Activity Title: Launch Your Satellite!

NOTE: This activity was adapted from NASA educational products:
Rockets Educator Guide EG-2003-01-108-HQ
http://www.nasa.gov/pdf/58269main_Rockets.Guide.pdf

Activity Objective(s): The teams' challenge is to launch the lunar satellite that they built last week using a balloon rocket. The objective is to get your satellite to go as far as possible.

Grade Levels: K-2

Lesson Duration: One 60-90 min session

Process Skills: observing, communicating, measuring, collecting data, inferring, predicting, making models

Materials and Tools (per group of three students):

Satellite model from last week's activity

General building supplies

Binder clips or clothes pins

Round balloons (several per group)

5 meter fishing line set-up strung between two tables

Pre-Activity Set-up: The fishing line apparatus should be at least 5 meters in length. Clamp or tie one end at table height and stretch the line across the space to another table at the same level. Holding the free end of the line taught for each trial enables easily restringing the successive balloon rockets. The line must be very taut for best results. Shoot the rockets toward the c-clamped end. Two fishing line set-ups should be sufficient for most clubs. (See Diagram on Teacher page 5)

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

1. Rocket Elements Data Table
2. Balloon Rocket Assembly Design
3. Improvement Phase of Rocket Design
4. Summary
5. Fun With Engineering at Home

6. Quality Assurance Worksheet

Club Facilitator or Teacher Notes by Stage:

(Based on those running 60-minute Clubs)

Stage 1: Meet and Motivate (Approx 5 minutes)

- Keep the same grouping of children from week #1. Ask everyone to retrieve their satellite that they created last week during club session #1.
- Re-share the **Design Story** orally with the students (provided in teacher pages in Activity 1). Re-reading this story provides the context and motivation for trying to accomplish this week's challenge. This week the **ASK** phase of the Engineering Design Process is, *How can we best launch our satellite to go to the moon?* We need for it to go <u>far</u> to get into orbit around the moon. *The objective is to plan and create a rocket that will take our satellite as far as possible.*
- After the stage is set, move on to Stage 2 of the engineering challenge.
- The fishing line apparatus should be at least 5 meters in length. Clamp or tie one end at table height and stretch the line across the space to another table at the same level. Holding the free end of the line taught for each trial enables easily restringing the successive balloon rockets. The line <u>must</u> be very taut for best results. Shoot the rockets toward the c-clamped end. Two fishing line set-ups should be sufficient for most clubs. (See Diagram on Teacher Page 5.)

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

- 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 (not the glue, tape, or scissors) in the middle of each team's area.
- Talk about the need for a rocket to launch their satellite from last session. The engineer-students must now imagine, plan and create a way to attach their satellite to a balloon rocket. The balloon rocket is attached to a straw that slides along the fishing line.
- Demonstrate how a balloon rocket works by sending a balloon connected to a straw up the fishing line using a push from your hands. 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.
- Hand out the ***Rocket Elements Data Table*** and the ***Rocket Design Sheet*** (1 of each of these worksheets per team). Ask them to think about

the different rocket elements on the *Rocket Elements* data table – which ones will they concentrate on as a 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 rockets based on their plans. Remind them to keep within specifications.
- Ask members of each team to check designs and models to make sure they are within the specified design conditions.
- Discuss how important **EXPERIMENTING** and feedback is for engineers. The *imagine, plan, create, experiment, improve* loop is key for engineers to be successful.
- Send each team to their assigned launch sites to test their rockets, filling in the data table as they conduct each trial launch.

Stage 4: Re-Design and Re-Build - Improve (Approx 10 minutes)

- Teams return to their rockets and satellites to make adjustments to their rockets. Hand out the ***Improvement Phase of Rocket Design*** worksheet.
- Teams re-launch satellites for one last measurement to try to improve their rocket's launch distance. Write down the new data.
- At the end of the session, teams report how far their rocket traveled, and explain which combination of variables gave the best results.

Stage 5: Final Launch and Challenge Closure (Approx 10 minutes)

- The teams launch their balloon rockets, one at a time. The FINAL DISTANCE is recorded for each team.
- At the end of the session, teams report how far their rocket traveled, and explain which combination of variables gave the best results.

- 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:
    - Deciding which rocket elements to change and why
    - Considering how to change the rocket elements
    - Working as a team, clearly communicating ideas
    - Imagine, plan, create, experiment, improve steps
    - Launching the rocket with the satellite

  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.

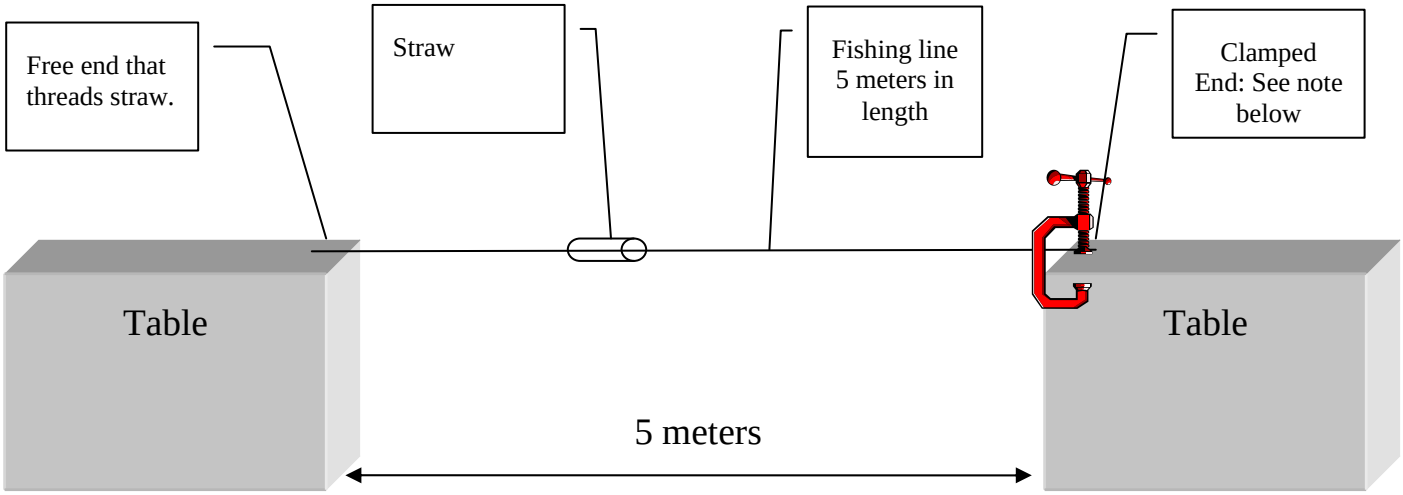
Stage 6: Previewing Next Week (Approx 1 minute)

- Ask students to think about how their satellite design would have to change to carry human beings. Next week they will build a Crew Exploration Vehicle model to take people to the Moon.

Special Notes: For Those with 90 minute Clubs

Quality Assurance (Approx 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 take their satellite, rocket and their quality assurance test worksheet to their assigned launch site. Ask each team to move one notch clockwise to offer feedback to the neighboring team, using the Quality Assurance worksheet.
- Ask each team to test their neighbor's rocket and offer them feedback on the quality assurance test worksheet.
- The teams then return to their seats to discuss the comments from the Quality Assurance Team on how to improve their satellite.



For the clamped end: the fishing line maybe difficult to clamp. To help, wrap a piece of duct or masking tape around the fishing line then clamp down on the taped end. See diagram below:

Separate here for Student Pages

1. Rocket Elements Data Table – Imagine, Plan, Create

Design Notes

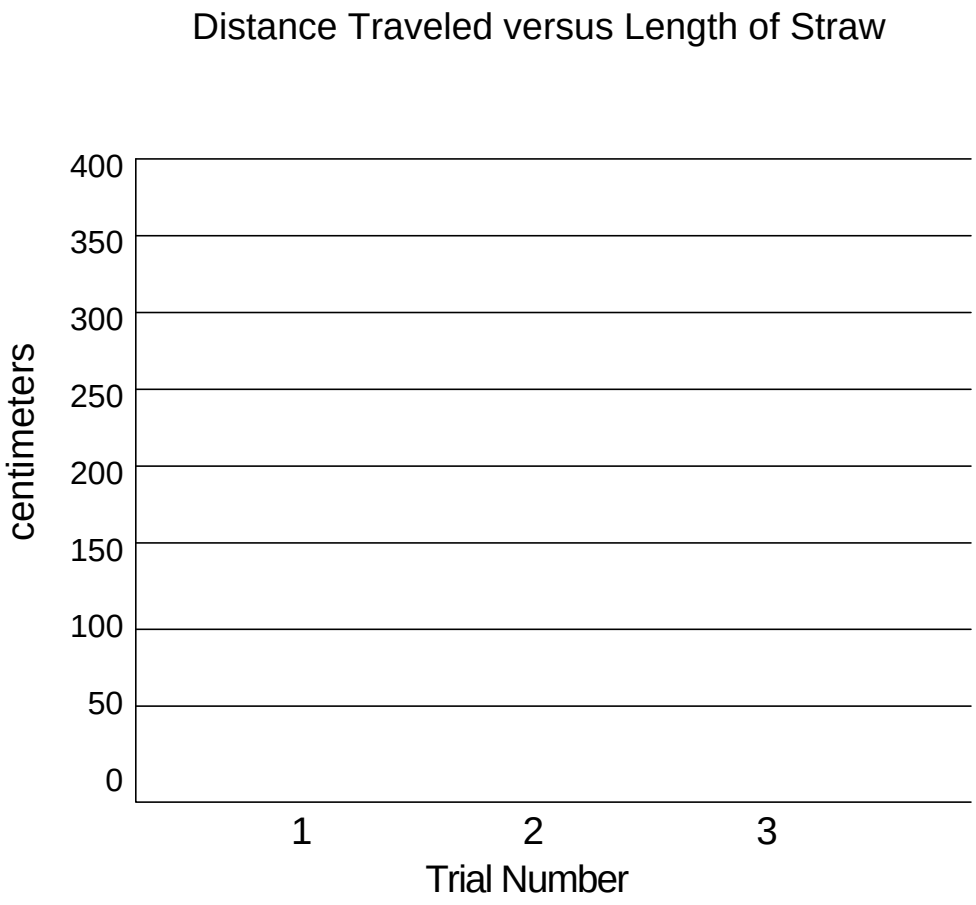
Last session, you designed and built your NASA satellite to go to the Moon. This session, you will **plan** and **create** a balloon rocket, and attach your satellite to the balloon. You will then launch your satellite using the balloon rocket. **You want to shoot the rocket the farthest distance.** Build your rocket with ONE balloon attached to a piece of drinking straw, which will slide along a fishing line stretched between two tables.

You control the length of the drinking straw. You will find out which length of straw allows your balloon rocket to go the farthest.

DATA TABLE

Rocket Elements	**Trial 1**	**Trial 2**	**Trial 3**
Straw Length	**Short** **_____ cm**	**Medium** **_____ cm**	**Long** **_____ cm**
Distance traveled (cm)			

As you do your trials, fill in the *Distance Traveled* box for each rocket trial then fill in the graph on the next page.


Distance Traveled versus Length of Straw
400
350
300
250
200
150
100
50
0
centimeters
1
2
3
Trial Number

2. Balloon Rocket Design

Top View of Our Balloon Rocket

Side View of Our Balloon Rocket

3. *Improvement Phase of Rocket Design*

Now that you have experimented with all of the different lengths of straw, build your final rocket – the one you expect to go the farthest.

Which straw length did you choose? Why did you choose it?

DATA TABLE

Rocket Elements	**New Trial after re-design**
Balloon Shape **(long or round)**	
Balloon Length **(cm)**	
Straw Length (cm)	
Distance traveled (cm)	

If you had more time, now you could test another rocket element, like Balloon Length!

4. Summary: Questions/Discussion for Understanding

What was the greatest challenge today for your team?

If you had more time to create and test the rocket, what rocket elements would you change and why?

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Team Name:_____

Fun with Engineering at Home

Activity 2: Launch your Lunar Satellite

Today we designed and built a rocket model to send our lunar satellite to 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 rocket. Finally, we **EXPERIMENTED** or tested our rocket by having other groups look at it, launch it and give us feedback. Last, we went back to our team station and tried to **IMPROVE** our rocket. 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 rockets – how they work, what they are used for, and how we get them up into space. You may even want to see if you can find out what kind of satellites rockets carry into orbit. What kinds of rockets carry people?

You can find this information in books, magazines or even on the Internet.

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

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

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

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

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

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Quality Assurance

Checking Each Other's Balloon Rocket Assembly

Team Name:_____

Participants' Names: _____

_____

_____

***To be filled in by the Quality Assurance team*:**

Fill out the table below and launch the rocket. Then fill out the distance traveled.

Balloon Shape	
Balloon Length (cm)	.
Straw Length (cm)	
Distance traveled (cm)	

What are some of the strengths of this team's design?

What are some weaknesses of this team's design?

List 2-3 recommendations you have to improve the design:

1.

2.

3.

Inspected by Team:

_____

Participant Signatures _____

_____

_____