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.

landing pod

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

Quality Assurance Form

Fun with Engineering at Home

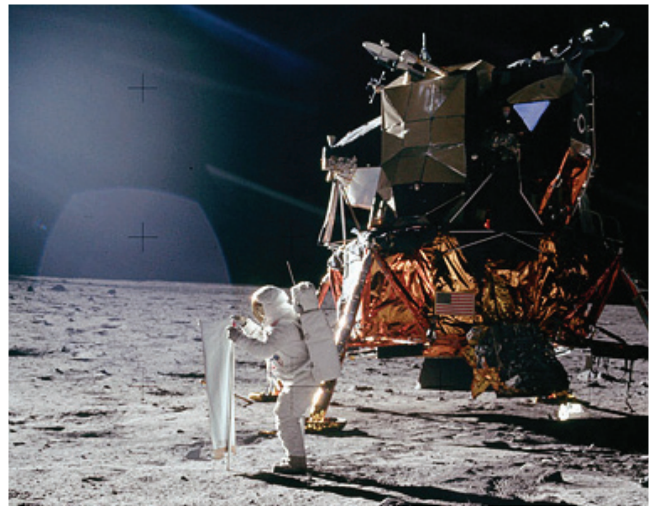
Please note: This activity may require two 60-90 minute sessions to complete.

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. Explain that with no atmosphere on the Moon, a parachute will not work!



SET THE STAGE:

ASKIMAGINE **&PLAN**

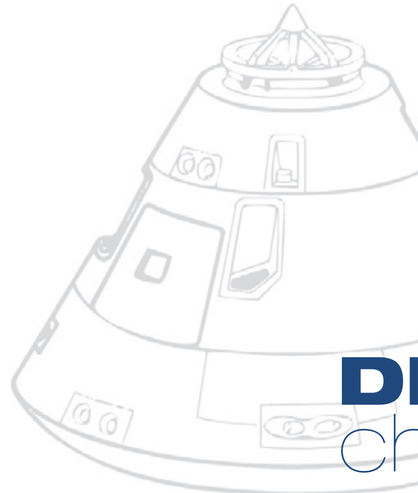
- Share the *Design Challenge* with the students.
- Remind students to imagine a solution and draw their ideas. All drawings should be approved before building.

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.

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 with a slope of 1-over-3, 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 beyond the ramp and check to see if the egg stayed closed.



IMPROVE

- Students *improve* their Landing Pods based on results of the three trial drops and roll tests.

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.

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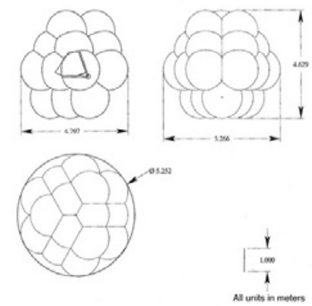
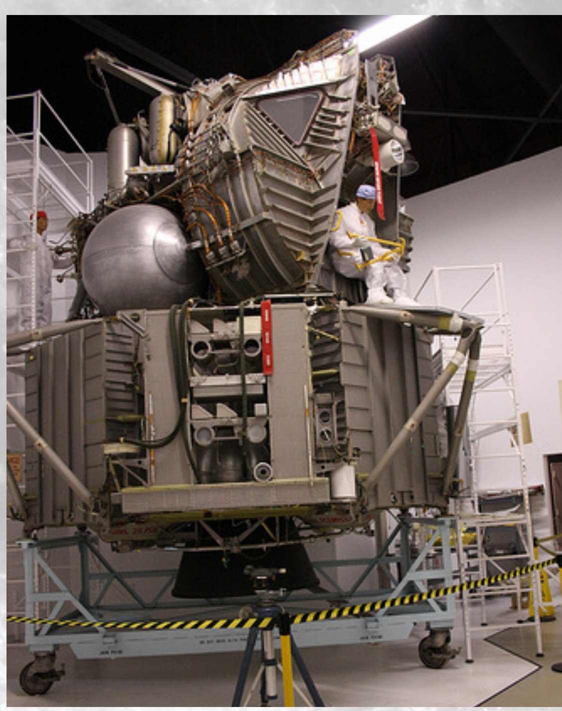
Design a
Landing Pod
Teacher page



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.

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 with a slope of 1-over-3 and 100 cm beyond the ramp.***

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Student page

landing pod

ASK IMAGINE & PLAN

What questions do you have about today's challenge?

From what height will you drop Landing Pod for testing? ________________

How do you plan to protect the buggy 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 on the surface in the Buggy's correct orientation?

____

____

____

DESIGN
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Draw your Landing Pod:

Outside view with door or "hatch"

Inside view with Buggy placement

Design a
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Approved by: ____

Experiment & Record

Perform several drop tests of various heights with your Landing Pod. Start with a height less than the height being used for the actual lunar landing (height mentioned by teacher). Note carefully how it lands and think about what changes need to be made to improve the landing.

Landing Pod Drop Test Data Table

Trial	Drop Height (m)	Observations
1		
2		
3		

What is the most difficult constraint to satisfy in your Landing Pod?

____

____

____

List the design changes made to your Landing Pod between trials.

____

____

____

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

Post Lunar Landing

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)

landing pod

QUALITY ASSURANCE FORM

Each team is to review another team's design and model, then answer the following questions.

Name of team reviewed: ____

Total mass of the Lunar Rover and Landing Pod is: ______ **grams**

Did the Landing Pod land upright when dropped from a height of ______ meters?

List specific strengths of the design.

List specific weaknesses of the design:

How would you improve the design?

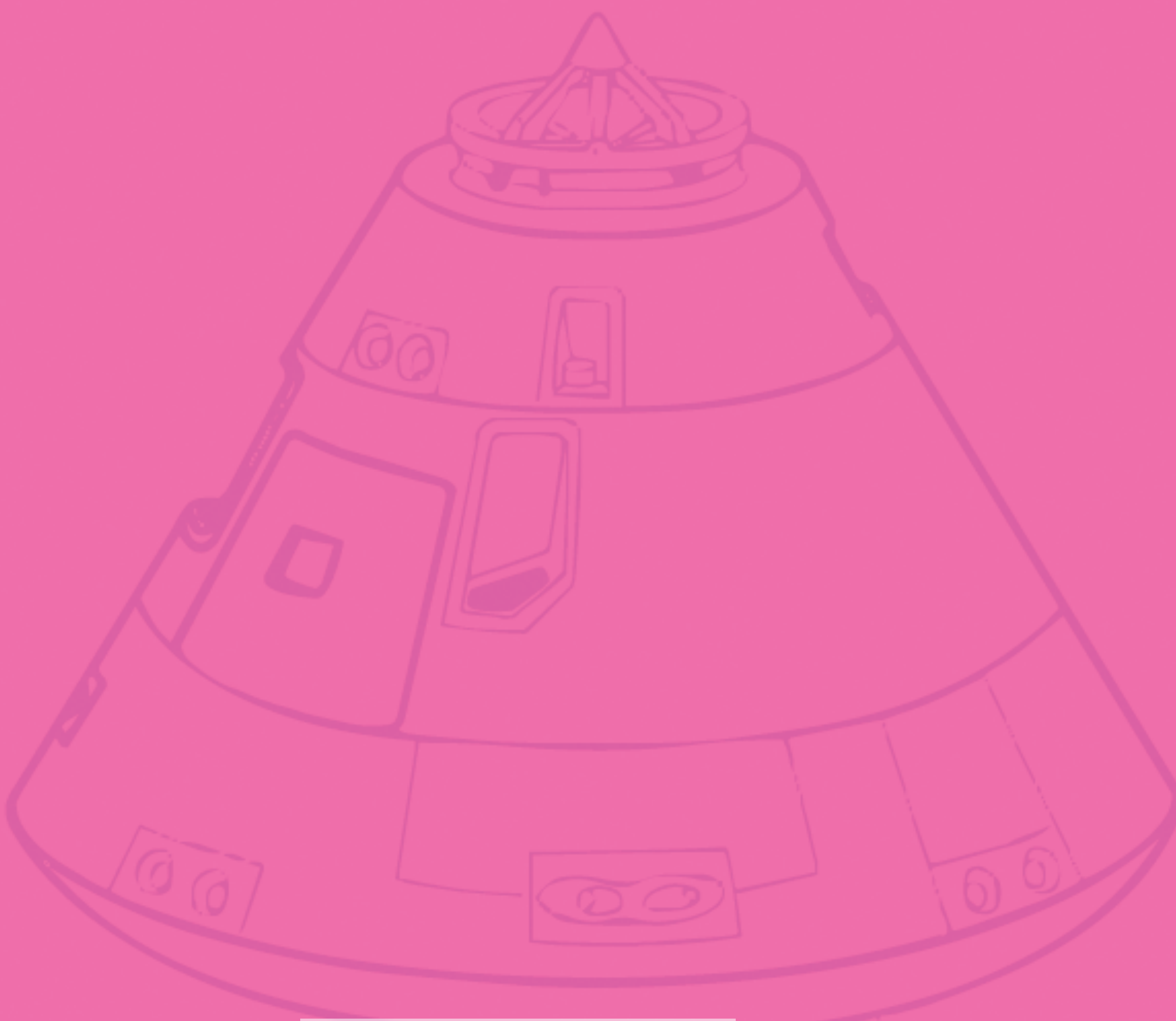
Inspected by: ____

____

____

____

Fun with Engineering at Home



TWO BIT CIRCUS FOUNDATION · INVENTING INSPIRATION · TWOBITCIRCUS.ORG

Today you simulated the landing of your Lunar Buggy on the Moon. This activity models the way the Mars Exploration Rovers landed on 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 differently? Ask family members if they have any ideas on how to improve the Landing Pod your team designed.

Mars is not the only planet NASA has visited through robotics. Do a little research with your family members to answer these questions:

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

2. When humans landed on the Moon, what kind of a vehicle did they use? How was this vehicle slowed down to prevent an impact on the surface?

CHALLENGE YOURSELF!

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.

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