Out of This World! - Week 7

Grades 6-8

Day 4: Test 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. Remind students about the Engineering Design Process.
    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.
2. Ask students to read over the Design Challenge, and take special notice of constraint #4.
3. Today students will be testing their satellites by dropping them from 1-meter and recording their observations. You may want to suggest students video their tests so that they can share and get feedback on their designs from classmates.

Closure:

Discuss the following with students:

1. What were some strengths of your satellite design?
2. What were some specific weaknesses of your satellite design?
3. How do you plan to improve your satellite design?

Extension:

Play & Learn- Satellite Motion

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: Test your satellite by dropping it from a 1-meter height and record your observations.

What happened when you completed the 1-meter Drop Test?

Did any pieces fall off? If yes, which ones?

What kinds of changes are needed to make to your satellite stronger?

Draw your satellite with these new modifications.

What is the total mass of your instruments and solar cells after making these new changes? *(Refer back to day 2)*