LESSON 3: LUNAR LANDERS

SUPPLIES

TEACHER BRINGS
- 1 bag mini marshmallows
- 1 bag large marshmallows

LESSON KIT #3
- Rubber bands (100)
- Plastic straws (40)
- Index cards (40)

MAIN BIN
- Plastic Cups (20)
- Masking tape (4)

PENCIL BOX
- Pencils (20)
- Glue Sticks (5)
- Scissors (15)

OBJECTIVES
- ☑ Learn how astronauts safely land on the moon
- ☑ Engineer a lunar spaceship that protects its cargo

HOOK
2-3 min

How do astronauts land safely on the moon?

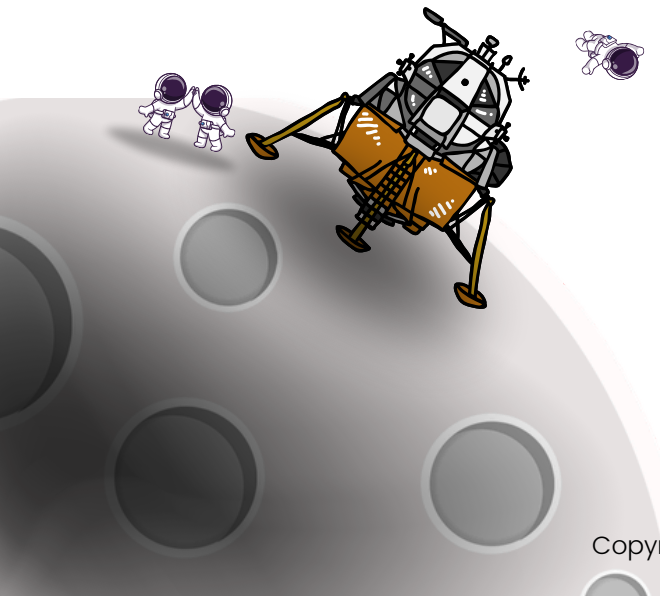
Do you think landing on the Moon is different from landing an airplane on Earth?

INTRODUCTION
3-5 min

Traveling to the Moon involves several complicated steps. And then, once a spacecraft arrives, landing on the Moon isn't an easy task!

A spacecraft traveling to the moon can travel over 4,000 miles per hour! Once in space, astronauts use precise scientific calculations to enter the lunar orbit and become captured by the moon's gravity. To land, the lunar lander separates from the main spacecraft. When the lander is just a few feet above the ground, it touches down softly on the Moon's surface. This gentle landing is important to keep the astronauts and equipment inside safe and ready for their mission on the Moon.

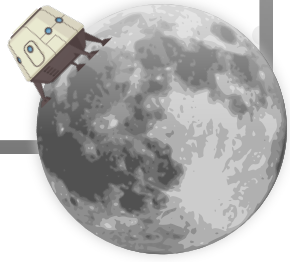
Today, we will design and build a lunar lander that can land safely without ejecting its important cargo.



LET'S LEARN ABOUT LUNAR LANDERS!

A lunar lander has to deal with low gravity, no atmosphere, and rough terrain. To face these challenges, the engineering of the lunar module is a combination of strong yet lightweight materials, exact control systems, and careful planning. The astronauts need to be safe when they land on the Moon!

A lunar lander has special legs with shock absorbers, like springs or cushions, to make the landing even softer.

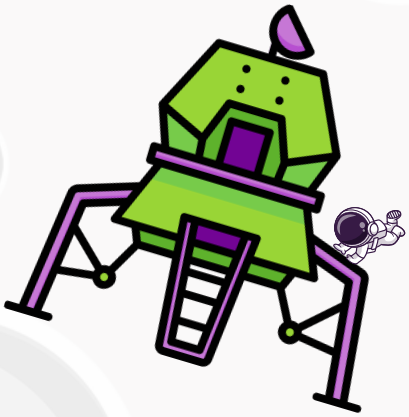


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LUNAR LANDERS

DESIGN AND BUILD

20-30 min



1. Divide students into groups of 3 with the following materials:
   - 1 piece of cardboard
   - 1 plastic cup
   - 5 index cards
   - 1 roll of masking tape
   - 2 large marshmallows
   - 10 mini marshmallows
   - 1 sheet of printer paper
   - 5 rubber bands
   - 5 bendy plastic straws
   - Scissors
   - Glue sticks
   - Pencil

2. Describe the design constraints to students.
   - Just like a real lunar lander must protect scientific instruments and astronauts, your challenge is to create a lunar lander that will keep the large marshmallows inside the cup during a landing.
   - You can only use the materials provided.
   - The lunar lander must be attached to the cardboard, and it must be able to absorb the impact of landing from a certain height.

3. Give students several minutes to brainstorm!
   - Encourage students to use the paper to help plan and sketch their Lunar Lander.
   - Make sure to follow the design constraints. After they come up with some ideas on their own, show the example from the following page as further inspiration, and read the following **Building Tips**!

4. Build the Lunar Lander!
   - Remind students to secure the cup to the cardboard, and to put 2 large marshmallows inside of the cup.
   - Remind them to create a shock absorption system for their Lunar Lander.

Building Tips

- **Shock Absorption:** What materials or structures could help reduce the force of landing?
  - Option 1: Index Card Springs
    - Fold index cards into accordion shapes to create springs.
    - Tape the "springs" to the bottom of the plate to act as shock absorbers.
  - Option 2: Marshmallow and Straw Shock Absorbers
    - Attach marshmallows to the ends of straws.
    - Tape the straws to the bottom of the plate, ensuring the marshmallows touch the ground first upon landing.
- **Stability**: How can we make sure our lander stays upright and doesn't tip over during landing? Making the parts below the platform weigh more than the parts on the top helps the lander fall straight down. Also, it helps to evenly distribute the weight on top of the platform.
- **Protection**: What can we do to ensure the marshmallows remain inside the cup, similar to how lunar landers protect their valuable cargo? Would a lid help?

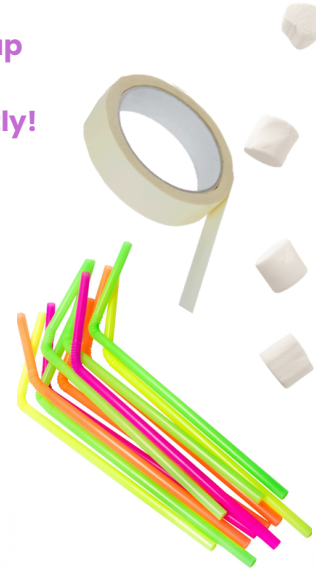
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LUNAR LANDERS

BUILDING INSPIRATION

Use mini mashmallows as shock absorbers!

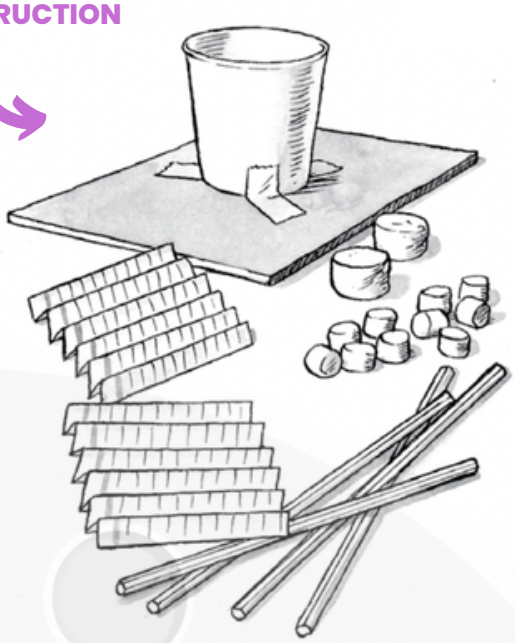
Marshmallows go in the cup before drop. Do not let students pack them in tightly!

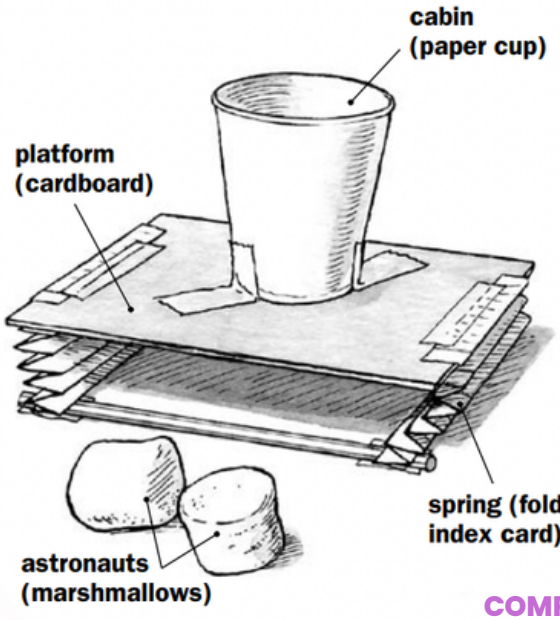




Accordian fold the index cards!

LUNAR LANDER UNDER CONSTRUCTION

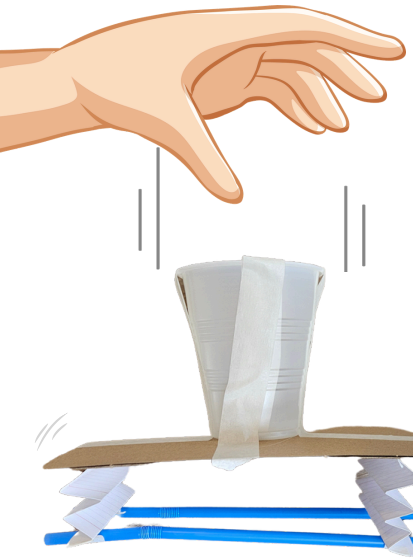




COMPLETED LUNAR LANDER

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LUNAR LANDERS



ACTIVITY: DROP TEST

2-3 min

- Now, it's time to see if your Lunar Lander works!
- Drop the lander from one foot off the ground
- Observe whether the marshmallows stay inside the cup.
- Did the springs or shock absorbers work as intended?

EVALUATE & REDESIGN

3-5 min

- Modify your lander based on your observations.
- Add more cushion using mini marshmallows, or thicker "feet" by switching the direction of the index cards.
- Perform another drop test to see if the improvements were successful.

OBSERVE & EXPLAIN

3-5 min

Facilitate a discussion about students' results:

- Explain the key features of their design, such as materials used, shock absorption mechanisms, and stability measures.
- Discuss any challenges they encountered during the design and building process.
- Share insights into why they made specific design choices based on their understanding of lunar lander requirements.

Encourage students to think about the steps they took in designing their lunar landers. Ask them:

- What was the most challenging part of designing your lunar lander?
- How did you decide on the materials and design features for your lander?
- Did your initial design work perfectly, or did you need to make adjustments along the way?

Understanding Shock Absorption and Stability:

- Guide students to reflect on the concepts of shock absorption and stability in their designs. Discuss:
  - Why is shock absorption important for a lunar lander?
  - How did you incorporate features like landing legs or cushioning materials to absorb the impact of landing?
  - What did you learn about stability from testing your lunar lander? How did your design prevent tipping or bouncing during the landing simulation?

Exit Ticket

Ask each student one of the following questions as they walk out the door.

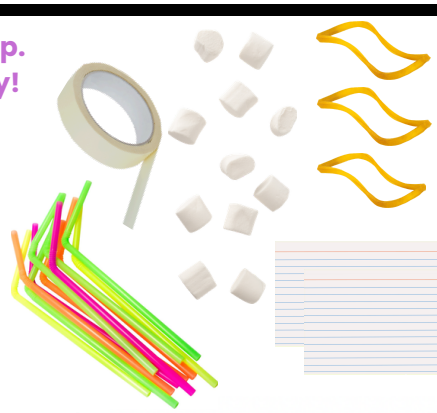
- Q: What does the term "Shock absorption" mean?
- Q: How did you design and build a shock absorbtion system for your lunar lander?

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LUNAR LANDERS: STUDENT EXAMPLES

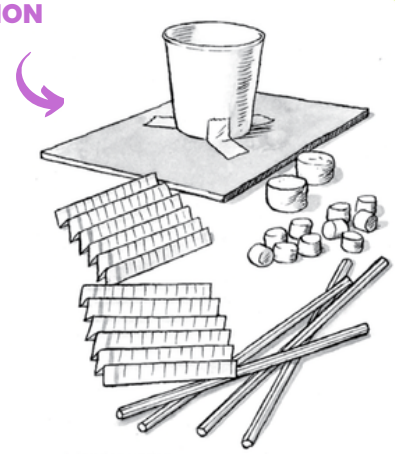
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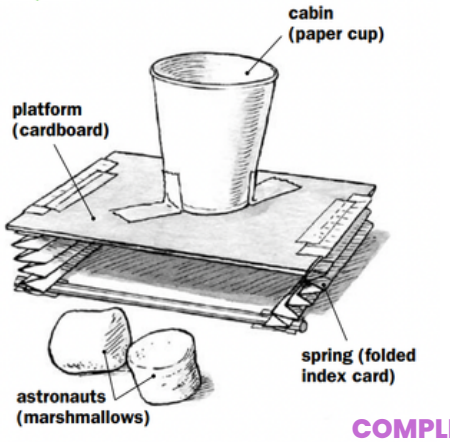


Accordian fold the index cards!

LUNAR LANDER UNDER CONSTRUCTION



A lander under construction

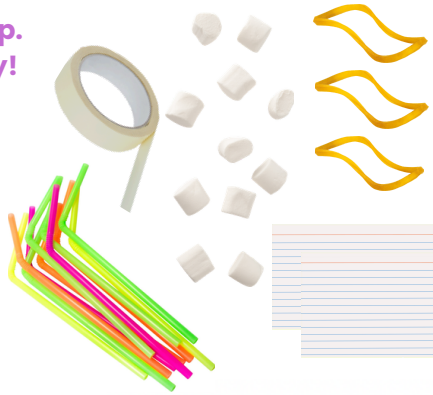


COMPLETED LUNAR LANDER

LUNAR LANDERS: STUDENT EXAMPLES

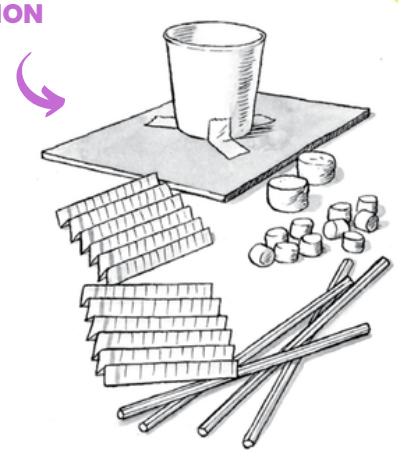
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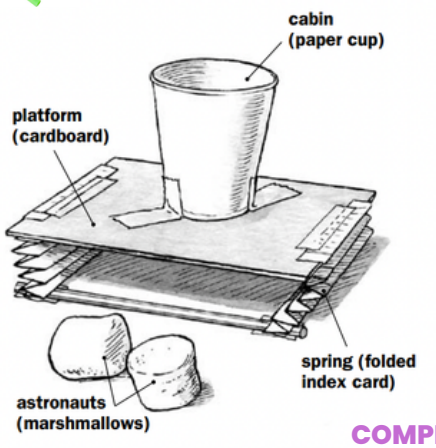


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LUNAR LANDER UNDER CONSTRUCTION



A lander under construction



COMPLETED LUNAR LANDER