Activity Title: Design a Landing Pod!

Activity Objective(s): The teams' challenge is to design and build a Landing Pod for the model Lunar Transporter Rover that they built last week.

Grade Levels: 3-5

Lesson Duration: One 60-90 min session

Process Skills: measuring, calculating, designing, evaluating

Apollo 11 Lunar Module
Descent Nozzle
http://history.nasa.gov/ap11ann/kippsphotos/apollo.html

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. Landing Pod Design Challenge
2. Landing Pod Imagine and Plan Sheets
3. Experiment Notes and Data Table
4. Fun With Engineering at Home
5. Quality Assurance Sheets

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)

- Share the **Design Story** (in the Unit 2 Overview) and **Challenge** (in teacher pages) orally with the students. The story provides the context and motivation for trying to accomplish the challenge. This is the **ASK** phase of the Engineering Design Process.
- Discuss the Mars Rover Entry, Landing and Descent video called "Six Minutes of Terror." (Available on Blackboard Site) Remind them why a parachute won't work on the Moon (no atmosphere on the Moon). Discuss this idea briefly to check for understanding of concepts.
- The NASA website with more video on the Mars rovers is: http://marsrover.nasa.gov/gallery/video/challenges.html
  The "Six Minutes of Terror" video is near the bottom of the page in the **Entry, Descent and Landing (EDL)** section.
- 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.
- Hand out the ***Landing Pod Design Sheet*** (1 of each of these worksheets per team).
- Let the challenge begin - Encourage them to **IMAGINE and PLAN** before building. Ask them to use their worksheets to capture their design ideas.
- Assign a final drop height to be used in the lunar landing simulation and write this on the board.

Stage 2: Create (Approx 20 minutes)

- Challenge the teams to **CREATE** or build their Landing Pod based on their designs. Remind them to keep within specifications. Remind them that they have a mass limit that includes the rover they made last session today plus the Landing Pod that they will make today (300 grams max).
- Ask members of each team to check mathematical calculations and check designs and models to make sure they are within specified design constraints.

Stage 3: Experiment – (Approx 20 minutes)

- The students should test to make sure that the rover, carrying the plastic egg, fits inside the Landing Pod. (All cargo placed inside the plastic egg from the previous lesson should be removed.) When dropped, the Landing Pod should land right side up and they should also be sure that they are able to open it, without damaging the Rover, and making sure the landing pod is reusable, after it comes to rest.

Stage 5: Challenge Closure – After week 3

The Summary of this activity will come after the simulated lunar landing.

Stage 6: Previewing Next Week (Approx 5 minutes)

- Ask teams to bring back their Lunar Transporter Rover model and the Landing Pod 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.
- Remind the teams that their Landing Pods, loaded with their Lunar Transporter Rovers will be "landing" (after being dropped out a second story window? Or at least off a tall ladder, or the top of a staircase. Just make sure they know from how high their models will be dropped.)

Special Notes: For Those with 90 minute Clubs

Quality Assurance - (Approx 15 minutes)

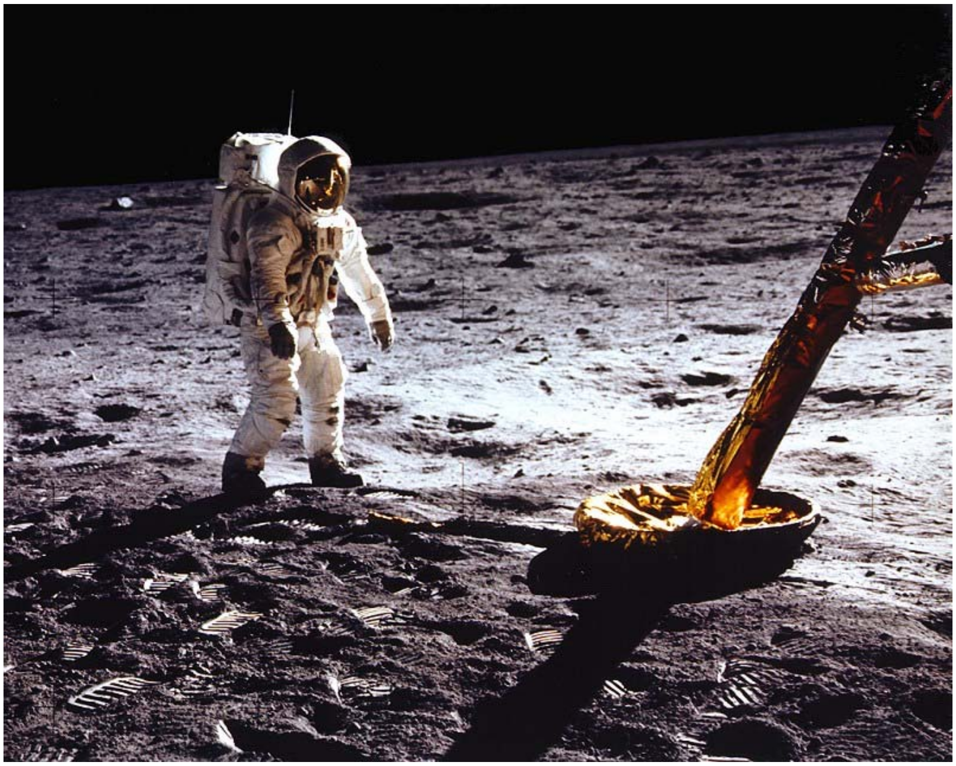
- Discuss how important FEEDBACK is for engineers. Hand out the ***Quality Assurance*** worksheets (1 per team) and ask them to fill out the top section with team name and participants' names.
- Ask each team to put their Landing Pod with the Lunar Transporter inside, together with their ***Quality Assurance*** 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 Test worksheet. The Quality Assurance Teams will toss the Landing Pod up in the air to see if it lands right side up. Note, Quality Assurance Teams should also check the mass of the loaded Landing Pod using a balance.
- Teams then return to their stations and discuss the comments from the Quality Assurance Team. What changes were suggested? Do they make sense?

Design Challenge

The **Landing Pod** must meet the following Engineering Design Constraints:

- It must safely deliver your Lunar Transporter Rover to the surface from a height given to you by your teacher.
- The Rover, inside the pod, must land RIGHT-SIDE up. (The rover must be able to "roll out", so it must land in the correct orientation with wheels on the surface.)
- The landing pod must be reusable. You must be able to open it, retrieve the Lunar Transporter Rover, and then use the Landing Pod again.

The combined mass of the Lunar Transporter Rover and the Landing Pod must be 300 grams or less.



Buzz Aldrin and the Apollo 11 lunar Module on the Moon

http://history.nasa.gov/ap11ann/kippsphotos/apollo.html

1. Landing Pod Design Challenge

Apollo 11 Lunar Module
Descent Nozzle

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2. Imagine and Plan Worksheet *Page 1*

From how high will your Landing Pod (with the rover inside) be dropped?

How will you protect the rover inside the Landing Pod?

How will you make sure the Landing Pod lands right-side up?

What will protect the outside of the Landing Pod?

How will you get the rover to roll out of the Landing Pod?

Imagine and Plan Worksheet Page 2

Side view of Landing Pod

Sketch the "door" or "hatch" component of the Landing Pod:

3. Experiment Notes and Data Table

Make two test drops with your Landing Pod. The first drop should be half the height of the final drop. Note carefully how it lands and think about what changes you should make to improve the landing for the final time.

Final Drop Height: ________ m (Assigned by your teacher.)

Trial	Drop Height (m)	Observations
1	½ of the final drop height: ____________	
2	Final drop height: _____________	

What is the biggest difficulty your rover faces?

What changes will you make to strengthen your design?

Team Name:____

Fun with Engineering at Home

Activity 6: *Design a Landing Pod for the Lunar Transporter Rover!*

Today we designed and built a Landing Pod for the Lunar Transporter Rover model we built last week. The Landing Pod must safely deliver the rover by protecting it from the impact and landing upright. Next week, the "landing" will take place.

Home Challenge: During this week, see what you can learn about landings that have taken place in the past. For example, NASA has landed spacecraft on the Moon and Mars.

Here are some questions to talk about with your parents, grandparents, brothers or sisters:

NASA has also dropped satellites into the atmospheres of Venus and Jupiter. What happened to those spacecraft?

Where in the Solar System, besides Earth, have humans visited? When was that? What kind of a lander did they use? How did it slow down before impact on the surface?

Why did Apollo 13 not land on the Moon? Who said, "Houston, we've had a problem," and what was the problem to which they were referring?

http://www.nasm.si.edu/collections/imagery/apollo/AS13/a13.htm

Quality Assurance – Checking Each Other's Landing Pods

Team Name:____

Participants' Names: ____________________________________

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To be answered by the Quality Assurance team:

Total mass of the Lunar Transportation Rover + Landing Pod is: ________grams

Did the Landing Pod land upright when dropped from a height of 1 meter?

YES or NO

Specific Design Strengths

Specific Design Weaknesses

How would you improve this design?

Inspected by Team: ______________________________________

Participant Signatures ________________________________

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