Activity Title: Build a Satellite to Orbit the Moon!

This activity was adapted from

http://www.lpi.usra.edu/education/explore/moon/lro.shtml

Courtesy NASA

Activity Objective(s): The teams' challenge is to build a satellite that falls within certain size and weight limits. This satellite will be designed to orbit the Moon. It will have to carry come combination of cameras, gravity probes, and heat sensors to look at or probe the Moon's surface.

Grade Levels: K-2

Lesson Duration: One 60-90 min session

Process Skills: measuring, calculating, designing, evaluating

Materials and Tools (per group of three students):

General building supplies

1 Bag "Shockers" candy

1 Bag "Chewy Sweet Tarts" candy

Club Worksheets: (Make copies for each student to put in binder)

1. Engineering Design Process Sheet
2. Detector or Instrument Table of Uses and Weights
3. Satellite Design Sheets
4. Summary Sheet - Questions/Discussions for Understanding
5. Fun with Engineering at Home Sheet
6. Quality Assurance Sheets - Checking Each Others Satellite Models

Club Facilitator or Teacher Notes by Stage:

(Based on those running 60-minute Clubs)

Stage 1: Meet and Motivate (Approx 10 minutes)

- Welcome the students!
- Give students nametags and have them go around and share their names – it is important that everyone get to learn the names of the club participants.
- Set the stage by telling them how excited you are about the club – let them know that they are very special; they will be learning how to become ENGINEERS.
- Spend a few minutes asking them if they know what engineers do….. then let them know that we will be experiencing what engineers do during our time together today….. Take a few minutes to go over the Engineering Design Process steps – hand out the ***Engineering Design Process*** Worksheet.
- Let's get started!

Stage 2: Set the Stage, Ask, Imagine, Plan (Approx 10 minutes)

- Share the **Design Story and Challenge** orally with the students (provided in the teacher pages). This story provides the context and motivation for trying to accomplish the challenge. This is the **ASK** phase of the Engineering Design Process.
- Put the students in teams of 3 around the room – try to separate the teams so they are not working "on top" of one another.
- Place building materials (with the exception of glue, tape and scissors), in a bag, in the middle of each team's area.
- Hand out the ***Detector or Instrument Table of Uses and Weights*** worksheet and the ***Satellite IMAGINE and PLAN Worksheet*** (1 of each of these worksheets per team)
- Let the challenge begin - Encourage them to **IMAGINE and PLAN** before building. Do not hand out the scissors, tape or glue for 7-10 minutes. Ask them to use their worksheets to sketch their design ideas.

Stage 3: Create and Experiment (Approx 15 minutes)

- Give out the scissors, glue and tape. Challenge the teams to **CREATE** or build their satellites based on their designs. Remind them to keep within specifications.

- Ask members of each team to check mathematical calculations and check designs and models to make sure they are within specified design constraints.

Stage 4: Challenge Closure (Approx 10 minutes)

- Give out the ***Summary: Questions/Discussion for Understanding*** worksheet (1 per team). Ask each team to fill out the worksheet.
- In summary have a short discussion with all teams. Ask them, "What was the greatest challenge for your team today?" Expect answers such as:
    - Planning and creating a satellite with detectors that fits within a certain space and weight set of specifications
    - Consider what it means to build something that will be launched into space
    - Work as a team, communicate
    - Imagine, plan, create, experiment, improve steps
    - Calculate weights of instruments/detectors, making sure that our instruments do not add up to more than the allowed weight limit

  If you do not get these types of answers, try to facilitate an interaction where you put these thoughts in play and ask for feedback. Encourage all teams to offer thoughts. Collect Summary Sheets for your review to see how students are doing with comprehension. Put these sheets in student notebooks after reviewing them.

Stage 5: Previewing Next Week (Approx 5 minutes)

- Ask teams to bring back their satellite model for use in next week's club challenge. You may want to store them in the classroom or have one of the facilitators be responsible for their safe return next week.
- Ask teams to think about satellites during the next week, ask their parents about satellites, look up satellites in books or on the Internet. (See Internet Resource List)
- There is really no homework, but you do want to encourage students to stay engaged mentally during the next week so they are ready for the club when it comes club time once again in 7 days. Please give each student the *Fun With Engineering at Home* worksheet. Tell them to share this sheet with their family. Tell them to ask their family to help them with the Home Challenge found on this sheet.

Special Notes: For Those with 90 minute Clubs

Quality Assurance - Experiment (10 minutes)

- Hand out the ***Quality Assurance*** worksheets (1 per team) and ask them to fill out the top section with team name and participants' names.
- Ask each team to put their satellite model together with their Quality Assurance worksheet around the edges of the room. Ask each team to move one notch clockwise to offer feedback to the neighboring team, using the Quality Assurance worksheet.
- Afterwards, teams return to their seats and discuss feedback from the Quality Assurance Team.

Design Story and Challenge: (*For Teacher Use*)

This is the story you will tell the students to paint the picture or set the context for this first challenge. It is important that you set the context with this story before jumping into the challenge. It is this story that makes the science, mathematics and engineering come to life; it is the story that makes the hands on activities have relevance and meaning.

NASA's Lunar Reconnaissance Orbiter

Launch Date: October 2008

NASA's Lunar Reconnaissance Orbiter (LRO) will launch in 2008, thrust into orbit aboard an Atlas 401 rocket. The LRO will spend at least a year orbiting the Moon. It will collect scientific data to help scientists and engineers better understand the Moon's features and environment, and will ultimately help them determine the best locations for future human missions and lunar bases.

The information gathered by LRO 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. For example: scientists and engineers need to know if there is any ice on the Moon. Humans need lots of water to live, and it is way too heavy to carry with us up to the Moon! The LRO will carry instruments (sometimes called "detectors" or "sensors") to look for ice (water in solid form). Additionally we need to make exact maps of the Moon's surface. And, for safety, we need to make careful measurements of the radiation falling on the lunar surface.

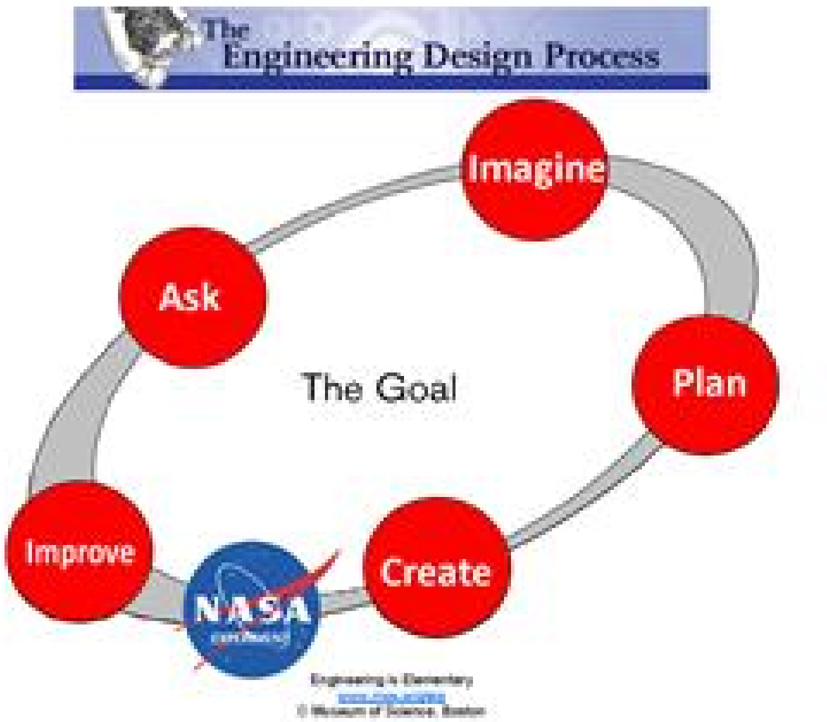
The different instruments are designed, tested, and assembled by different teams of engineers and scientists. The separate teams have to work together to make sure that the instruments are the right weight, fit correctly, and make proper measurements.

Overall, the weight of anything we want to send into space is the most challenging problem for the engineers. The more an object weighs the more energy it takes to launch it.

Design Challenge

The students must build a model of the LRO with the general building supplies, using the candies as the various instruments. The big candies are the instruments and represent **large weights**. The small candies are the solar cells and represent **small weights** (see the Data Table). The total weight of the instruments, detectors, probes, sensors and the solar cells that power them can be no greater than **4 large weights** and **5 small weights** in total.

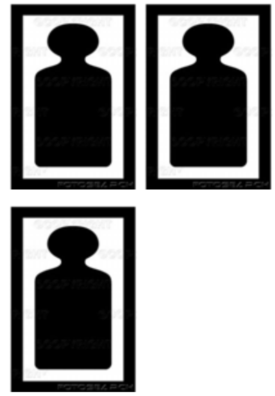
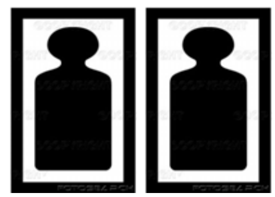
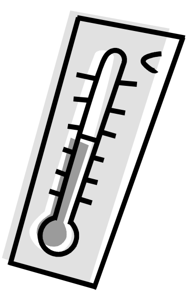
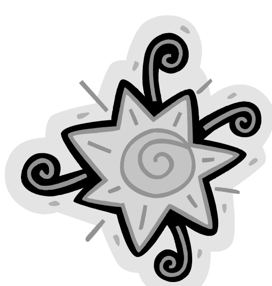
1. Engineering Design Process



The Engineering Design Process is a series of steps that engineers use to guide them as they solve problems.

1. **Ask** a question or set a challenge
2. **Imagine** a solution to the question or challenge
3. **Plan** a solution - Include drawings and diagrams
4. **Create** – Follow your Plan, build your design
5. **Experiment** – Test what you've built
6. **Improve** – Talk about what works and what doesn't; modify your creation

2. Detector and Instrument Table of Uses and Weights

Detectors or Instruments	**Use**	**Weight**
Camera 	Takes Pictures (needs 1 solar cell to operate)	
Gravity Probe 	Measures (needs 2 solar cells to operate)	
Heat Sensor 	Measures Temperature (needs 3 solar cells to operate)	
Solar Cell 	Collects Energy from the Sun to Power an Instrument, Detector, Sensor, or Probe	

3. Satellite Imagine and Plan Sheet *Page 1*

Team Name:____

Draw your sensors and probes -- and draw their weights beside them:

How many total big weights?

How many total small weights?

Draw your satellite. Label Sensors, Probes and Solar Cells:

4. Summary: Questions/Discussions for Understanding

List two things you learned about what **engineers** do through building your satellite today:

1.

2.

What was the greatest difficulty you and your team had today while trying to complete the satellite challenge?

Tell how you solved your greatest team difficulty in 2-3 sentences.

Team Name:____

Fun with Engineering at Home

Today we designed and built a satellite model to orbit the moon. We used the same process that engineers use when they build something. We had to **ASK**: what is the challenge? Then we thought, talked and **IMAGINED** a solution to the challenge. Then we **PLANNED** with our group and **CREATED** our model satellite. Finally, we **EXPERIMENTED** or tested our model by having other groups look at it and give us feedback. Last, we went back to our team station and tried to **IMPROVE** our satellite. These are the same 6 steps engineers use when they try to solve a problem or a challenge.

Home Challenge: During this week, see what you can learn about satellites – how they work, what they are used for, and how we get them up into orbit. You may even want to see if you can find out what kind of sensors, instruments, and probes satellites carry that are currently orbiting the earth.

You can find this information in books, magazines or even on the Internet. Here are some Internet links you may want to use:

1. 1. World Book at NASA: Artificial Satellites
http://www.nasa.gov/worldbook
2. The World Almanac for Kids Science: Artificial Satellites
http://www.worldalmanacforkids.com
3. NASA Space Place
http://spaceplace.nasa.gov/en/kids/quiz_show/ep001/

Ask your parents, grandparents, brothers or sisters to help you find out more about satellites. Have fun!

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Quality Assurance – Checking Each Others Satellite Models

Team Name:____

Participants' Names: _________________________________

____

____

List the sensors and probes used:

1.

2.

3.

How many solar cells?_______________

Is this the correct number? YES NO

If NO, what is the correct number? _______________

Total number of large weights:____________________________

Total number of small weights: ____________________________

What did you like about the satellite design?

How would you change the satellite design?

Team Name:____

Participants' Names: ________________________________

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