Out of This World! - Week 7

Grades 6-8

Day 2: Design a Satellite to Orbit the Moon

Teacher/Parent Background:

Our solar system has been studied and observed for centuries. Ancient civilizations would observe the movements of the Moon, Sun, and stars and try to determine what these movements meant to their crops, their family, and their culture. It was not until the 20th century that humans would have the ability to send objects into space for closer study.

A satellite is a small object that orbits, or revolves around, a larger object in space. Satellites can be natural or artificial. All the planets in the solar system except Mercury and Venus have natural satellites. Earth's Moon is one example. Artificial satellites are sent into space to gather information. Most are launched into space by rockets.

The first artificial satellite was Sputnik 1. The Soviet Union launched it into orbit around Earth in 1957. Now dozens of new satellites are put into space every year. They orbit around Earth as well as the Moon, Venus, Mars, Jupiter, and other bodies.

Artificial satellites have many purposes. Scientific satellites collect information about space. The Hubble Space Telescope is a scientific satellite that orbits around Earth. It sees the sky more clearly than telescopes on the ground. Communications satellites help send telephone calls, radio and television programs, and computer information all over the world. Airplanes, ships, and cars with special equipment can use information from satellites to find the way from place to place. Militaries use satellites for spying. Satellites are used in weather forecasting, too.

Overview:

In this activity, students will design and build a satellite that meets specific size and mass constraints.

Related Standards:

Use ratios and proportions to **analyze and interpret data** related to scale, properties, and relationships among objects in our solar system.

Key Terms:

- Satellite- Something that orbits around another object; for example, a moon orbiting a planet or a human made object orbiting Earth.
- NASA- National Aeronautics and Space Administration; the American governmental agency dedicated to space exploration.

Materials List:

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

Activity Description:

1. Ask 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
2. Using the Engineering Design Process (EDP) graphic to help discuss the Engineering Design Process with your students:
    a. Ask a question about the goal.
    b. Imagine a possible solution.
    c. Plan out a design and draw your ideas.
    d. Create and construct a working model.
    e. Experiment and test that model.
    f. Improve and try to revise that model.
3. Ask students to read the Design Challenge, brainstorm ideas, solve the given problems and then create a drawing of their satellite.

Closure:

Discuss the following with students:

1. List two things you learned about what engineers do through designing your satellite today?

Extension:

Play & Learn- Satellites, Shuttles and Space Stations

Student Handout

Challenge Details

Dear Student,

NASA has announced its plans to return astronauts to the Moon by 2024 through a collaboration with commercial and international partners. In going to the Moon, NASA is laying the foundation that will eventually enable human exploration of Mars. The Moon will provide a proving ground to test technologies and resources that will take humans to Mars and beyond, including building sustainable, reusable architecture.

In preparation for 2024, NASA has been analyzing information gathered by lunar exploration 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.

Your mission is to build a model of a lunar exploration satellite with the general building supplies provided. 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. The design constraints are:

1. The total mass of the instruments, detectors, probes, sensors and solar cells can be no greater than 60 kilograms (see Satellite Instrument Data Table in following pages).

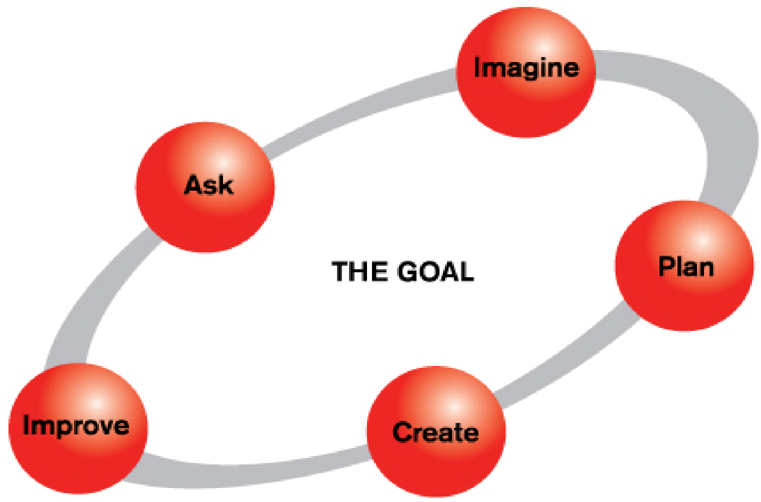
    - The satellite cannot be launched if the mass of instruments, detectors, probes and solar cells exceeds a total of 60 kilograms, so choose your instruments carefully.

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. At least two instruments must “deploy” (unfold or pop out) when the satellite is launched. These instruments must be mounted on a part that moves.

4. The satellite must withstand a 1-meter Drop Test without any pieces falling off.

Engineering Design Process Image



The Engineering Design Process, EiE, Museum of Science, Boston.

Step 1: Ask Table

What is the problem?	What do you need to know to solve the problem?	What have others done when solving a similar problem?

Step 2: Choose Instruments to be included on your satellite.

Use the data in this table to determine which instruments, and how many of those instruments, to include on your satellite.

Detectors or Instruments	Use	Mass (kg)	# of Solar Cells Needed to Power
Camera	Takes pictures	30	1
Gravity Probe	Measures gravity	20	2
Heat Sensor	Measures temperature	10	3
Solar Cell	Collects energy from the Sun to power an instrument, detector, sensor or probe	1	n/a

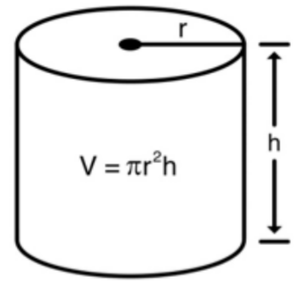
Instrument	Mass
	kg
	kg
	kg
Total # of Solar Cells:	kg
Total mass of instrument	kg
Volume of Payload Container**	cm^3
Does your satellite fit w/in size constraints	kg

***Hint: How to calculate the volume of a cylinder:*

1. Find the radius (r) of the circle found at the top and bottom of the cylinder. The radius is half of the measurement of the diameter of the circle.

2. Square the radius value and multiply it by π (pi).

3. Determine the height (h) of your cylinder and multiply it by the value found in step #2.



Your Volume Calculations

Step 3: Imagine and Plan

How will the instruments on your design deploy when the satellite is launched?

Draw two views of the satellite with its instruments you intend to build:
View 1
View 2