National Aeronautics and
Space Administration

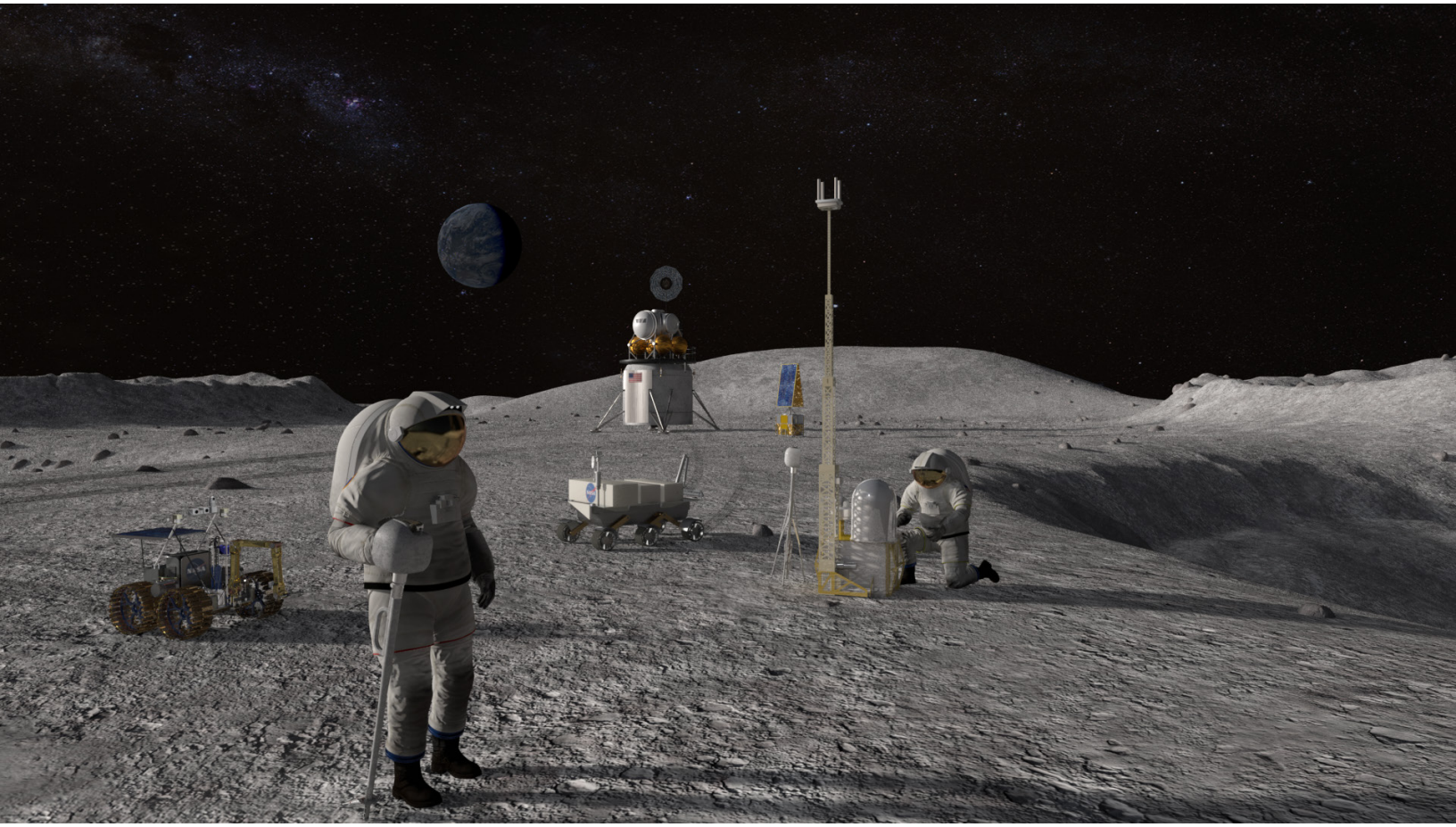
NASA STEM ACTIVITY

HEAVY LIFTING

OVERVIEW

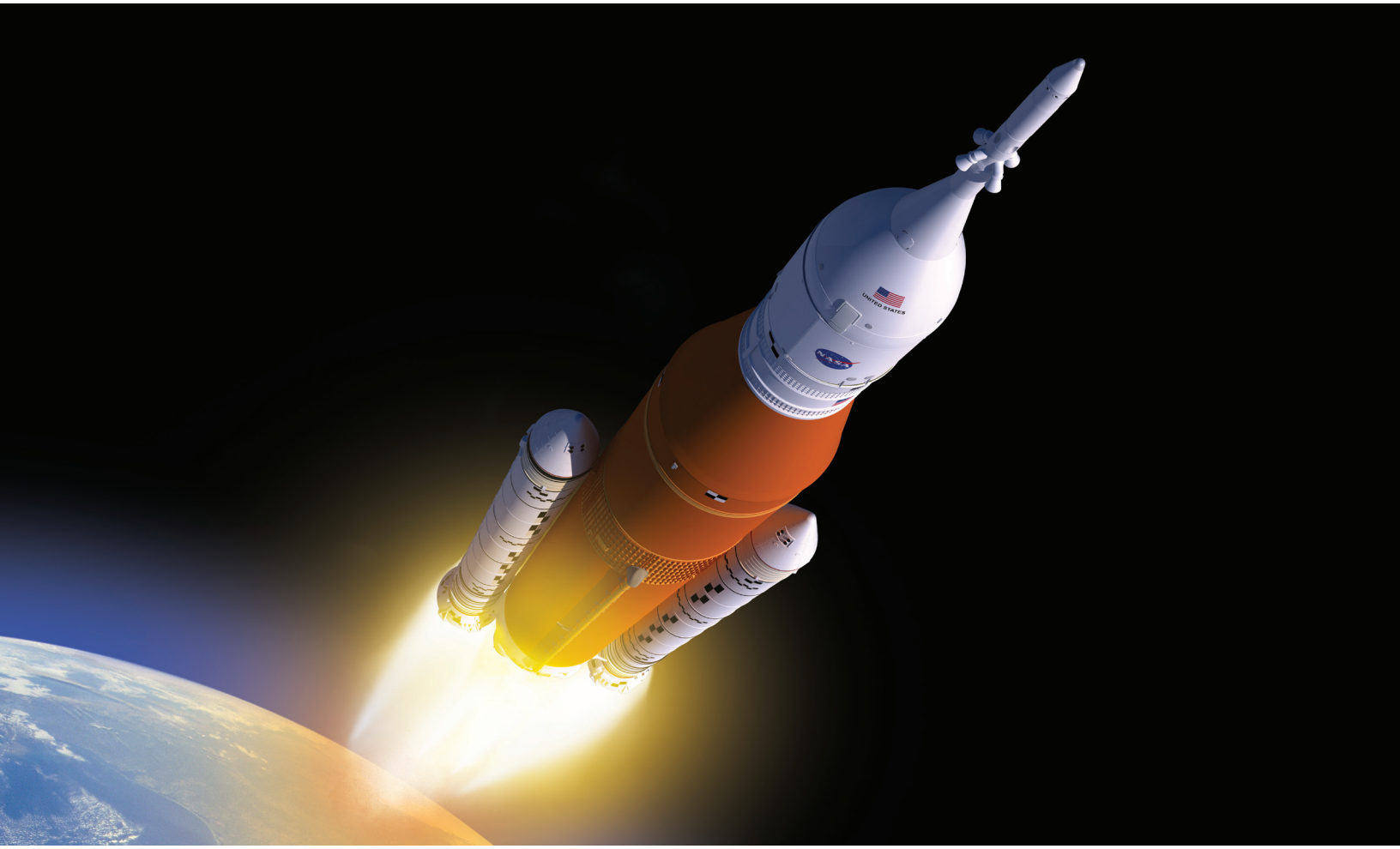
NASA has been given its most ambitious and challenging mission in half a century: to rapidly accelerate its human lunar program and land the first woman and the next man on the surface of the Moon in 2024. This program is named Artemis, after the Greek goddess of the Moon. Artemis is the twin of Apollo, the historic NASA program that first landed humankind on the Moon 50 years ago. Artemis will establish a long-term presence in lunar orbit and on the surface of the Moon. The goal of Artemis is continuous exploration of the lunar surface through a sustainable human presence on the Moon.

This is not an easy task. Even though some of the hardware, such as the Space Launch System (SLS) and Orion, have been in development and are nearing completion, there are several critical technologies, including spacesuits, Gateway modules and a lunar lander, that must be engineered, designed and built at a rapid pace. While NASA and its commercial partners are at work developing this hardware, you can participate as well. These activities simulate some of the same challenges faced by NASA astronauts, engineers, and scientists. It is your mission to solve these challenges throughout the lunar mission, from demonstrating the distance of the Moon from Earth, to launching a rocket and keeping astronauts healthy after landing on the Moon, We are counting on you!



LEAVING EARTH

Planning and preparing for a mission to the Moon can be quite the challenge. Do you know just how far away the Moon actually is? The 384,400 kilometer trip to the Moon will take three days each way! NASA's first mission to launch its Space Launch System (SLS) and Orion Crew Module to the Moon will be called Artemis 1 and it is scheduled for 2020. This will be an uncrewed mission to test the performance and critical systems of both the rocket and spacecraft. The first crewed launch, Artemis 2, will follow in 2022. The crew of Artemis 2 will travel in the Orion Crew Module around the Moon and become the first humans to leave low-Earth orbit since 1972. In 2024, Artemis 3 will travel to the Moon, carrying the first woman and next man to the lunar surface.



Related Videos:

SLS No Small Steps

Build and Launch a Foam Rocket

HEAVY LIFTING

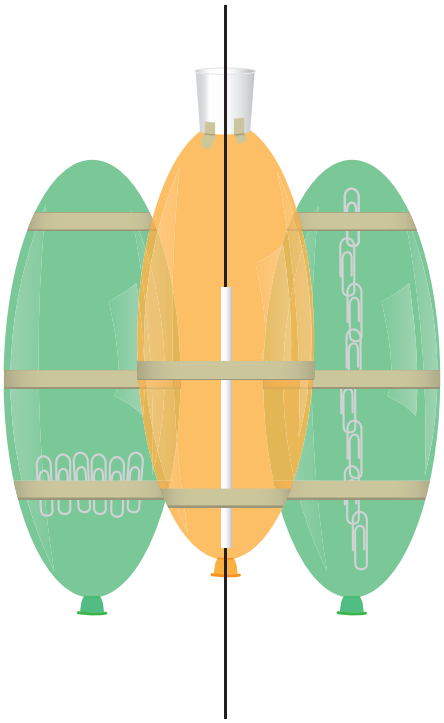
Objective

During this activity, you will:

- Construct balloon-powered rockets to launch the largest payload possible.

Materials

- Large binder clips (one per launch pad)
- Fishing line or smooth string
- Balloons (5-inch x 24-inch long balloons work best, but round balloons will work if long balloons are not available)
- Balloon hand pumps (optional)
- Bathroom size (3 oz.) cup
- 2 straight (non-bendable) drinking straws
- 50 small paper clips
- Sandwich-sized plastic bag
- Masking tape
- Wooden spring-type clothespins or small binder clips
- Printout of Heavy-Lift Rocket Mission Report



Procedure

Setup

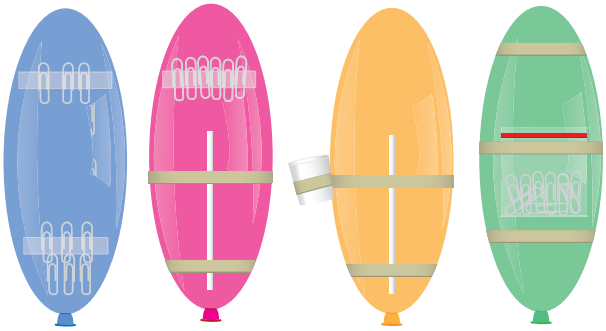
1. Have a parent or adult help you by attaching one end of the fishing line close to the ceiling using the large binder clip.
2. Assemble the materials that are available for the challenge. Try to only use materials that are available on the list.
3. If this is going to be a team challenge, give each team an identical supply of materials.

Launching

1. When it is time to launch, inflate your balloon, or balloons, and keep them from deflating by rolling the nozzles and securing them with a clothespin or small binder clip.
2. Thread the loose end of the fishing line through the guide straw on the rocket from the top.
3. Pull the fishing line tight enough so that there is no slack.
4. Perform a countdown and release all the clips on the balloon nozzles simultaneously.
5. A successful launch is one that reaches the ceiling (or highest point on the string) without spilling its payload.

Challenge

1. NASA is looking for creative ideas for launching heavy payloads into orbit. Payloads will be parts and supplies; large-aperture telescopes; and spacecraft that will carry humans to the Moon and Mars, and possibly transport large fuel tanks to be used to power deep space rockets. You are challenged to design and build a heavy-lift rocket from the set of materials provided. Your goal is build one as powerful as possible, capable of carrying the most payload (paperclips) as possible along. Your rocket will be guided on a string to keep it on its course. A successful launch requires your rocket to reach the end of the string without spilling any of its payload. Be sure to record your progress on the Heavy-Lift Rocket Mission Report.



Heavy-Lift Rocket Mission Report

Name:

Team Name:

Team Members:

Flight Test	Mass Lifted (g)
1	
2	
3	
4	
5	

Describe your rocket:

How did you change your rocket to make it carry more mass?

What other ways could you change your rocket to improve it?

Conclusion

- When attaching the straw to help guide the rocket, why was it important to align it in the same direction as the balloon nozzle?
  The thrust of the rocket needs to be in line with its desired path of travel. Otherwise, thrust will be wasted fighting against the guide string.
- Was attaching a single extra balloon an effective strategy?
  Probably not. Unless the guide straw was placed directly between the two balloons, the thrust would be imbalanced and the rocket would fight against the string.
- How can the lessons learned in your design be applied to real-life heavy rocket launches?
  Modern heavy-lift rockets attach additional rockets, called boosters, to increase the rocket's payload capacity.

Reference

Modified from *Heavy Lifting*: https://go.nasa.gov/2XKTjnz

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