Design a Landing Pod

DESIGN challenge

To design and build a Landing Pod for the model Lunar Buggy that was built in the previous session.

OBJECTIVE

To demonstrate an understanding of the Engineering Design Process while utilizing each stage to successfully complete a team challenge.

PROCESS SKILLS

Measuring, calculating, designing, evaluating

MATERIALS

Lunar Buggy with egg cargo

General building supplies

Meter stick

Balloons

Bubble wrap and/or packaging material

Cardboard and/or shoeboxes

STUDENT PAGES

Design Challenge

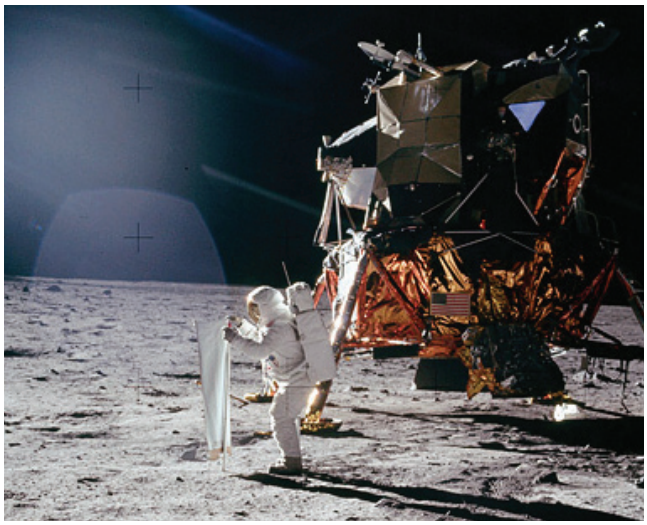
Ask, Imagine and Plan

Experiment and Record

Please note: This activity may require two 60-90 minute sessions to complete.

landing pod

MOTIVATE



- Show the video titled "Entry, Decent, and Landing (EDL)."

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

- Ask students to pay particular attention to the ways NASA slowed the rovers down as they entered the atmosphere. Note the difference between the Martian atmosphere and that of the Moon.

SET THE STAGE:

ASK IMAGINE **& PLAN**

- Share the *Design Challenge* with the students.
- Remind students to imagine a solution and draw their ideas. All drawings should be approved before building.

CREATE

- Challenge the teams to build their Landing Pod based on their designs. Remind them the Lunar Buggy must be secured inside the Pod but cannot be taped or glued in place. Students should also be sure that the egg inside the rover is empty.

EXPERIMENT

- Each team must complete three trial drops and record observations.
- The actual "landing" is simulated by the facilitator. Suggestions: Drop Landing Pods safely out of a second story window, from a landing of a stairwell or from the top of a ladder. (Safety note: follow the manufacturer's recommendation when using a ladder.) Just be sure the students know ahead of time what to expect.
- Open each Landing Pod after it comes to rest and check Buggy is upright.
- Using the same ramp as last session, place the Landing Pod at the top of the ramp and let the Lunar Buggy roll out. (It might require a little push.)
- The students should measure the distance the Buggy rolls and check to see if the egg stayed closed.

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IMPROVE

- Students improve their Landing Pods based on results of the three trial drops.

CHALLENGE CLOSURE

Engage the students with the following questions:

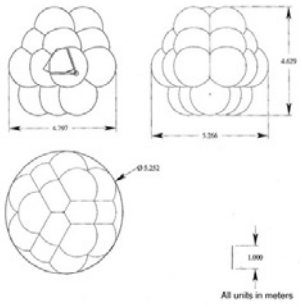
- *Which materials worked best to protect the Lunar Buggy?*
- *If you knew you ahead of time that your Buggy had to survive a landing, would you have made any changes to your design?*

PREVIEWING NEXT SESSION

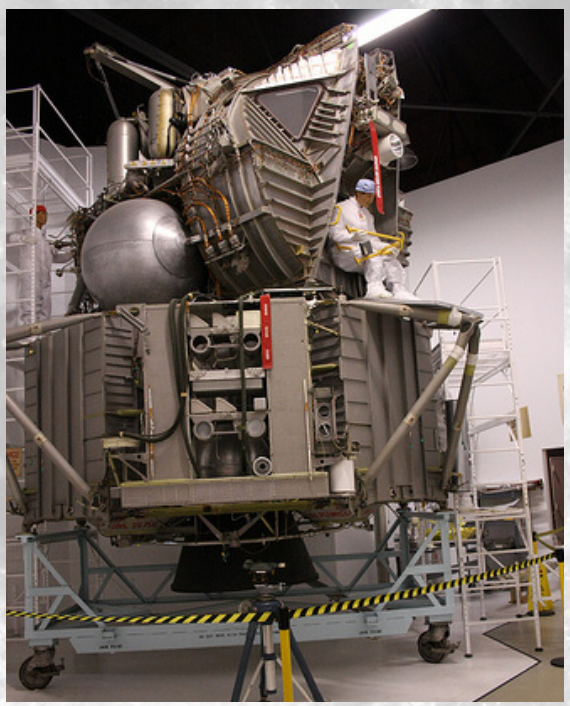
Soon NASA will send the next generation of explorers to Mars or other destinations in the solar system aboard a new *Crew Exploration Vehicle* (CEV). The next session will have teams design and build a CEV that will carry two - 2 cm sized passengers safely and will fit within a certain size limitation.

Design a Landing Pod
Teacher page

landing pod



Fragile Cargo! Handle with Care!



Now that you have designed a Lunar Buggy that will transport astronauts around the lunar surface, you need to think about safely delivering this vehicle to the Moon. When NASA sent its two robotic rovers, ***Spirit*** *and* ***Opportunity****, to Mars, they landed on Mars in a very interesting fashion. They fell out of the Martian sky, slowed down by a parachute and then bounced on the surface until they came to a stop! How did they do that? The rovers were inside a landing pod made of AIR BAGS! But the Martian atmosphere and surface is very different from the Moon, so to repeat this on the Moon would require several design modifications.*

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THE CHALLENGE:

Each team must design and build a Landing Pod that will safely deliver your Lunar Buggy to the Moon's surface. The Landing Pod must meet the following constraints:

1. *The Landing Pod must safely deliver your Lunar Buggy to the surface from a height given by the teacher.*
2. *The Landing Pod must land RIGHT-SIDE up, and the Lunar Buggy roll out in the correct orientation.*
3. *Materials of the Landing Pod must be reusable for other missions on the lunar surface. If a balloon pops or tape folds over on itself, those items are no longer reusable.*
4. *The Landing Pod must have a hatch or door for release of the Lunar Buggy, and should then roll out with no more than a nudge onto the ramp. Therefore, the Lunar Buggy cannot be taped or glued inside the Landing Pod.*
5. *The Lunar Buggy should not suffer any damage from the lunar landing and still be able to roll down a ramp.*

Design a Landing Pod **Student page**

landing pod

ASK IMAGINE &PLAN

What questions do you have about today's challenge?

From what height will you drop your Buggy for testing?_____

How do you plan to protect the rover inside the Landing Pod?

What will you use to protect the outside of the Landing Pod?

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

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landing pod

Design a Landing Pod
Student page

Draw your Landing Pod:

Outside view with door or "hatch"

Inside view with your Lunar Buggy

Approved by: _____

Experiment & Record

Make two test drops with your Landing Pod, but the first drop should be half the height of the final drop height given by your teacher. For example, if the final test drop is 3 meters, you should first test a drop at 1.5 meters (150 cm). Record what happens to your Landing Pod and the Lander inside.

Landing Pod Drop Test Data Table

Trial	Drop Height (m)	Observations
1		
2		

What is the biggest difficulty that your Buggy faces?

_____

_____

_____

Name one change your team should make to your Landing Pod to improve its landing.

_____

_____

Now for the actual lunar landing! Follow your teacher's instructions, then answer the following questions.

Post Lunar Landing Questions

Did the Landing Pod remain closed during impact? (YES or NO)	Did the Lunar Buggy land in an upright position? (YES or NO)	How far did the Buggy roll beyond the ramp? (cm)

If you answered "no" to the above questions, or your Buggy did not roll down the ramp properly, explain what happened to your design or draw the damage that occurred.

_____

_____

_____

_____

_____

_____

_____

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