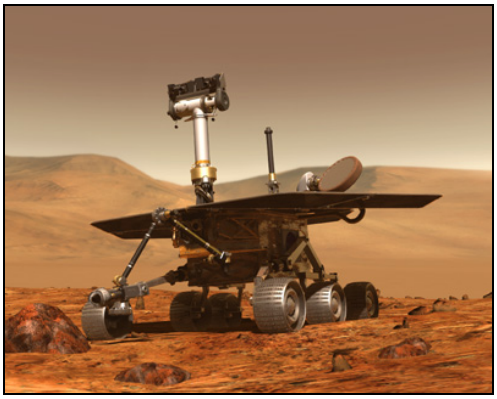
Activity Title: Design a Lunar Transporter Rover!

Activity Objective(s): The teams' challenge is to design and build a model of a Lunar Transporter Rover that will carry equipment and people on the surface of the Moon. It must be able to roll down a ramp. Next week they will design and build a landing pod for this rover, and the week after that, they will simulate a lunar landing. The goal is that the rover survives the landing so that it can roll down a ramp.



Artist conception of a Rover: Courtesy NASA
Two rovers that look like this are on Mars NOW! See http://marsprogram.jpl.nasa.gov/ for more information on the Mars Exploration Rovers

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 and tools
- (2) small plastic people (approx 2 cm each)
- (1) plastic egg
- (10) pennies to represent cargo weight
- (4) plastic wheels
- Something to use as a ramp (a book would work – but preferably a flat surface that would enable the rover to roll for 25 cm or more)
- Metric rulers

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

1. Lunar Transporter Rover Design Challenge
2. Lunar Transporter Rover Imagine and Plan Sheets
3. Experiment/Observation Notes Sheet
4. 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)

- Share the **Design Story and Challenge** orally with the students (provided in 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.
- Show the Mars Rover Entry, Landing and Descent video called "Six Minutes of Terror." (Available on Blackboard Site) Ask them to pay attention to the ways NASA slowed the rovers down as they entered the atmosphere. Tell them to keep in mind that some of the techniques will work on the Moon, and some will not. They should think about what the difference would be (no atmosphere on the Moon which means a parachute device won't work).
- The NASA website with more video on the Mars rovers is: `http://marsrover.nasa.gov/gallery/video/challenges.html`
- 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 ***Lunar Transporter Rover 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.

Stage 2: Create (Approx 20 minutes)

- Challenge the teams to **CREATE** or build their Lunar Transporter Rovers based on their designs. Remind them to keep within specifications.
- While each group is working, the teacher should create a ramp in which all groups will use to roll their rovers and record observations.

Stage 3: Experiment – (Approx 10 minutes)

- Students will let their rover roll down the ramp and record their observations.
- Students will test how much cargo weight their rovers can support by adding pennies to the plastic egg. Each penny is equal to 1 g of cargo weight.

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

- Students **IMPROVE** (Re-Design and Re-Build) their Lunar Transporter Rovers models based on results of the EXPERIMENT phase.

Stage 5: Challenge Closure – After week 3

The Summary of this activity will come at the very end, after the simulated lunar landing.

Stage 6: Previewing Next Week (Approx 5 minutes)

- Ask teams to bring back their Lunar Transporter Rover 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 potential landing pods during the next week. Tell them they will be building the landing pod out of the standard materials that have been available to them. The pod will be dropped from as high as possible (out a second story window? at least off a tall ladder, or the top of a staircase).

Story and Design Challenge:

Let's Go For A Ride!

Over the past weeks, we have spent some time thinking about how to get to the Moon. Now we need to think about landing on the Moon, and what we are going to do once we get there. NASA has two very famous rovers on Mars already. Their names are ***Spirit*** and ***Opportunity***. They landed on Mars in a very interesting fashion: they fell out of the Martian sky and bounced on the surface until they came to a stop! How did they do that? They were inside a landing pod made of...AIR BAGS! Wasn't that a clever idea?

Now it's your turn! Your job over the next three weeks is to build a model of a Lunar Transporter Rover. The rover's job will be to carry people and cargo on the Moon. You also have to figure out a way to land your Lunar Transporter Rover safely on the surface by designing and building a Landing Pod. Once the landing is complete, you will open the Landing Pod and roll your Lunar Transporter Rover down a ramp.

(The "landing" is simulated by the facilitator. Suggestions: toss it out of a second story window, or toss it across the classroom. Just be sure the students know ahead of time what they are designing for.)

Design Challenge

The Lunar Transporter Rover must meet the following Engineering Design Constraints:

- Carry one plastic egg snugly. The egg may NOT be taped or glued into place. (The egg will be what materials are carried in around the Moon.)
- Carry cargo weight inside the plastic egg, represented by pennies. Groups should test how much cargo weight they can carry in the egg and record this observation (1 penny = 1 g of cargo weight).
- Have room for two plastic people. (The people do not land with the rover. They will get in the rover on the Moon and drive it around.)
- Roll on its own down a ramp about 25 cm or more.
- Survive the "landing." This means it should be able to roll down the ramp after the landing, and the plastic egg should not have popped open.

1. Lunar Transporter Rover Design Challenge

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Design Challenge

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- Survive the "landing." This means it should be able to roll down the ramp after the landing, and the plastic egg should not have popped open.

2. Imagine and Plan Worksheet *Page 1*

What parts do you need to make your rover roll?

What will hold the egg in place?

Imagine and Plan Worksheet Page 2

Sketch of our Lunar Transportation Rover

Experiment **Page 3**

Observation Notes

How many pennies can your rover carry?

_____ pennies

How many grams of cargo weight can your rover carry?

(Remember: 1 penny = 1 gram of cargo weight)

_____ grams

How far does your rover roll down the ramp? _____ cm

Team Name:_____

Fun with Engineering at Home

Activity 5: *Design a Lunar Transporter Rover!*

Today we designed and built a Lunar Transporter Rover model to transport people and cargo on 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 Lunar Transporter Rover. 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 rover. 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 rovers that NASA has already built and used. For example, you can learn about the challenges in building the Mars Exploration Rovers from this website:

http://marsrover.nasa.gov/gallery/video/challenges.html

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

NASA used a parachute to slow the descent of the Mars rovers onto Mars. Why can we not use a parachute to land a spacecraft on the Moon?

They also used a heat shield on the Mars entry spacecraft. Why do we not need one of those on the Moon?

What is the most important consideration when designing a rover that will carry people and cargo?

What kind of cargo might the rover need to carry on the Moon?