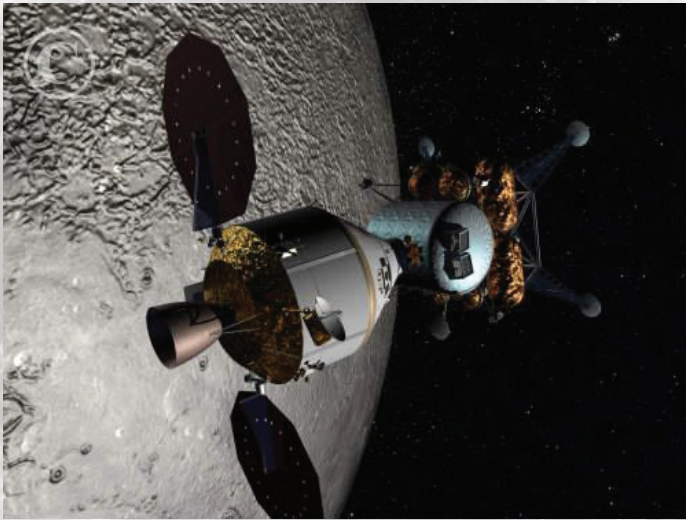


Taking humans back to the Moon...40 years later!



NASA needs a new vehicle to take astronauts to the Moon because the Space Shuttle was never designed to leave the Earth's orbit. NASA and its industry partners are working on a space vehicle that will take astronauts to the Moon, Mars, and beyond.

This spacecraft is called the Crew Exploration Vehicle (CEV). The CEV is a vehicle to transport human crews beyond low-Earth orbit and back again. The CEV must be designed to serve multiple functions and operate in a variety of environments.



THE CHALLENGE:

Each team must design and build a Crew Exploration Vehicle with the following constraints:

- 1. The CEV must safely carry two “astronauts”.**
You must design and build a secure seat for these astronauts, without gluing or taping them in place. The astronauts should stay in their seats during each drop test.
- 2. The CEV must fit within the _____.** *This item serves simply as a size constraint. The CEV is not to be stored in this or launched from this item.*
- 3. The CEV must include a model of an internal holding tank for fuel with a volume of 30 cm³.**
(Note: your tanks will not actually be filled with a liquid.)
- 4. The total mass cannot exceed 100 grams.** *Use a scale or balance to measure the mass of your design components.*
- 5. The CEV must have one hatch that opens and closes and is a size that your “astronauts” can easily enter/exit from.** *The hatch should remain shut during all drop tests.*

DESIGN challenge

To design and build a Crew Exploration Vehicle (CEV) that will carry two 2 cm-sized passengers safely and will fit within a certain volume (size limitation). The CEV will be launched in the next session.

Design a CEV
Student page

ASK IMAGINE & PLAN

What questions do you have about today's challenge?

Draw your Crew Exploration Vehicle (CEV) and show a view with the hatch. Also include an inside look (cutaway view) at where your astronauts sit and where the internal tank is positioned.

Approved by: _____

CEV Characteristics Data Table

Vehicle components	Use	Measurement or Calculation
Astronauts	Crew	Mass: _____ grams each _____ grams total
CEV	Carries crew to Moon	Mass: _____ grams
Hatch	Allows entry and exit	Dimensions: _____ cm (long) by _____ cm (wide)
Internal Tank	Stores liquid fuel	Mass: _____ grams Volume: _____ cm ³
Mailing Tube	To test size constraint	Volume: _____ cm ³

DESIGN challenge

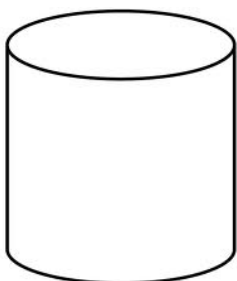
To design and build a Crew Exploration Vehicle (CEV) that will carry two 2 cm-sized passengers safely and will fit within a certain volume (size limitation). The CEV will be launched in the next session.

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Hint

– How to calculate the volume of a cylinder:

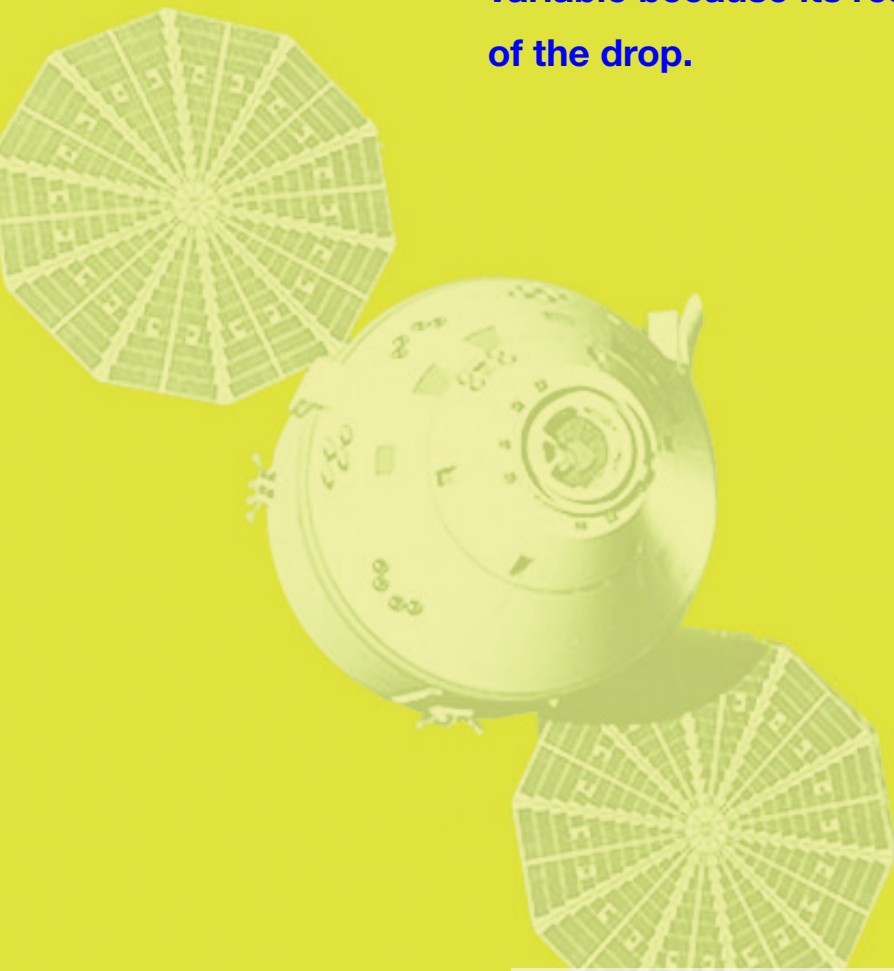
$$V = \pi r^2 h$$

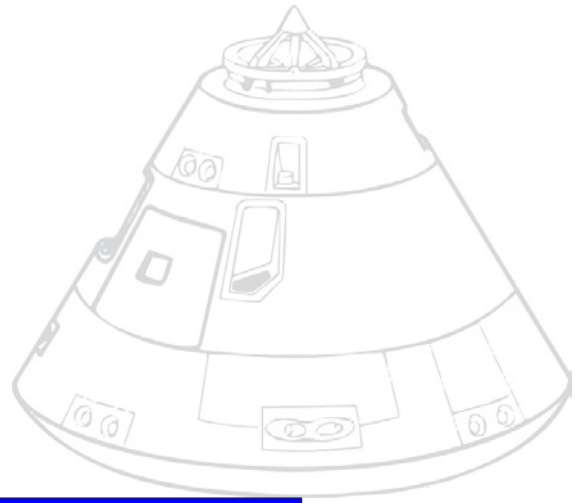


1. Find the radius of the circle found at the top and bottom of the cylinder. The radius (r) is half of the measurement of the diameter of the circle.
2. Square the radius value and multiply it by π (pi).
3. Determine the height (h) of your cylinder and multiply it by the value found in step #2.

Experiment & Record

Drop your CEV model from three different heights: 1 meter, 2 meters and 3 meters. The drop height is the *independent variable* of this experiment. Record a *dependent variable* from each drop, noting the results of the drop. For example, the number of astronauts that stayed in their seats during the drop is a *dependent variable* because its results are dependent upon the height of the drop.





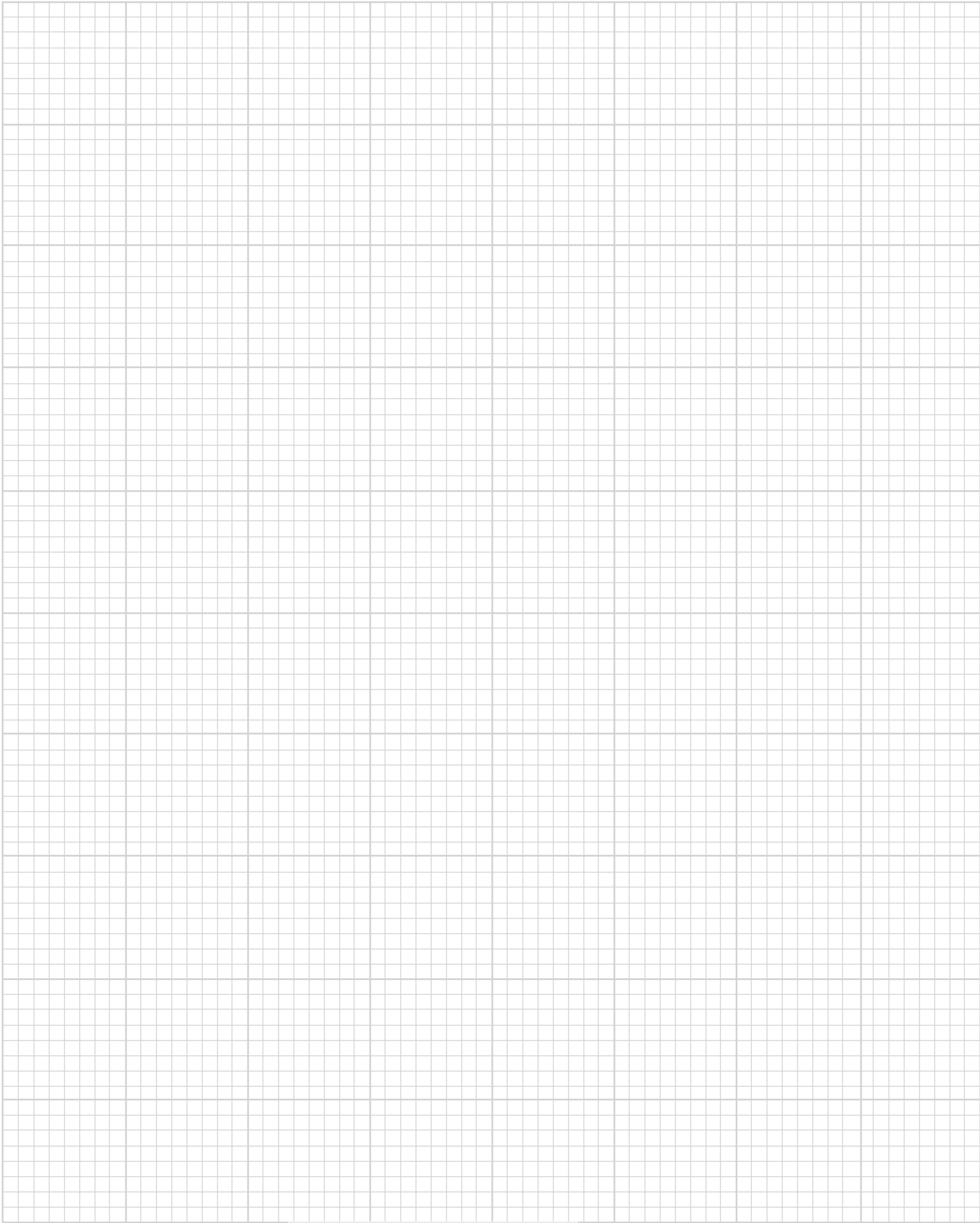
CEV Drop Test Data Table

Independent Variable Drop Height	Dependent variable(s)
1 meter	
2 meters	
3 meters	

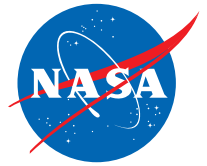
Design a CEV
Student page

What was the most difficult constraint to satisfy in your CEV?

List the design changes made to your CEV between trials.



exploration



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 Crew Exploration Vehicle is: _____ grams

Does the CEV fit within specified dimensions?

Does the hatch open and close?

Did the astronauts stay in their seats during the drop tests?

List specific strengths of the design.

List specific weaknesses of the design:

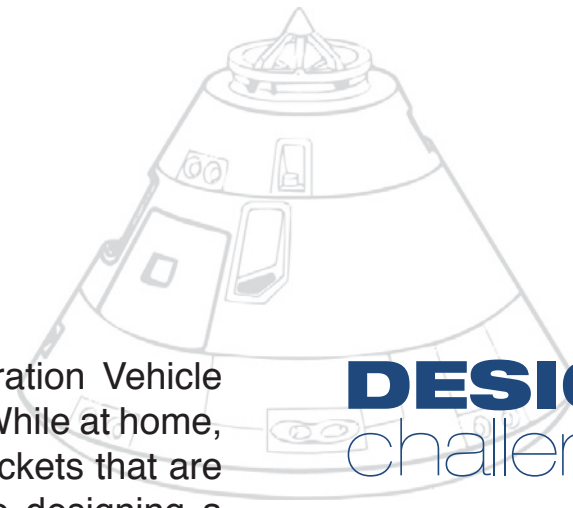
How would you improve the design?

Inspected by:

Design a
Landing Pod
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Fun with Engineering at Home





Today you designed and built a Crew Exploration Vehicle (CEV) model to carry astronauts to the Moon. While at home, see what you can learn about satellites and rockets that are launched into orbit. Next session, you will be designing a launcher for the Crew Exploration Vehicle. It will be important to test launch the CEV several times so that in the future we may send humans SAFELY into space.

DESIGN challenge

To design and build a Crew Exploration Vehicle (CEV) that will carry two 2 cm-sized passengers safely and will fit within a certain volume (size limitation). The CEV will be launched in the next session.

YOU BE THE TEACHER!

Sending humans back to the Moon is a highly debated subject amongst leading scientists, engineers, politicians and the public. Try hosting a family discussion about this topic. Use these questions as a guide:

1. *Do you believe we should send humans back to the Moon? Why or why not?*
2. *Would you want to go to the Moon?*
3. *What might be some of the dangers for humans in a new CEV?*
4. *What is the most dangerous part of the journey to Mars?*

Design a CEV
Student page

