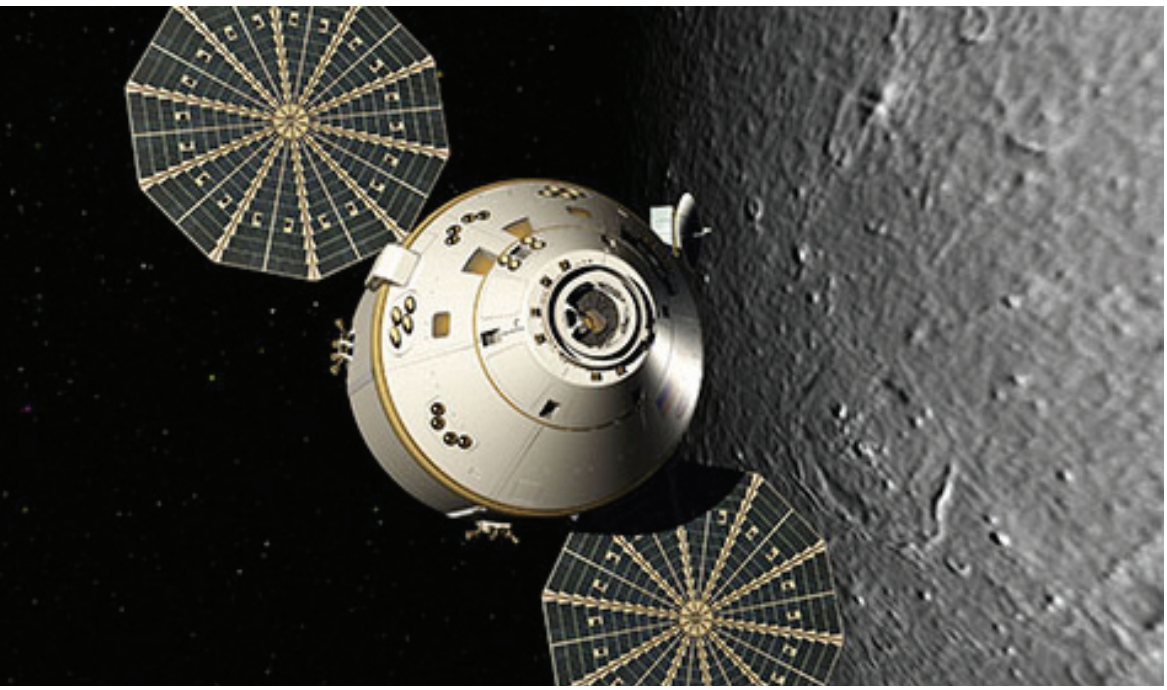
Design a Crew Exploration Vehicle



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.

OBJECTIVE

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

PROCESS SKILLS

Measuring, designing, evaluating

MATERIALS

General building supplies

Mailing tube, oatmeal canister, or small coffee can (used as size constraint)

2 plastic people (i.e. Lego)

STUDENT PAGES

Design Challenge

Ask, Imagine and Plan

Experiment and Record

PRE-ACTIVITY SET-UP

Select a size constraint (mailing tube, oatmeal canister or coffee can). Fill in the sentence on the Design Challenge so students will know what the size constraint is for their CEV.

exploration

MOTIVATE

- Show the NASA BEST video titled "Repeatability":

  http://svs.gsfc.nasa.gov/goto?10515

- Ask the students why it is important to test their own designs.

SET THE STAGE:

ASK IMAGINE
& PLAN

- Share the *Design Challenge* with the students.
- Remind students to ask questions and brainstorm ideas, then break into teams to create a drawing of a CEV. All drawings should be approved before building.

CREATE

- Challenge the teams to build their CEVs based on their designs and to keep within specifications.
- Visit each team and test their designs to ensure they fit within the size specifications of the cylinder you are using.

EXPERIMENT

- Each team should conduct two drop tests from about 1 meter. The students can simply hold the CEV model over their heads and drop it. They should record their results after each test, and note what changes they plan to make as a result of the drop test.

IMPROVE

- After each drop test, the students should improve the CEV models based on the results of the experiment.

CHALLENGE CLOSURE

Engage the students with the following questions:

- *What was the greatest challenge for your team today?*
- *Why was it important that the hatch stay closed during the Drop tests?*
- *What process will your CEV undergo that makes it important for the astronauts to stay secured in their seats?*

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PREVIEWING NEXT SESSION

Ask teams to bring back their CEV model for use in next session's challenge. You may want to store them in the classroom or have one of the facilitators be responsible for their safe return next session.

Ask teams to think about potential launch mechanisms before the next session. Tell them they will be building a launcher out of the standard materials that have been available to them, including large rubber bands.

Design a CEV
Teacher page

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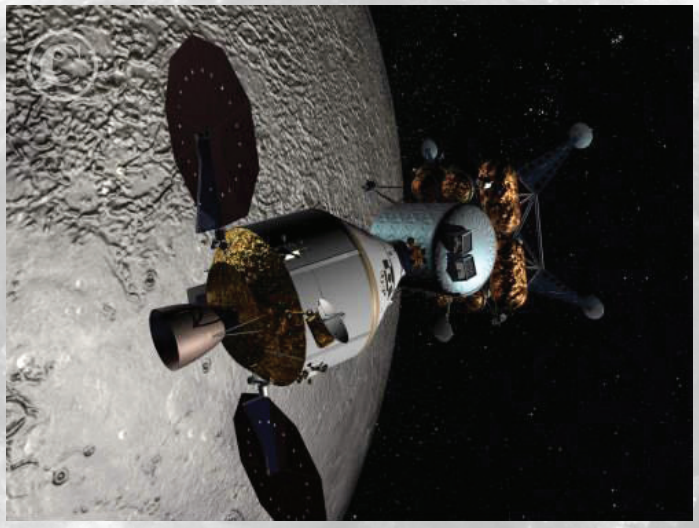
Taking humans back to the Moon...40 years later!



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.

DESIGN challenge

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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 the 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 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 a CEV
Student page

exploration

ASK IMAGINE &PLAN

Draw your Crew Exploration Vehicle (CEV) and show where the astronauts will sit.

Approved by: _____

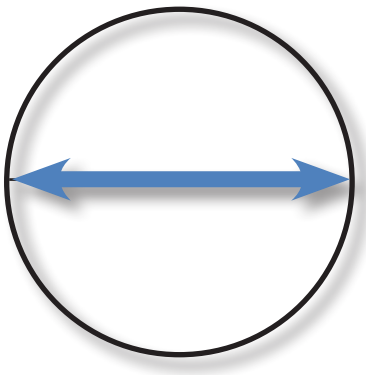
DESIGN challenge

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.

Review your team's design. Answer the questions in the table.

Vehicle components	Use	Measurement
Astronauts	Crew	How many?
CEV	Carries crew to Moon	What is the diameter (cm) of the container serving as your size constraint? Does your CEV fit the size restrictions?
Hatch	Allows entry and exit	How many people wide? How many people high?

Design a CEV
Student page



HINT!

What is diameter? The diameter is the length of a straight line that passes through the center of a circle. Use a ruler to measure the line from one edge of the circle to the opposite edge.

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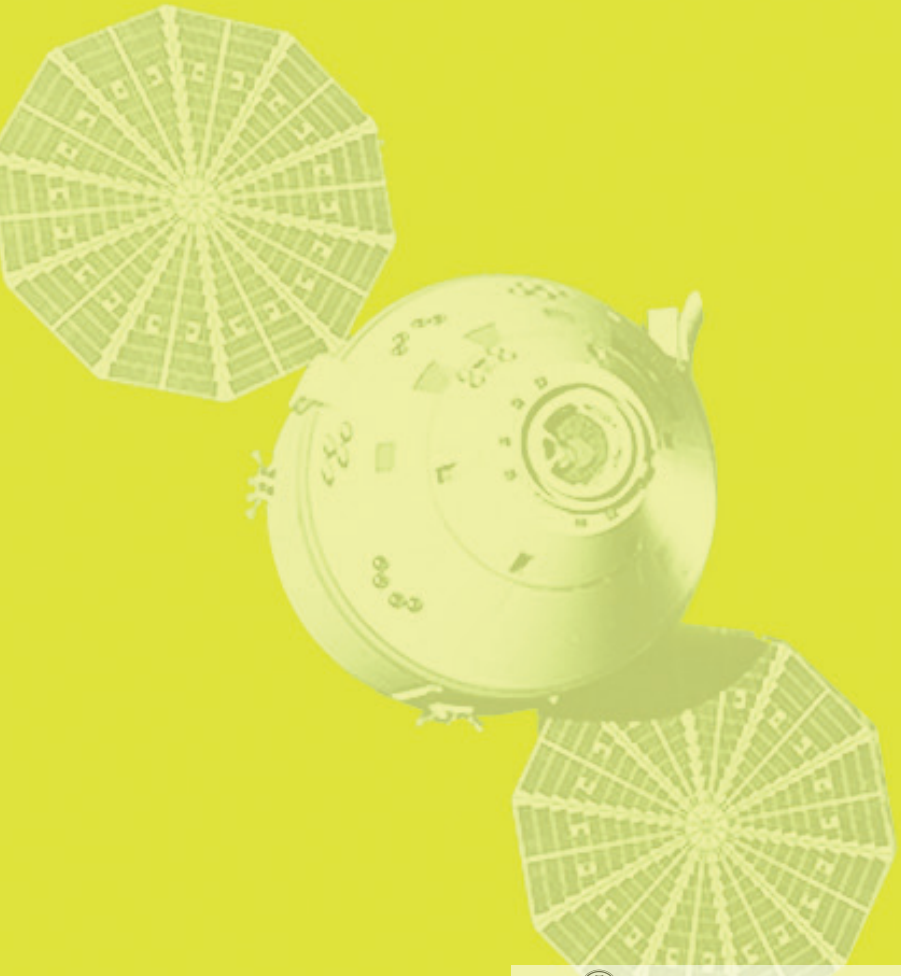
Experiment & Record



Drop your CEV from over your head.
Answer the questions in the table.

CEV Drop Test Observation Table

Trial Number	Observations
1	**Did the astronauts stay in their seats?** **YES or NO** **Did the door fly open?** **YES or NO**
2	**Did the astronauts stay in their seats?** **YES or NO** **Did the door fly open?** **YES or NO**

If any damage occurred to your CEV, or your astronauts did not stay in place, discuss with your team how you should design the CEV differently. If there is time, make changes in your drawing and add those changes to the model CEV.