DESIGN challenge

To design and test a Reusable Launcher for the Crew Exploration Vehicle (CEV). The CEV should travel 5 meters when launched.

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

Model CEV that was built last session

General building supplies

Meter stick or measuring tape

C-clamps

Rubber bands of various sizes

STUDENT PAGES

Design Challenge

Ask, Imagine and Plan

Experiment and Record

PRE-ACTIVITY SET UP

See next page.

launch your CEV

MOTIVATE

- Show the first two minutes of the video titled “Constellation: Flight Tests”. (if time permits, show all)

  www.nasa.gov/mission_pages/constellation/multimedia/index.html

- Ask the students what was the most important lesson learned from those images? (test, test and test again!)

SET THE STAGE:

ASK IMAGINE **&PLAN**

- Share the *Design Challenge* with the students.
- Emphasize that the objective is to create a launcher that gives repeatable results. It is more important for the CEV to reach the same distance each time than for the CEV to travel the farthest.
- Remind students to imagine a solution and draw their ideas. All drawings should be approved before building.

CREATE

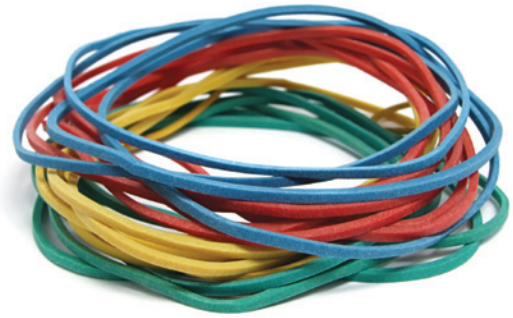
- Challenge the students to build a Reusable Launcher based on their designs.

EXPERIMENT

- Students will test the effects of three different “pull lengths” and record their data.

IMPROVE

- Students improve the Reusable Launcher based on results of the tests.



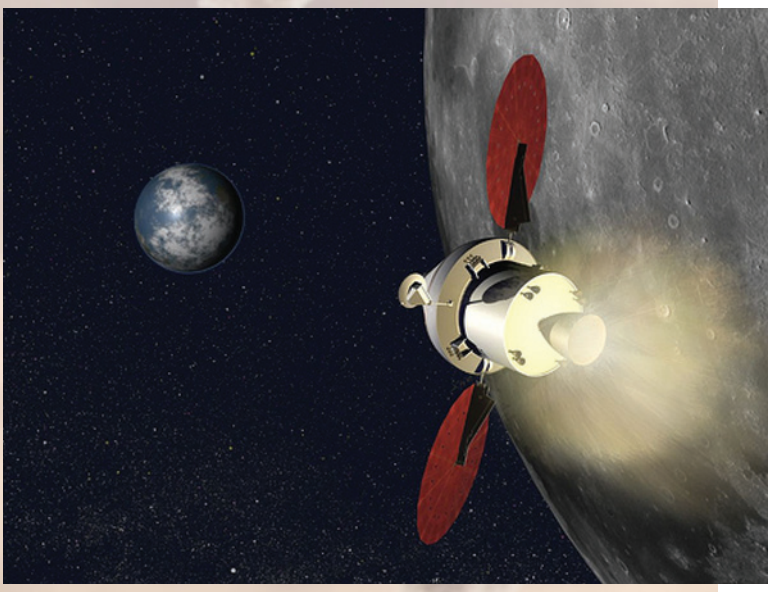
CHALLENGE CLOSURE

Engage the students with the following questions:

- *Why was it important that the launcher be reusable?*
- *Why was it important that your results were repeatable?*

PREVIEWING NEXT SET OF ACTIVITIES (SERIES 3)

The Moon is a very harsh environment. There is no atmosphere to protect astronauts and their equipment from solar radiation and the extreme temperature swings between night and day. Next session, we will begin to find ways to protect astronauts from those extreme temperature changes.



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launch your CEV

Launch Your CEV
Teacher page

It's Time to Launch into Space!

For years, NASA has been reusing launch components to send rockets and the Space Shuttle into space. For example, the solid rocket boosters (SRB's) on the Space Shuttle are often retrieved from the ocean, brought back to Kennedy Space Center, then cleaned and prepped for another Shuttle Launch. Why? The same reason we recycle our aluminum cans. It helps the environment and helps us save money for future launches. During this session, you must design and test a Reusable Launcher for your Crew Exploration Vehicle that will journey to the Moon. Therefore, your goal will be to launch your CEV into an orbit around the Moon.

THE CHALLENGE:

To design and test a Reusable Launcher with the following constraints:

1. *Launch the CEV to reach a goal of **5 meters**. See the drawing on the previous page for an idea of how to set up your launch.*
2. *The Launcher must be reusable for each trial. If your rubber band breaks because it was pulled too far, it is not reusable for another launch.*
3. *The Launcher must produce a repeatable outcome. If you set up the Launcher the same way twice, the CEV should travel the same distance both times. It is more important that the CEV is launched the same distance using the same setup than it is to get the CEV to travel the farthest distance.*

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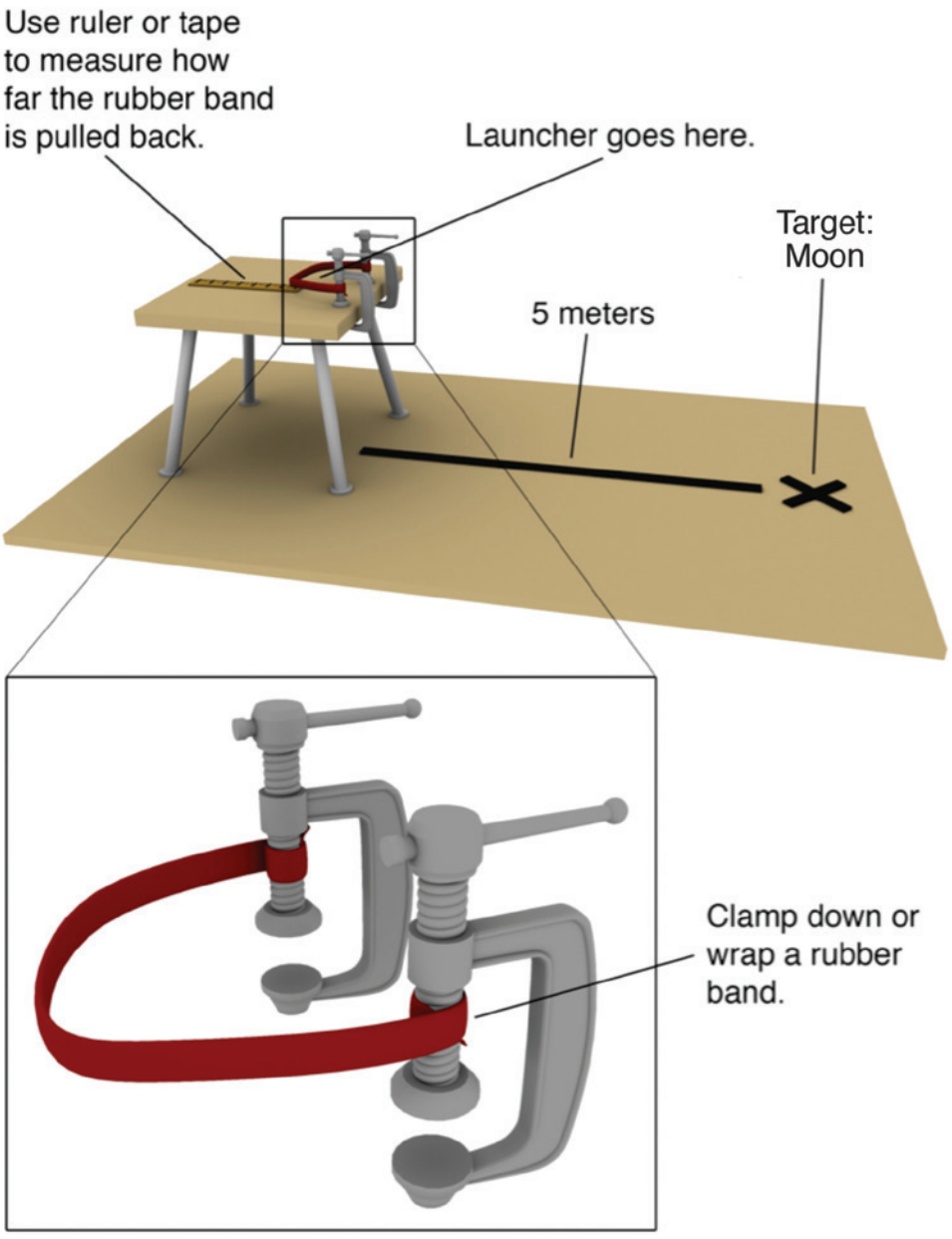
Launch Your CEV
Student page

launch your CEV

Launch Set-Up



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Launch Your CEV
Student page

launch your CEV

ASK IMAGINE &PLAN

What questions do you have about today's challenge?

Describe the rubber band your team will choose to use. How wide and how long?

How will you test your rubber bands to see if they will work well as a "Reusable Launcher"?

Draw a picture of your team's Reusable Launcher with your CEV.

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Launch Your CEV
Student page

launch your CEV

Approved by: _____

Experiment & Record

Write a hypothesis. Complete the following statement:

By changing the distance the rubber band is pulled, our CEV will…

_____

_____

Record your observations. Measure how far back you pull the rubber band and record the data. Repeat for two more trials. Pull the rubber band back at a different length and launch your CEV. Measure the new distance and record your data. Repeat.

CEV Launch Data Table

Distance rubber band is pulled back	Trial	Dependent Variables	
		Distance traveled (m)	Distance from target (m)
Setup A: ____ cm	1		
Setup A: ____ cm	2		
Setup A: ____ cm	3		
Setup B: ____ cm	1		
Setup B: ____ cm	2		
Setup B: ____ cm	3		

Did your Launcher produce the same distances for each pull of the rubber band? If not, discuss with your team how to improve the Launcher. Make those changes in your drawing and your launcher. Repeat the experiment.

CEV Launch Data Table (continued)

Distance rubber band is pulled back	Trial	Distance traveled (m)	Distance from target (m)
Setup C: ____ cm	1		
Setup C: ____ cm	2		
Setup C: ____ cm	3		