one (1) meter.

____

____

____

Did any instruments fall off the satellite?	Yes	No
Was the satellite damaged during the fall?	Yes	No

If you answered yes to either question above, explain how your team could improve the design to make sure these errors would not happen again.

____

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____

____

satellite