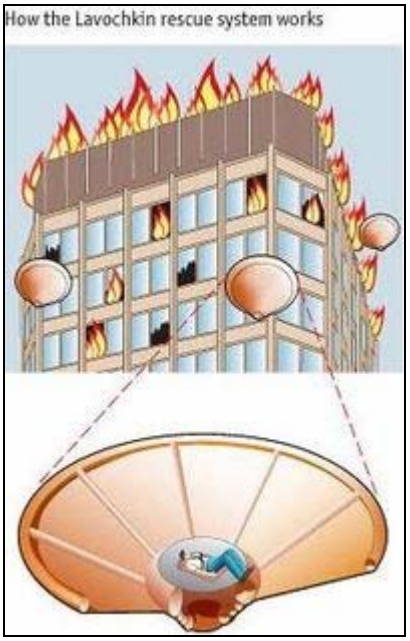
Activity Title: The Rover has Landed!

Activity Objective(s): The Landing Pod, with the Lunar Transporter Rover inside, is to land and deliver the payload safely and upright when dropped from a significant height.

Grade Levels: 6 - 8

Lesson Duration: One 60-90 min session

Process Skills: predicting, observing, measuring, evaluating



The Lavochkin Association, a Russian aerospace firm, invented the **Lavochkin Rescue System** for escaping from burning buildings.

Materials and Tools (per group of three students):

- General building supplies and tools
- Bubble wrap (available, but not required)

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

1. The Rover Has Landed! Data Table and Discussion Questions
2. Summary
3. Fun With Engineering at Home

Club Facilitator or Teacher Notes by Stage:

(Based on those running 60-minute Clubs)

Stage 1: Set the Stage, Ask, Imagine, Plan (Approx 15 minutes)

- Remind the students of the **Design Story** (in the Unit 2 Overview) and today's **Challenge: Today the Landing Pods, with the Lunar Transporter Rovers inside, will be dropped from _____ m.** (Tell them from how high the Landing Pods will be dropped.)
- Ask the following questions in preparation for the launch. Encourage all students to participate in the discussion.

1. What were your design constraints on the combination of Landing Pod and Lunar Transporter Rover?
2. When you were designing the Landing Pod, what were the decisions you had to make to meet the design constraints?
3. What are you most concerned about when your Landing Pod hits the surface?

Stage 2: The Landing (Approx 5 minutes per team)

- Hand out the ***Landing Data Table*** (1 worksheet per team).
- Gather the teams together – everyone should observe all of the landing events.
- Bring one of the balances near the drop site. Remind the teams that they have a maximum mass limit that includes the Lunar Transporter Rover plus the Landing Pod of 300 grams. Check the mass of each "loaded spacecraft." The students should write the mass on the top of the Landing Data Table.
- One at a time, "drop" the Landing Pods (from a second story window is best. If you are dropping from a ladder, add some force to the drop and/or give it a vigorous throw outward and/or upward).
- Open each Landing Pod after it comes to rest. First check to see if the Rover is upright. Place ramp up against the Landing Pod and let the Lunar Transporter Rover roll out. (It might require a little push.)

- The students should:
    1. Check to see if the Rover landed upright.
    2. Measure height of ramp.
    3. Measure the length of ramp.
    4. Measure the distance the rover rolls.
    5. Check to see if the egg stayed closed.

Stage 3: Improve (Approx 10 minutes)

- Students answer the discussion questions on the worksheet as a team.
- Students **IMPROVE** (Re-Design and Re-Build) their Landing Pods based on their observations from the first drop.
- If there is time, after the teams make changes to their Landing Pods, the teacher will drop it again. (Everybody doesn't need to watch this time.) The students should collect the measurements for the second trial on the **Landing Data Table**.

Stage 4: Landing Challenge Closure

- Hand out the Summary Sheets (please collect one per team and save in a folder for NASA).

Stage 5: Previewing Next Week (Approx 5 minutes)

- Up until now, we have been thinking about how to get to the Moon. Starting next week, we will be thinking about what it takes to live on the Moon.

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The Rover has Landed!

Mass Constraint:

Lunar Transporter Rover + Landing Pod = _____ grams.

Landing Data Table

Trial	Drop Height (m)	Ramp Rise-over-Run	Distance Rolled (cm)
1			
2			
3			

Post Landing Questions

Did your Landing Pod remain closed during impact?

Did the Pod land such that the Rover is upright when unwrapped?

Did the egg remain closed during impact?

Did your rover roll down the ramp?

How far did it roll?

Did you need to make design changes?

If so, what changes did you make?

2. Summary

Consider the entire project: designing and building the Lunar Transporter Rover, designing and building the Landing Pod, and actually launching the Landing Pod with the Lunar Transporter Rover inside. What was the most challenging aspect of this process?

Did you think about the whole process when you were designing the Lunar Transporter Rover? Did you worry about how it would survive the landing as you were building it, or did you not think about that until you were building the Landing Pod?

If you were to start this project again, would you change the design of the Lunar Transporter Rover? If so, how?

Would you change the design of the Landing Pod? If so, how?

Team Name:_____

Fun with Engineering at Home

Activity 7: *The Rover has Landed!*

Today we simulated the landing of the Landing Pod containing the Lunar Transporter Rover. This activity models the way the Mars Exploration Rovers were landed onto the surface of Mars.

Tell your family about how your Landing Pod survived the stress of impact. What were its strong points? If you could design it again, would you do anything different?

Home Challenge: During this week, talk to your family members to see if they have any ideas on how to improve the Landing Pod. Write a one-page letter to the NASA engineers working on lunar exploration telling them of your suggestions for building a Landing Pod that will deliver its payload safely to the surface.

Bring these letters to the NASA STEM Club next week, and your teacher will turn them in to NASA. The letters will be reviewed, and the best letters will be posted on the World Wide Web. Neatness and spelling count!!

Your teacher will be given the Web address where you can see which letters get selected for posting.

Please put your name ONLY ON THE BACK of the letter, not on the front of the letter, because NASA is not allowed to post the names of children on the World Wide Web. Be sure to include your teacher's name and the name of your school.