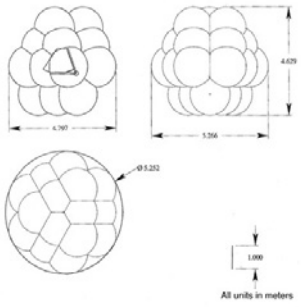
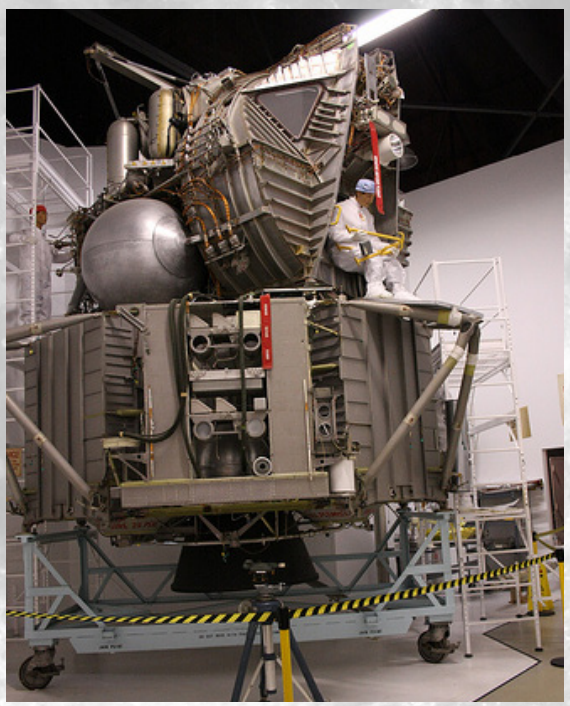


Fragile Cargo! Handle with Care!



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.

DESIGN challenge

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

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.***

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 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 challenge

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

landing pod

Design a Landing Pod
Student page

Draw your Landing Pod:

Outside view with door or "hatch"

Inside view with Buggy placement

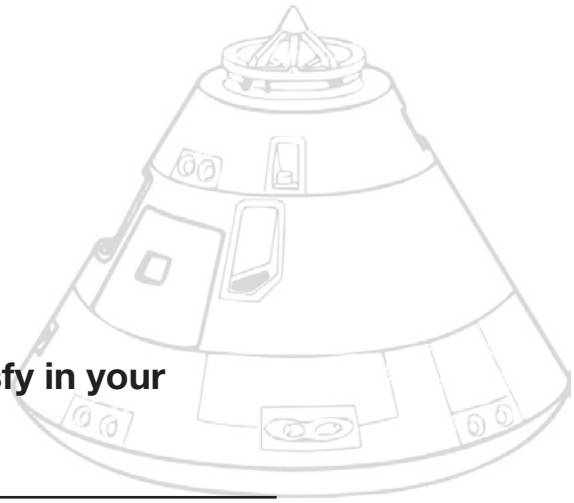
Approved by: _____

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)

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?

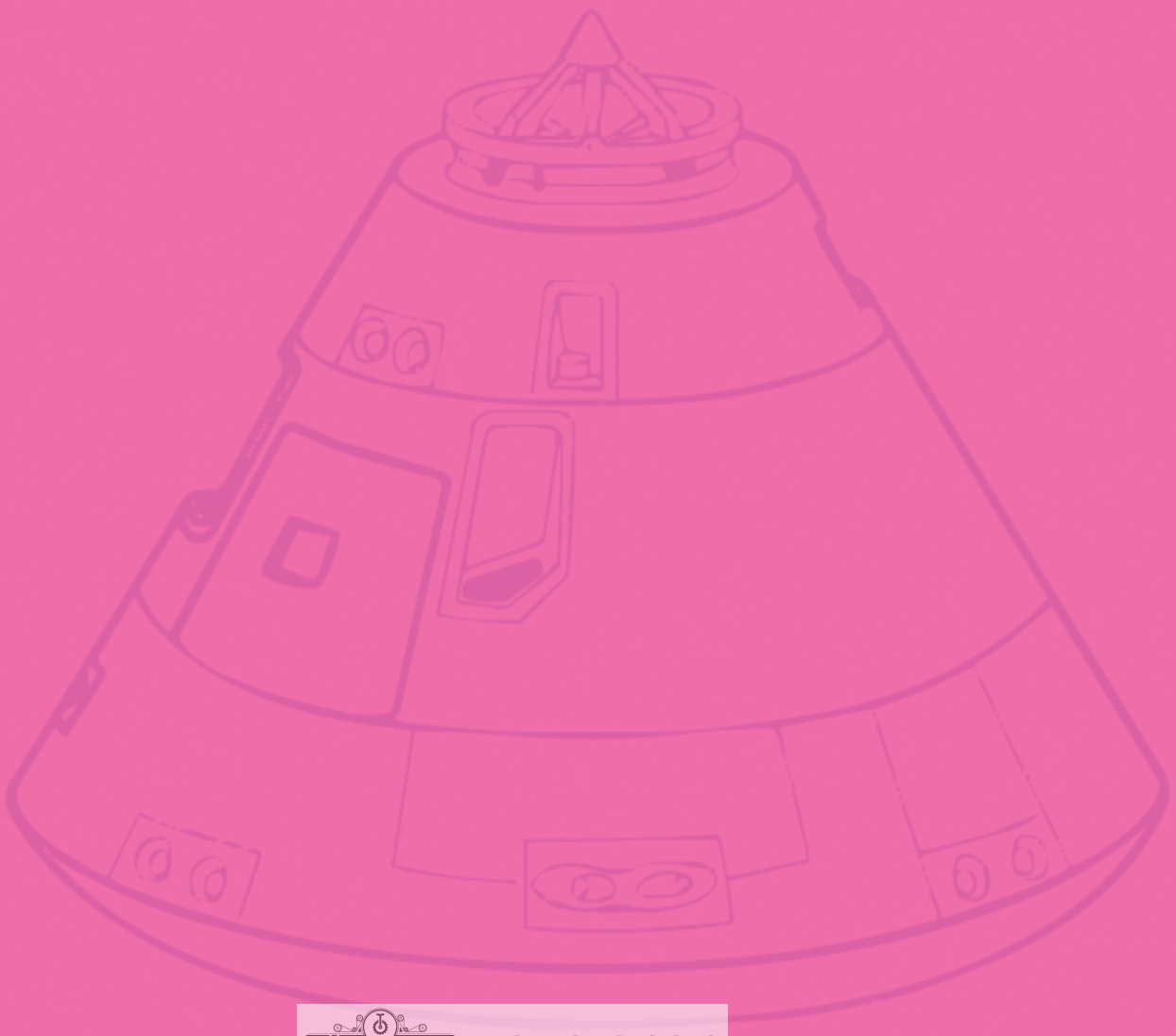
Inspected by: _____

_____

_____

_____

Fun with Engineering at Home



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.

DESIGN challenge

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

Design a Landing Pod **Student page**