Lunar Landing

Touchdown!

Engineering Design Notebook

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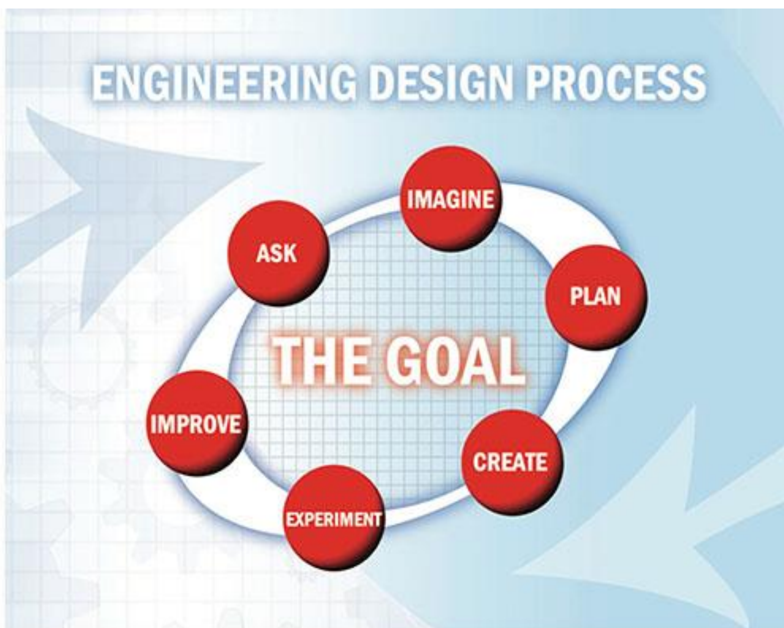
Big Concept: Force & Motion

Standards:

- NGSS - 3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- NGSS - 3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- NGSS - 3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

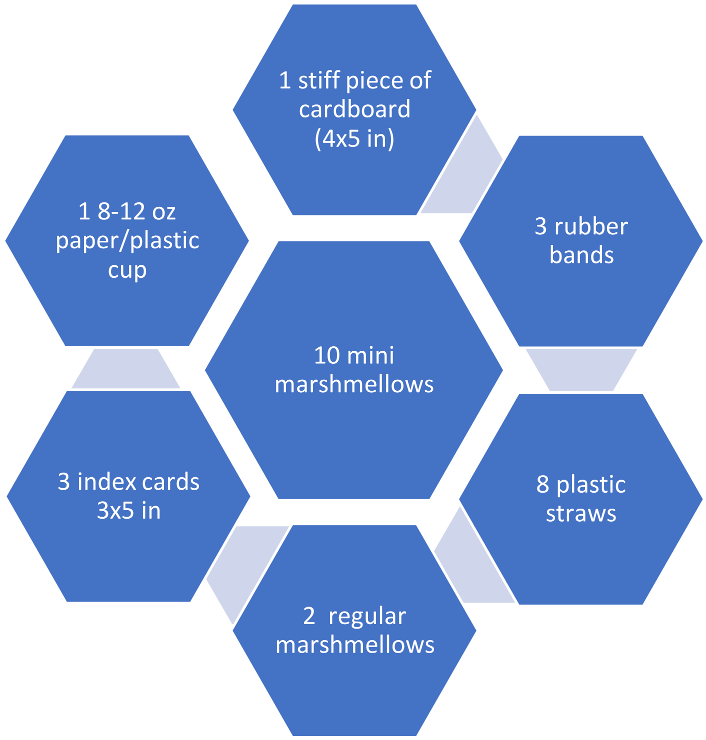
Objectives and Ancillary Concepts/Content:

- Connect this problem to a STEM Career
- Real-world examples from either an event or object
- Build and test their prototype. Redesign for improvements
- Brainstorm different ideas
- Describe how force and gravity affecting the prototype



Preparation Materials

- Scissors
- Tape



Throughout this project, you will be implementing the steps of the Engineering Design Process. As you progress through the project, make sure you are documenting each step of the challenge in you design notebook through photos and text.

Ignite your design!

TOUCHDOWN!

Identifying the Problem

Students will read out the informational text that will provide them with background information on the upcoming project. It states:

"Landing on the Moon is tricky. Since a spacecraft can go as fast as 18,000 miles per hour (29,000 km per hour) on its way to the Moon, it needs to slow down in order to land gently. And if there are astronauts onboard, the lander also needs to keep them safe.

NASA's Artemis program will return humans to the Moon by sending the first woman and the first person of color to the lunar surface. A foundational piece of the program is NASA's Space Launch System, or SLS, a rocket that will allow for human exploration beyond Earth's orbit. SLS will be used in the Artemis program for a series of uncrewed and crewed missions, eventually carrying astronauts to the Moon during the Artemis III mission. NASA plans to continue sending missions to the Moon about once a year after that while also using SLS to launch robotic scientific missions to places like the Moon, Mars, Saturn, and Jupiter.

Spacecraft on their way to Mars may be traveling as fast as 13,000 miles per hour (21,000 km per hour) when they reach the Red Planet and need to slow down to land safely on the surface. Future missions to Mars will also need to safely land astronauts on the surface."

Students will then watch the first moon landing clip.

What problem did the needs to be addressed for the astronaut?	Sample answer: "Astronauts that are on the ship need to land the lander safely on the moon.
What problem of the moon lander needs to be addressed?	Sample answer: "The spacecraft can move as fast as 18,000 mph and will have to slow down in order to land smoothly."
If you had the opportunity to travel to the moon, would you or would you not? Briefly explain.	Answers will vary.

Brainstorming

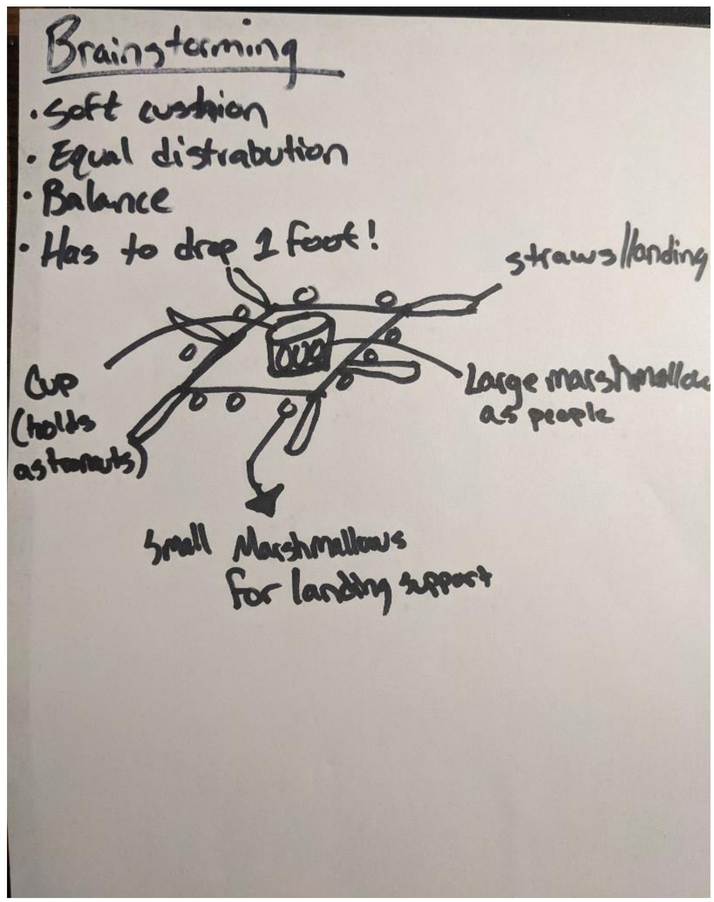
During this phase of the project, you will start thinking about your spacecraft and the ideas you might have that will solve the problem.

Think about how to build a spacecraft that can absorb the shock of a landing. While thinking of your build, think of the following questions:

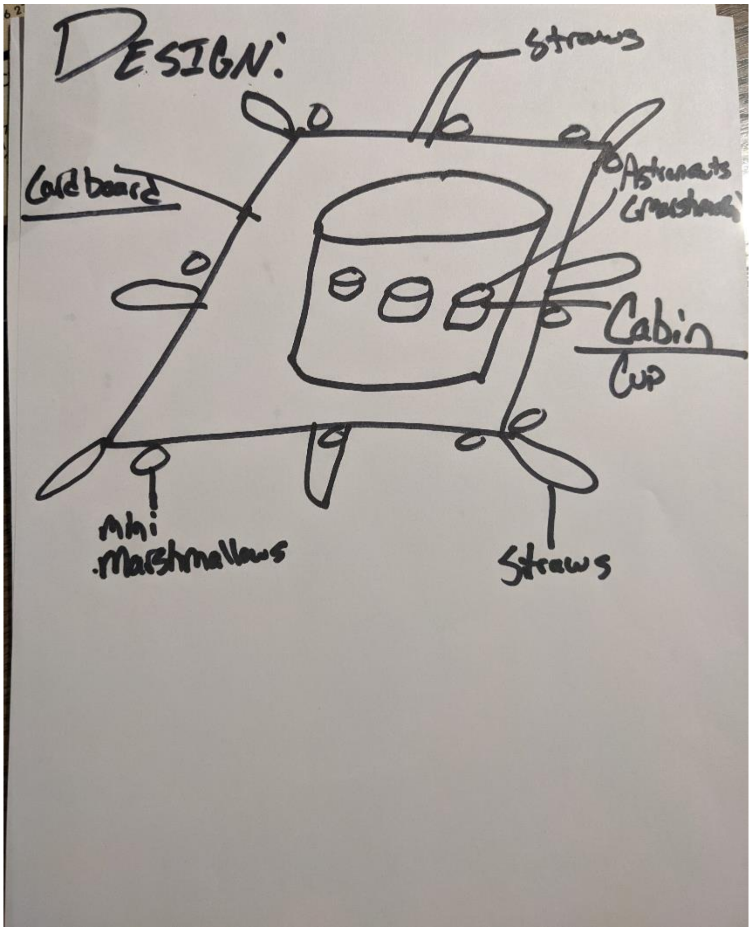
- What kind of shock absorber can you make from these materials that can help soften a landing?
- How will you make sure the lander doesn't tip over as it falls through the air?

What ideas are you thinking about when trying to solve this problem? What are some of the things that you might need to know that will help you complete your design?

In the space below, write or draw some of your idea.



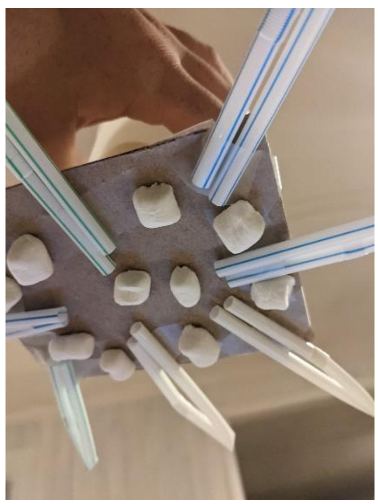
Design

During this phase, you will design a shock-absorbing system. Discuss with your group and decide on one design that you would like to build. In the space below, sketch out your design. Be sure that you label all parts of the design and include the entire build. Refer to the materials list if needed.


Build

During the build phase, you will be putting your design to the test! You will finally be building your product. A couple of things to remember:

1. Design a shock-absorbing system. (Think springs and cushions)
2. Put your spacecraft together. (Attach the shock absorbers to the cardboard platform)
3. Add a cabin for the astronauts. (Tape the cup to the platform. Put three astronauts (the large marshmallows) in it. You will not be putting a lid on the cup)

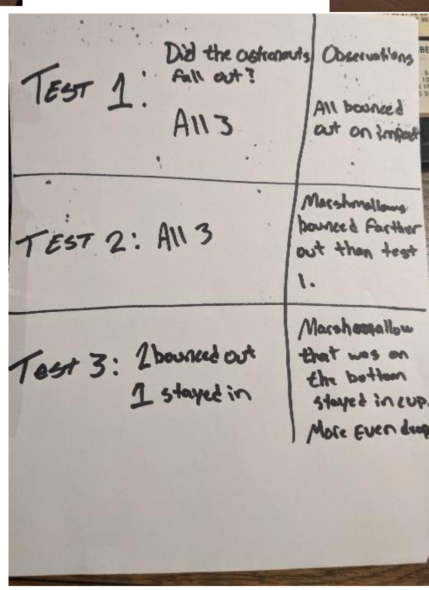
In the space below, insert picture/images of your build!
  

Test and Evaluate

During the testing and evaluating phase, you will test your design three times. Do not get disappointed if your results aren't what you expected them to be. Think about what worked well and what could be improved on.

The Test!

Drop your lander from a height of one foot (12 inches). If the "astronauts" bounce out, figure out ways to improve your design. Study any problems you might encounter. In the space below, include a picture of your testing your design.
 



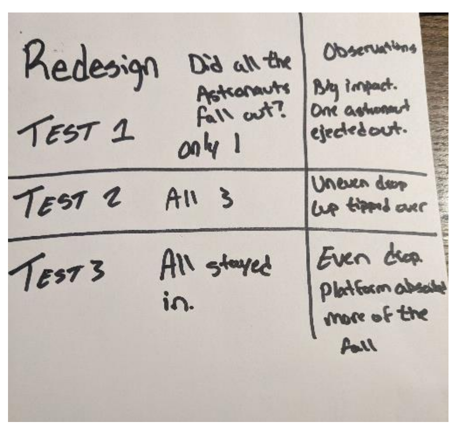
	Did the astronauts fall out?	Observations
Test 1:	All 3	All bounced out on impact
Test 2:	All 3	Marshmallows bounced farther out than test 1.
Test 3:	2 bounced out 1 stayed in	Marshmallow that was on the bottom stayed in cup. More even drop.

Redesign

After you have tested your prototype, identify the issues that you encountered with you build and think about what you can do to improve your design. Think about the following questions:

- Did the launcher tip over as it fell? (Move the cup slightly away from the side that's tipping. Or, reposition the parts of the shock-absorbing system to better balance the weight.)
- Did the astronauts bounce out of the cup? (Bounces instead of landing softly: Change the size, position, or the number of shock-absorbing parts. You can also add mini-marshmallows for landing-pad feet. Or, you can use marshmallows at key junctions in the lander's frame to help absorb energy.

In the space below, show how you redesigned your project to improve on the problems that you have encountered during the testing phase.



Redesign	Did all the Astronauts fall out?	Observations
TEST 1	only 1	Big impact. One astronaut ejected out.
TEST 2	All 3	Uneven drop Cup tipped over
TEST 3	All stayed in.	Even drop. Platform absorbed more of the fall

Share the Solution

After you have tested your redesigned solution, share your product with your classmates. Make sure that you explain to them what complications you witnessed in the first testing phase and what you did during the redesign phase to improve your project.

Be prepared to share your answers to these questions:

- What forces affected your lander as it fell?
- After testing, what changes did you make to your lander?
- Engineers' early ideas rarely work out perfectly. How does testing help them improve a design?
- What did you learn from watching others test their landers?
- The moon is covered in a thick layer of fine dust. How might this be an advantage? A disadvantage?