# What's In The Kit?

Moon Colony Kit Contents


SPACE FOUNDATION

# MOON Colony Kit

## Components

### What's in the Box?

- 50 STEAM Character Cards (Split into 10 categories)
- Cipher
- Mission Envelope
- Mission Log
- Dice
- Moon Map
- Payload List

Age: **4th – 8th Grade**
Number of Players: **1 to 10 players**

*These materials are confidential and proprietary to Space Foundation.*


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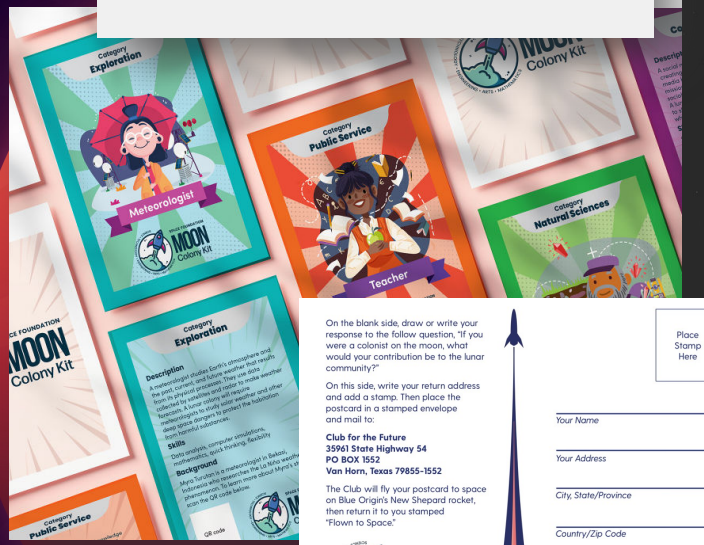
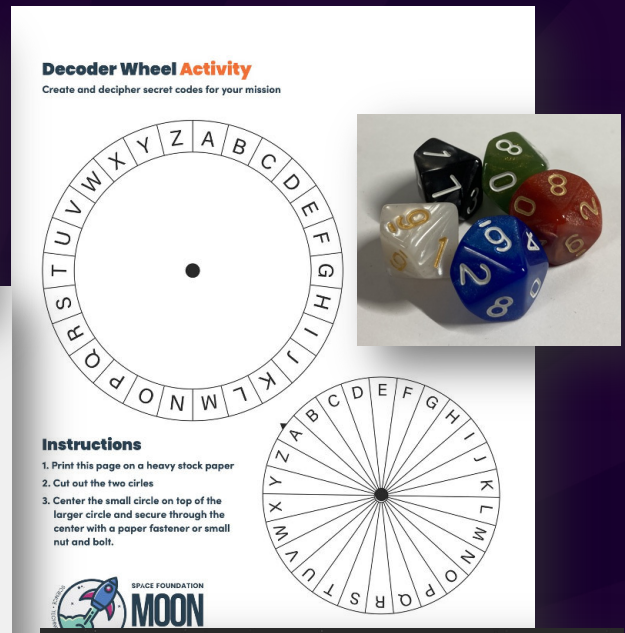
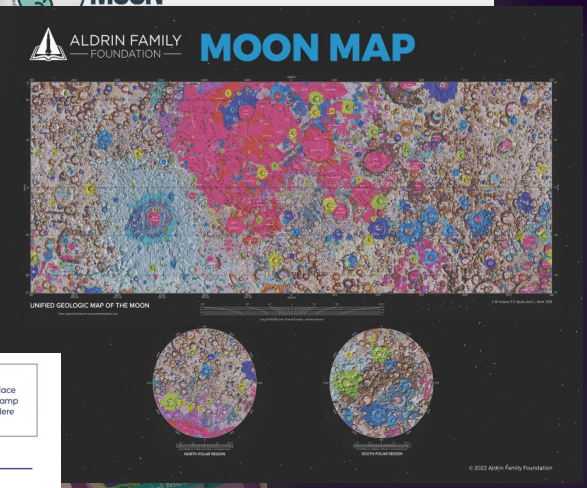
## Mission Log Book







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# How to Play

## Starting the Game

Sort and separate the 50 character cards by color. Each color represents a different category: **Arts, Business, Communications, Design, Exploration, Government, Healthcare, Natural Sciences, Public Service and Technology.**

Each player should determine the category that interests them most and look through each of the 5 character cards. Select one character card per player. Best results will occur when each player chooses a character from different color categories.

Once your crew is assembled release the airlock and open your mission envelope. The contents of this envelope include all the details of your mission. Use the remaining materials in the Moon Colony Kit to complete your mission. **Good luck, space explorers!**

**Categories**

- Arts
- Business
- Communication
- Design
- Exploration
- Government
- Healthcare
- Natural Sciences
- Public Service
- Technology

## Mission Envelope







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## Expeditions:

- The mission log will record your crew's journey during this lunar exploration and provide details on how to successfully reach your goal by building a Lunar base.
- Record each player's name and character profile in the mission log.
- Choose one player to roll the dice. Follow instructions in the mission log to obtain the correct expedition card and begin your journey to the Moon's South Pole.
- Once an expedition has been obtained, the player with the matching color character card shares the expedition with crew members. During each expedition your crew will encounter a challenge as you travel toward the South Pole, with two possible solutions.
- Determine the location of each expedition using the moon map and turn to the corresponding page of the mission log.
- Choose one player to roll the die. This roll will determine the number of items you may use from your payload to solve the challenge. As a crew, discuss which items you will use to complete your expedition. The player with the matching color character card makes any final decisions about items used to complete the expedition.
- Use your mission log and group discussion to determine the choice your crew will make. Write down any group discussion, draw pictures, and choose carefully—the decisions you make along the way will determine if your lunar colony is a success!
- After your choice has been made use the mission log to receive further instructions about the lunar base from mission control. Save this information to help your crew build the final lunar colony and complete the mission.
- Complete all 10 expeditions.

## Reaching the South Pole

Use the information gathered with the cipher throughout expeditions to construct a successful lunar colony. Utilize your mission log to complete the mission.

## Find Out More

Find out more about Space Foundation, our game, and the Artemis mission at ***DiscoverSpace.org***

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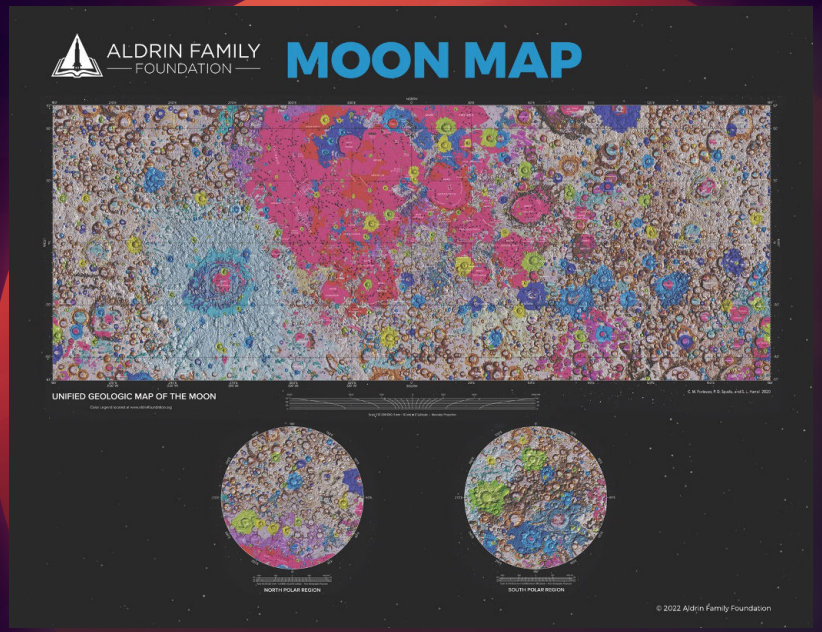
# MOON Colony Kit

# Mission Log Book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MOON Colony Kit

# Expedition Chart

**Roll the 10-sided die. Then use the chart below to see which expedition challenge your crew will tackle next!**

PAGE 8

**EXPEDITION** Spacesuit Malfunction

PAGE 10

**EXPEDITION** Rover Shut Down

PAGE 12

**EXPEDITION** LunaNet Failure

PAGE 14

**EXPEDITION** Solar Flare Hazards

PAGE 16

**EXPEDITION** Search and Rescue

PAGE 18

**EXPEDITION** Beauty of Space

PAGE 20

**EXPEDITION** VIPER

PAGE 22

**EXPEDITION** Houston, we have a problem

PAGE 24

**EXPEDITION** Regolith

PAGE 26

**EXPEDITION** Midnight Sun

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# Expedition 1

## What is a Spacesuit?

A spacesuit is more than a set of clothes astronauts wear for spacewalks. They are actually a one-person spacecraft that protects the astronaut from all the dangers of being in space! Spacesuits for the Moon mission will be called Exploration Extravehicular Mobility Units (xEMU). The xEMU is a new and improved version of the spacesuits worn on the Moon during the Apollo missions. Technology is way more advanced since the Apollo missions in the 1970s. These new suits will allow astronauts to move more freely and make it easier to work on the Moon. The spacesuits will also be made of 16 layers of material, making them more resistant to rips and protecting astronauts from the sharp dust on the surface of the Moon, while also helping them absorb more oxygen.

## Why Do Astronauts Need Spacesuits?

Spacesuits protect astronauts from extreme temperatures in space. On a spacewalk, astronauts can feel conditions as cold as minus 250 degrees in Earth orbit and as hot as 250 degrees in the sunlight. Small impacts from space dust can be very dangerous for astronauts. Spacesuits protect astronauts from space dust and radiation. Visors in the spacesuit protect astronauts' eyes from the bright sunlight.

These suits also provide astronauts with everything they need to survive several hours during a spacewalk. Spacesuits supply astronauts with oxygen to breathe while they are outside the spaceship in the vacuum of space. The suits contain water to drink through a sippy straw and a bar designed for the astronaut to pull up the bar with their mouth inside the helmet. Astronauts also wear Maximum Absorption Garments (MAG) under their clothes. That's right – astronauts wear a large absorbent diaper to help collect waste during their spacewalks!

## Why Are Spacesuits Pressurized?

Space is a vacuum. This means there is very low pressure and this causes molecules to want to spread out. Spacesuits must be pressurized to protect astronauts' bodies from experiencing the effects of a vacuum. Human skin will expand, or swell, to about twice its normal size in a vacuum! Pressurizing spacesuits also ensures that astronauts have breathable air. Astronauts only have about 15 seconds without oxygen before passing out in their spacesuits.

A tear or puncture to a spacesuit could be fatal for an astronaut. However, a small hole doesn't have to be disastrous. Many layers of materials help to make sure spacesuits stay pressurized and keep astronauts safe on spacewalks.

## Expedition: Spacesuit Malfunction

Two crewmates are attempting to complete the second moonwalk in your mission. Both members entered the Lunar Terrain Vehicle (LTV) driving a short distance away to collect rock samples for geological testing later in the mission. Previously your crew spent 1.5 hours setting up tools and dust cleaning equipment outside the lunar lander before arriving at the collection site.The LTV is seen driving back toward the lander, and rock samples are successfully located.

One of your crewmates brushes against a sharp tool as they are trying to get back to safety inside the lunar lander. This creates a small tear in the left boot of their spacesuit! While the tear only made it through two of the layers in the spacesuit, it could be deadly if the spacesuit becomes depressurized.

Have a group discussion with the Design (lavender) category in your crew acting as the expert for solving this expedition. How will you use resources from your payload list and save your crewmates? You have two options. Will you...

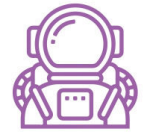
1. **Use payload materials to repurpose and fix the xEMU to use for the rest of your scheduled moonwalks?**

2. **Cancel the remainder of the moonwalks scheduled for the mission until Mission Control can send extra xEMUs?**

**If you choose Option 1: repurpose, go to page 37.**

**If you choose Option 2: help from Mission Control, go to page 28.**

## Colonist Recording Area



## Expedition 1

### Expedition: Spacesuit Malfunction

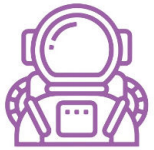
Option 1: Use payload materials to repurpose and fix the xEMU to use for the rest of your scheduled moonwalks.

Use the circle cipher to decode the secret message below. As a crew, use all the unscrambled codes to design the Moon Colony.

Code: H = W

ESQ SLMTELE XLJ MP DPYE TY ATPNPD LYO MFTWE ZY ESQ XZZY.

### Colonist Recording Area



## Expedition 1

### Expedition: Spacesuit Malfunction

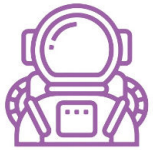
Option 2: Cancel the remainder of the moonwalks scheduled for the mission until Mission Control can send extra xEMUs.

Use the circle cipher to decode the secret message below. As a crew, use all the unscrambled codes to design the Moon Colony.

Code: P = J

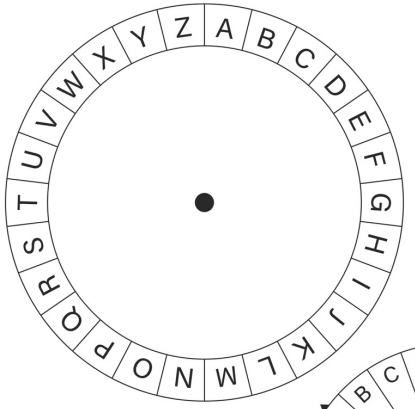
SGZKXOGRY ZU HAORJ YNUARJ HK ROMNZCKOMNZ.

### Colonist Recording Area



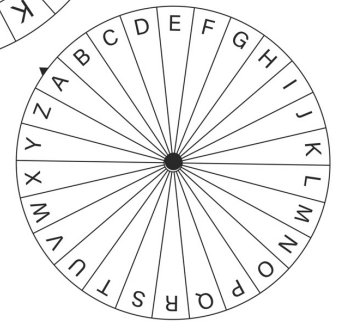
## Decoder Wheel Activity

Create and decipher secret codes for your mission




### How it works

Select a key combination by lining up any letter on the larger dial with a letter of your choice on the inner dial. Tell your friends which two letters you lined up and once their dial is set to match you can write and decipher messages by using the letters on the inner dial in place of the real letters on the outer dial.




### Instructions

1. Print this page on a heavy stock paper
2. Cut out the two cirles
3. Center the small circle on top of the larger circle and secure through the center with a paper fastener or small nut and bolt.

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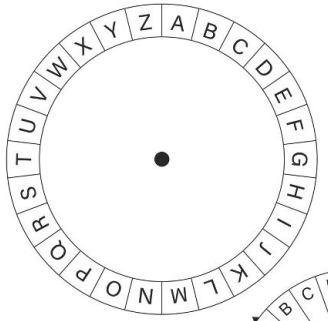
## Lunar Base Directions

Use the decoded messages collected from Expeditions and work as a team to design your Moon Colony.

## Decoder Wheel Activity

Create and decipher secret codes for your mission

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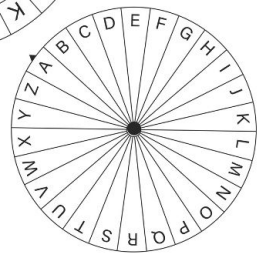


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# Mission Log Book

Illustration of NASA astronauts on the lunar South Pole. Credit: NASA

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## Hi, Lunar Colonist!

Now that you have designed your Moon Colony, think about your place in space. If you were a colonist on the moon, how would you contribute to lunar society?


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# STEAM in the Classroom

## Barriers, Mindset, and Strategies

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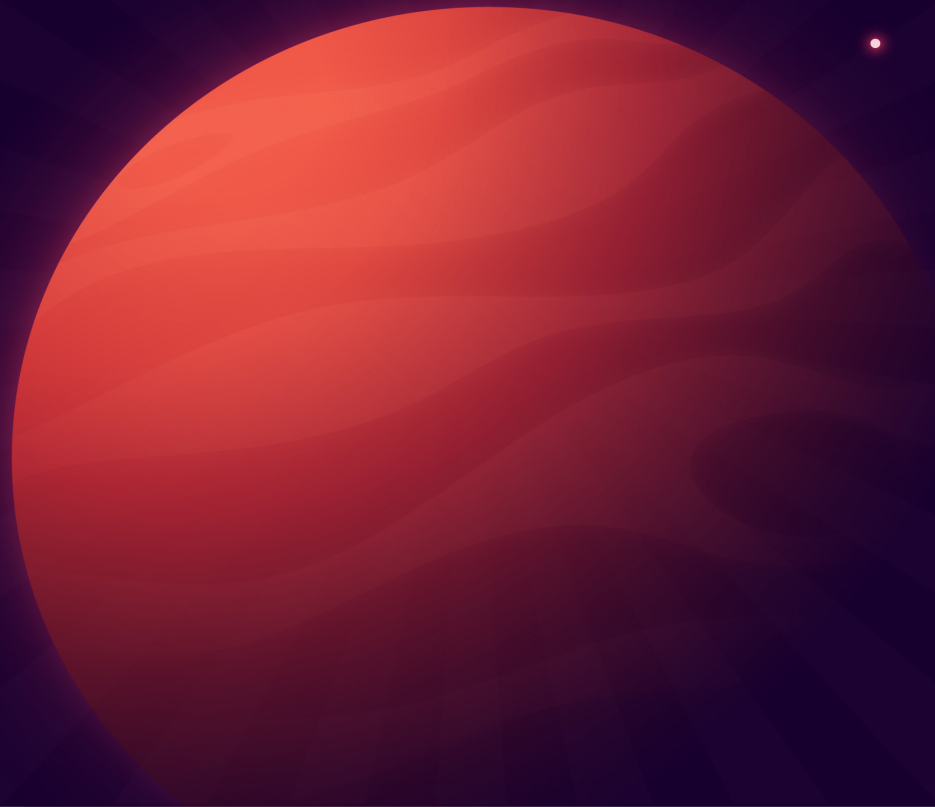
# Systemic Barriers

- **Technology**
  - Computers/tablets, internet access, robotics
- **Resources**
  - People, products, support
- **Role Models**
  - Color, age, background



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# What is STEAM?

- … an **interdisciplinary approach** to learning focusing on **real-world** lessons.
- … about students **applying content** in contexts that make **connections** between school, community, and the world around them while encouraging them to **fail forward**.
- … allows young generations to practice **creativity**, **collaboration**, **communication**, and **critical thinking**, to become the **innovative problem solvers** our **future** needs.

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# What is STEAM?

STEM education also promotes[1]:

- Quicker executive function
- Deeper level of understanding
- Higher retention of knowledge
- Increased student confidence

[1]NSTA- Exemplary STEM Programs: Designs for Success

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# STEAM Strategies

- DEI Education Mindset
- Effective Questioning
- Wait Time
- Explore Time

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# Effective Questioning

## 5 Principles

1. Use questions to encourage **student-led thinking** & reasoning.
2. Ask questions in ways that **include everyone**.
3. Give students **time to think**.
4. **Avoid judging** students' responses.
5. Follow up with ways that encourage **deeper analysis**.

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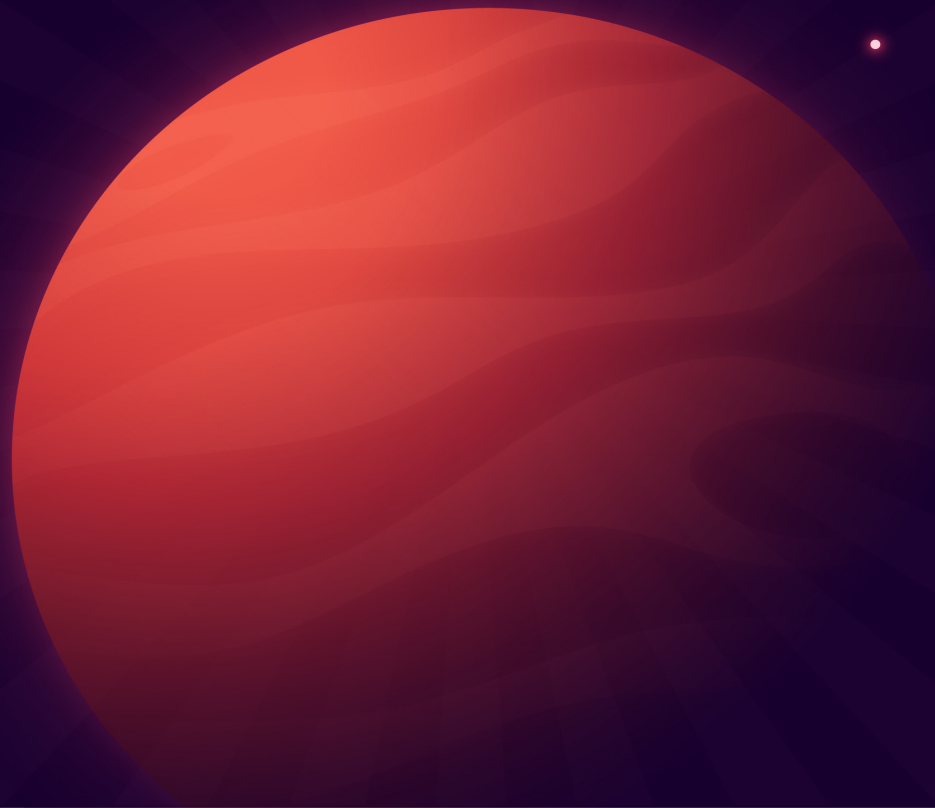
# Wait Time

- 3-5 second pause
- Move beyond regurgitation
- Encourage application, critical thinking, evaluation
- What do YOU think?

# Exploration Time

- Hands-on, minds-on, student-led exploration.
- Chance to experience phenomena in real-time.
- Freedom to fail forward.
- Practice makes proficiency.



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# SPACE FOUNDATION




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National Aeronautics and Space Administration

# Next Gen STEM

**Reaching students where they are using NASA's missions, content, people and facilities**

Date: September 19, 2022

NASA OSTEM Education Specialist Jen Hudgins



## Hometown
Milford, DE


## Education

Oral Roberts University, Tulsa OK

Mississippi State University

| Jen Hudgins |
| --- |
| Kennedy Space Center |
| Office of STEM Engagement |

# AGENDA

- *Introductions*

  *5 minutes*

- *Overview of Next Gen STEM and Artemis Resources*

  *10 minutes*

- *Exploration Station: Safe Landing on the Lunar Surface and Design a Heat Shield Activity*

  *20 minutes*

- *Discussion and Questions*

  *10 minutes*

# What is Next Gen STEM?

## Who?

Next Gen STEM (NGS) is for K-12 students and educators.

## Why?

NGS makes meaningful connections to NASA's missions, content and people to spark and sustain students' interest in STEM.

## How?

NGS has a portfolio of products, experiences, resources, challenges, competitions, and awards.

## Where?

Anywhere – in school, after school, at home, and through informal education institutions (e.g., libraries, museums, science centers).

- What is Next Gen STEM?
  https://www.youtube.com/watch?v=tQkqa0FWydE


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The Next Generation of Explorers

# Next Gen STEM Portfolio

Live Connections with NASA Experts

Challenges & Competitions

NASA CONNECTS Community of Practice

STEM Lesson Plans & Educator Guides

Professional Development & Digital Badging


Tutorial & Supplemental Resource Videos

Curricula Support Materials & Toolkits

Partnership Support


Award Opportunities

# NASA CONNECTS Community of Practice

An online, professional learning community for educators to collaborate with each other and NASA.

Join Discussions & Connect With Others

Ask Questions & Get Answers

Share & Discover New Best Practices

Download Free STEM Products

Learn About Upcoming Events

See The Latest Opportunities

Museum & Informal Education Alliance


NASA CONNECTS

# NASA CONNECTS!

National Aeronautics and Space Administration

## NASA's Community of Practice for Educators

**NASA CONNECTS**, **C**onnecting **O**ur **N**ASA **N**etwork of **E**ducators for **C**ollaborating **T**ogether in **STEM,** is an online platform used to connect educators to NASA content, resources, and opportunities enabling collaboration amongst fellow educators and NASA team members.

- Access NASA resources!
- Discussions with educators!
- Access to exclusive events!
- Join the NASA STEM community!

- Ask questions and get answers
- Curate your NASA content
- Calendar of NASA engagements
- Join groups focused on your interests

To join, click: https://stemgateway.nasa.gov/connects/s
or scan the QR code with your smart device.

NASA CONNECTS

Brought to you by NASA's Next Gen STEM Project

NASA STEM
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www.nasa.gov

Additional NASA STEM resources and information can be found at stem.nasa.gov.

NP-2022-02-3037-HQ

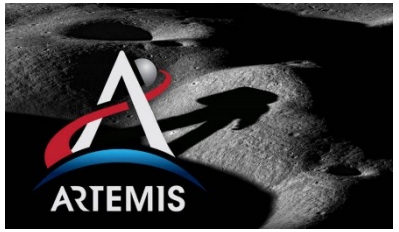
# NASA STEM Engagement: Next Gen STEM

## Earth


Explore Earth from above with the International Space Station, satellites, and more.

## Moon


Activities focused on NASA's Moon exploration Campaign through the Artemis Program

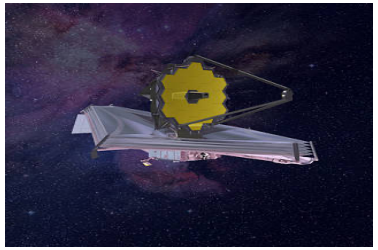



## Aeronaut-X


Learning experiences surrounding the new generation of experimental aircraft

## Solar System and Beyond


Educational resources for NASA's exploration beyond the Moon.



nasa.gov/stem/nextgenstem

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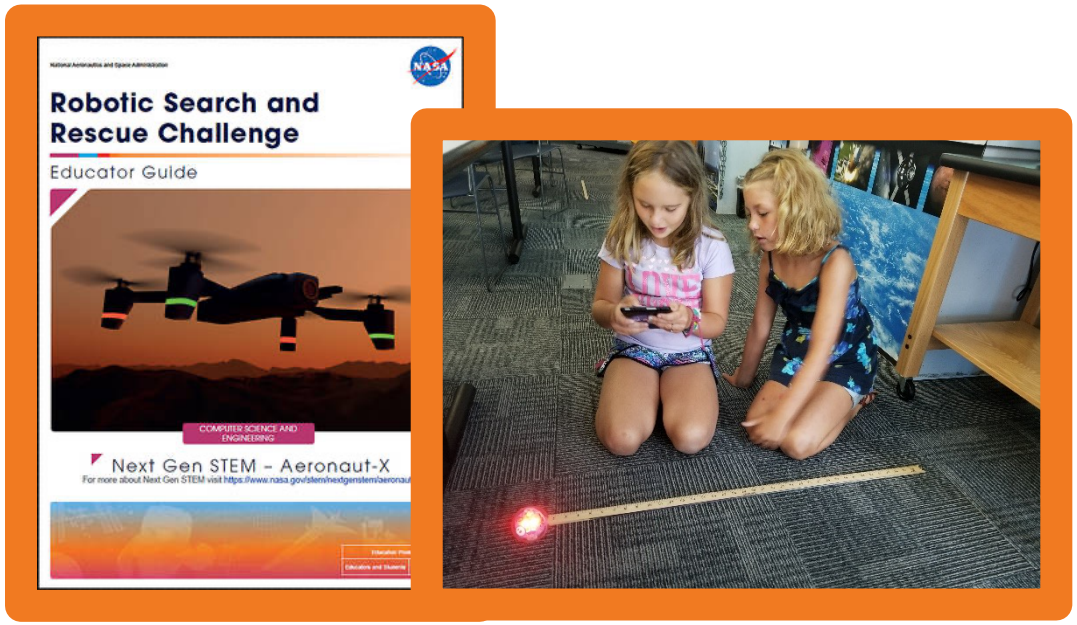
The Next Generation of Explorers

# STEM Lesson Plans & Educator Guides

Evidence-based educator guides, lesson plans, and activities that are aligned with national STEM standards.





More examples
at nasa.gov/stem

# Curricula Support Materials & Toolkits

Curated content including educational and outreach products, images, visualizations, videos and resources.


## #LaunchAmerica STEM Toolkit

Participate virtually in NASA launches and milestones. Host your own NASA launch party.

## Mars 2020 STEM Toolkit

STEM lessons and do-it-yourself projects covering biology, geology, physics, math, engineering and coding.

## Webb Space Telescope STEM Toolkit

Find resources, activities, videos and more for your students to learn about NASA's newest space observatory.

More examples
at nasa.gov/stem

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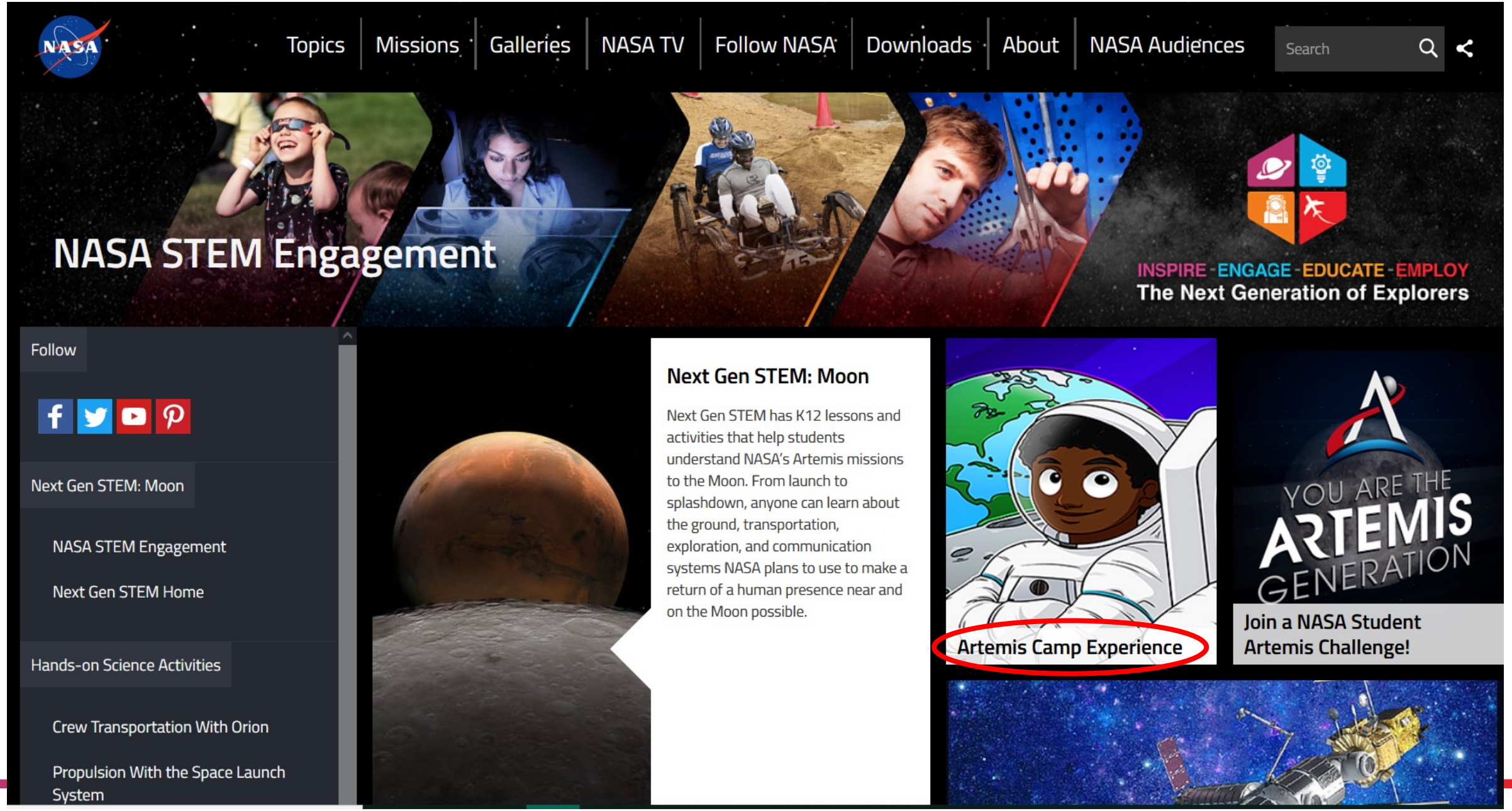
The Next Generation of Explorers




https://www.nasa.gov/stem/nextgenstem/moon/index.html


# How to Draw Artemis

**Product Type**: Hands On Activity / Play and Learn

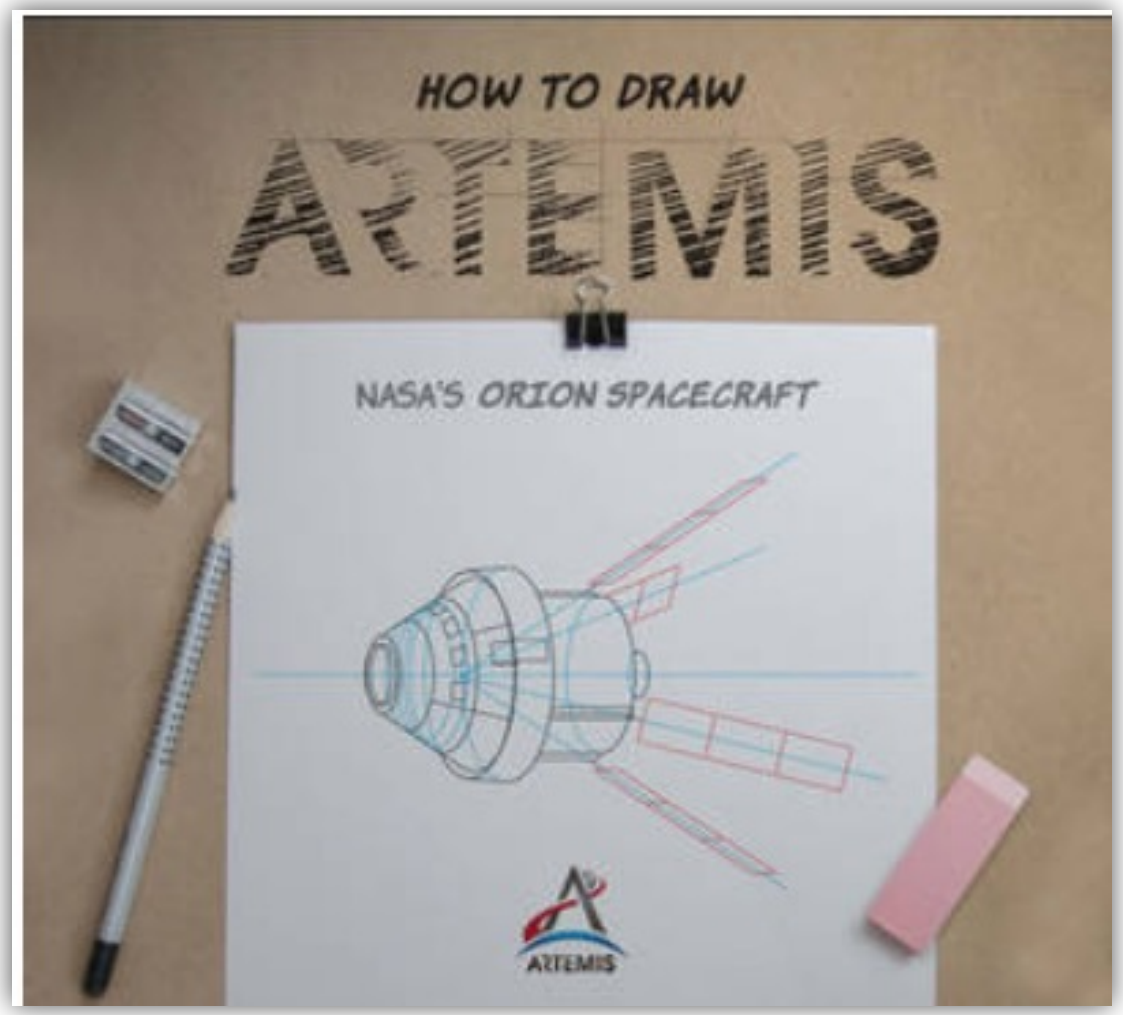
**Audience**: Students

**Grade Levels**: 5-8, 9-12, Higher Education

**Time**: 45 minutes

**Activity Overview**:

- Follow these instructions and use simple shapes to draw parts of NASA's Artemis program, which will take us back to the Moon. The Space Launch System rocket, the Orion spacecraft, the Lunar Gateway orbiting spacecraft, the launch pad, two spacesuits and more are included!








**AND…**

Two new guides are coming soon!

- **Exploration Ground Systems- Build, Launch and Recover**
- **Artemis Generation Spacesuits**

# Engineering Design Process

Guide & Help Students  THINK Like an Engineer!

The engineering design process (EDP) is crucial to mission success at NASA. The EDP is an iterative process involving a series of steps that engineers use to guide them as they solve problems. The steps outlined below can be used by student teams to solve the challenges in this activity guide. Learn more about the EDP with NASA's Educator Professional Development Collaborative at https://www.txstate-epdc.net/models-of-the-engineering-design-process/.

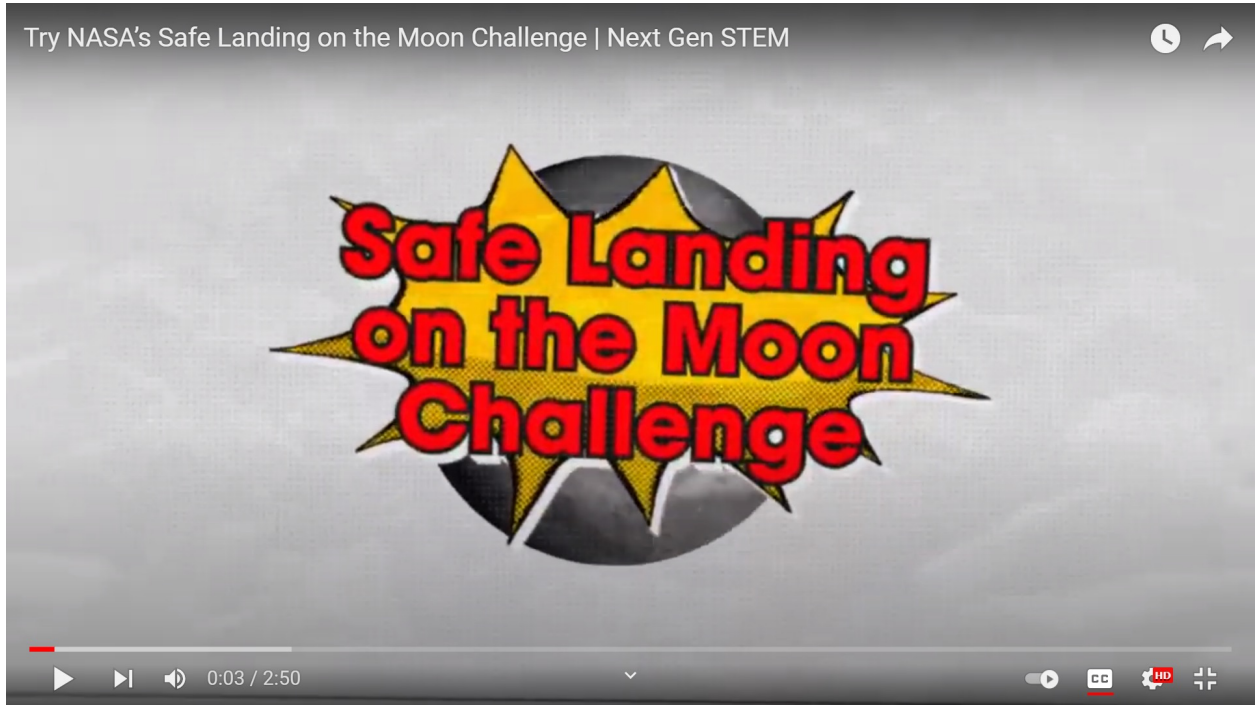
1. **Ask**: Identify the problem, requirements that must be met, and the constraints that must be considered.
2. **Imagine**: Brainstorm solutions and research what others have done in the past.
3. **Plan**: Select and sketch a design.
4. **Create**: Build a model or a prototype.
5. **Test**: Evaluate solutions by testing and collecting data.
6. **Improve**: Refine the design.
7. **Share**: Communicate and discuss the process and solutions as a group.


## Landing Humans on the Moon

- Choose Your Own Landing Site
- Sculpting Lunar Geology
- Priority Packing for the Moon
- Safe Landing on the Lunar Surface

https://www.nasa.gov/stem/moontomars

- Safe Landing on the Moon Challenge: https://youtu.be/Sx7jnsyaFsA




# Safe Landing on the Moon

- GRADE LEVEL: 6th-8th grade, adaptable to all grades.
- YOUR CHALLENGE: Construct a model of a Lunar Landing Craft that will land as gently as possible using the thrust of balloons.
- GROUP SIZE: Groups of three to four.

# Safe Landing on the Moon

## Challenge Objectives:

Students will use the engineering design process to

- Identify the challenges of landing a craft on the surface of a body without an atmosphere.
- Design, build, and improve a model of a lunar landing craft that can slow its descent using the downward thrust of a balloon.
    - Must use at least one Inflated balloon.
    - Must utilize landing legs that result in a stable, upright landing
    - Lander must survive a drop test from a height of two meters,

## Design Constraints:

- May only use everyday, readily available supplies
- May not use parachutes or other items designed to create drag.

# Safe Landing on the Moon

## Materials:

# Safe Landing on the Moon



What am I trying to accomplish in this activity?

- What is the goal?
- What is my role on the team?
- How do we measure success?

What are the rules?

- What are my design criteria? (must haves)
- What are my design constraints (can't haves)

# Safe Landing on the Moon



# Safe Landing on the Moon

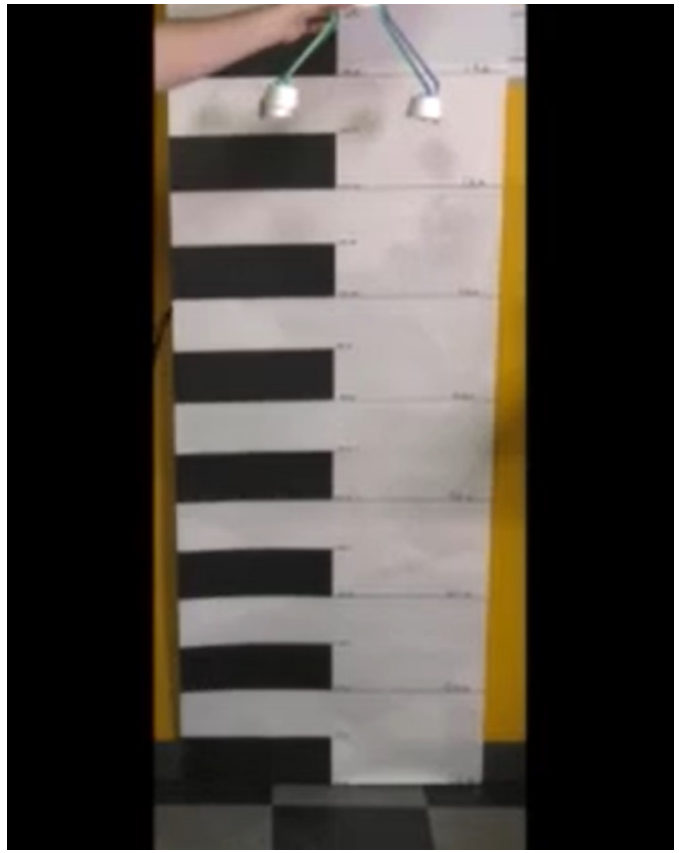


# Safe Landing on the Moon



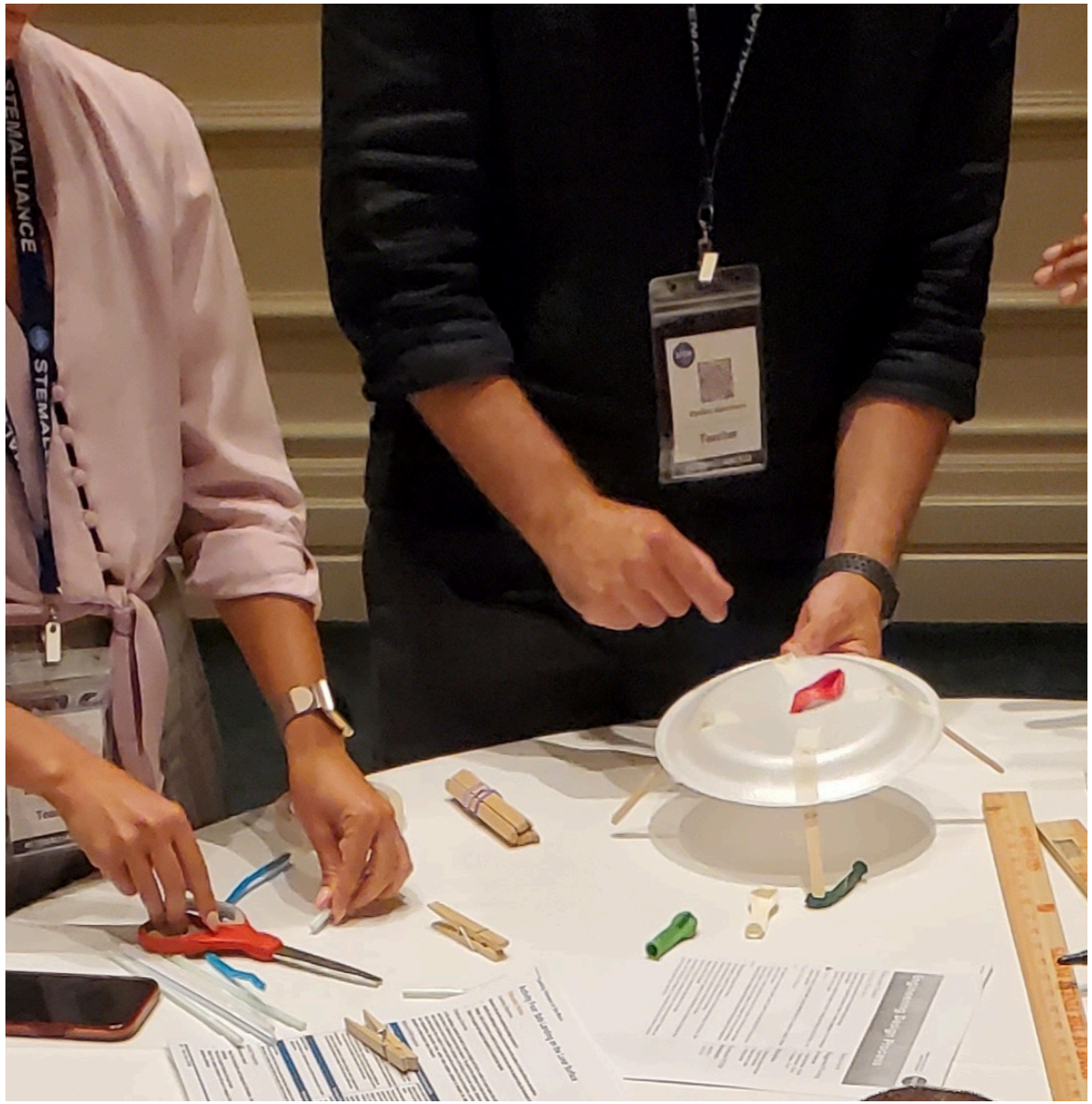
# Safe Landing on the Moon





# Safe Landing on the Moon

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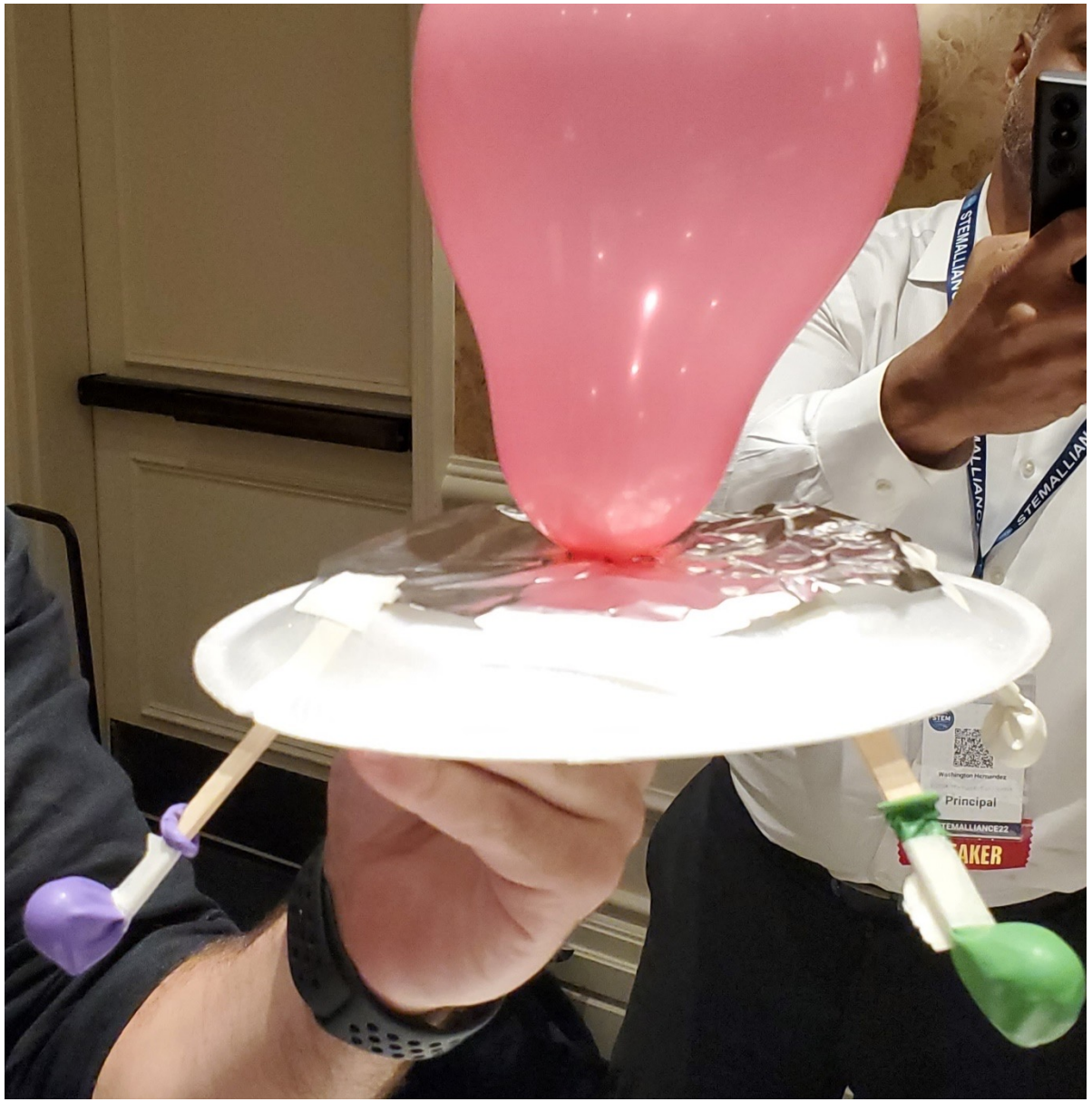
STEMALLIANCE
Principal

# Safe Landing on the Moon



- Where we able to successfully meet the objectives of the challenge?
- What difficulties did we have to overcome?
- What innovative idea did we use that was different than what other teams used?
- What was my role/contribution to the team?

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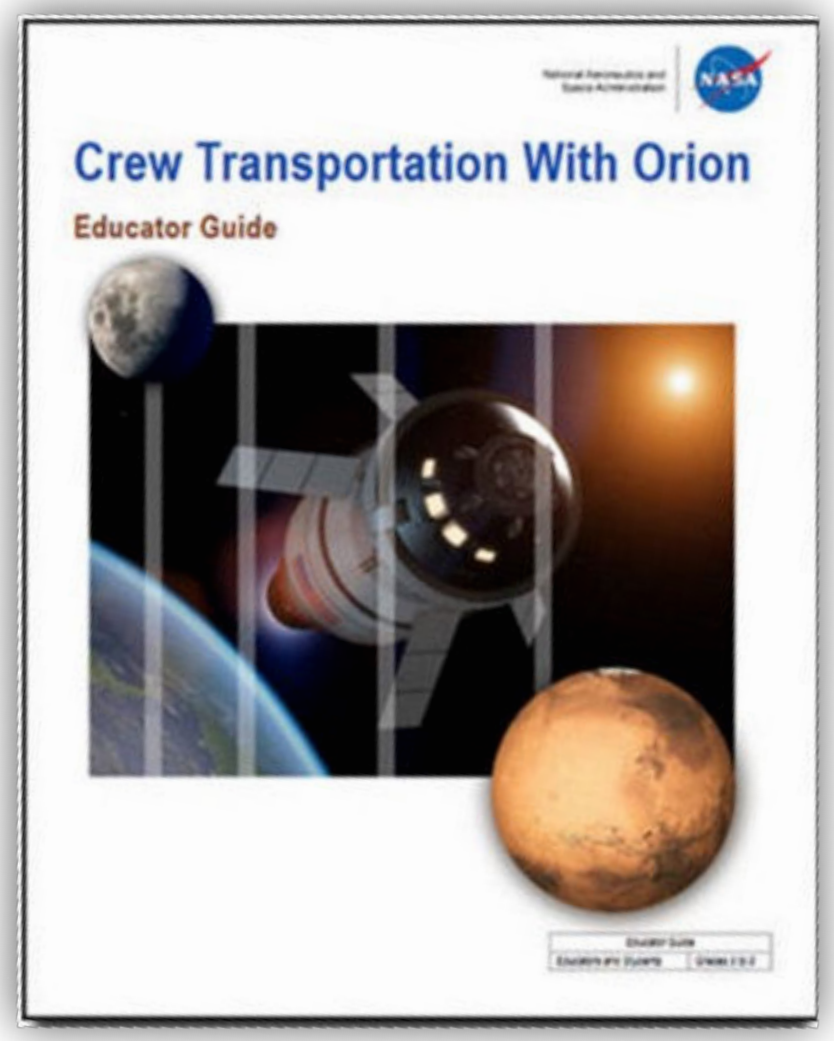
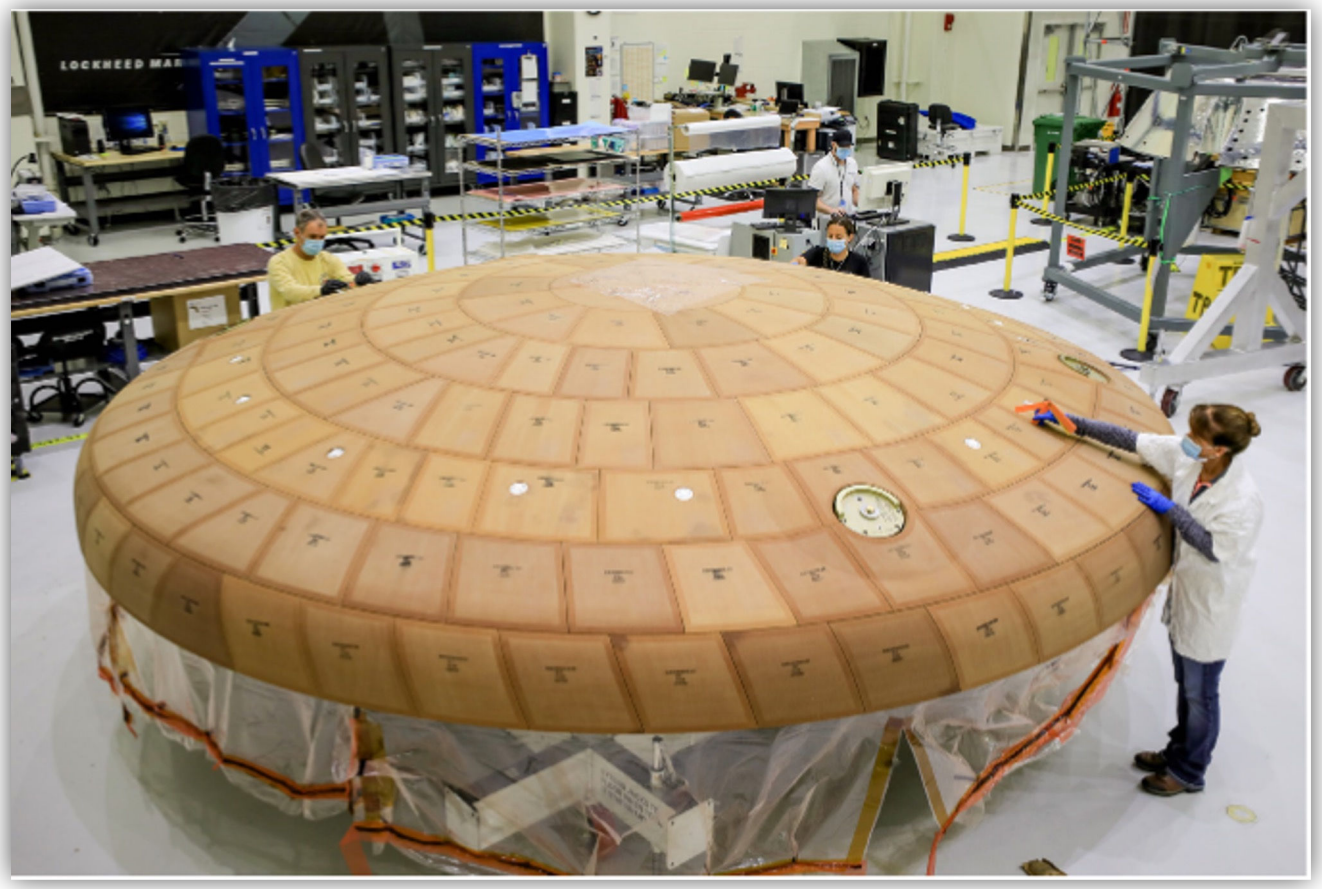



## Crew Transportation with Orion

- Analyze the Geometry of a Spacecraft
- Design a Crew Module
- Model a Spacecraft Docking System
- Build a Heat Shield

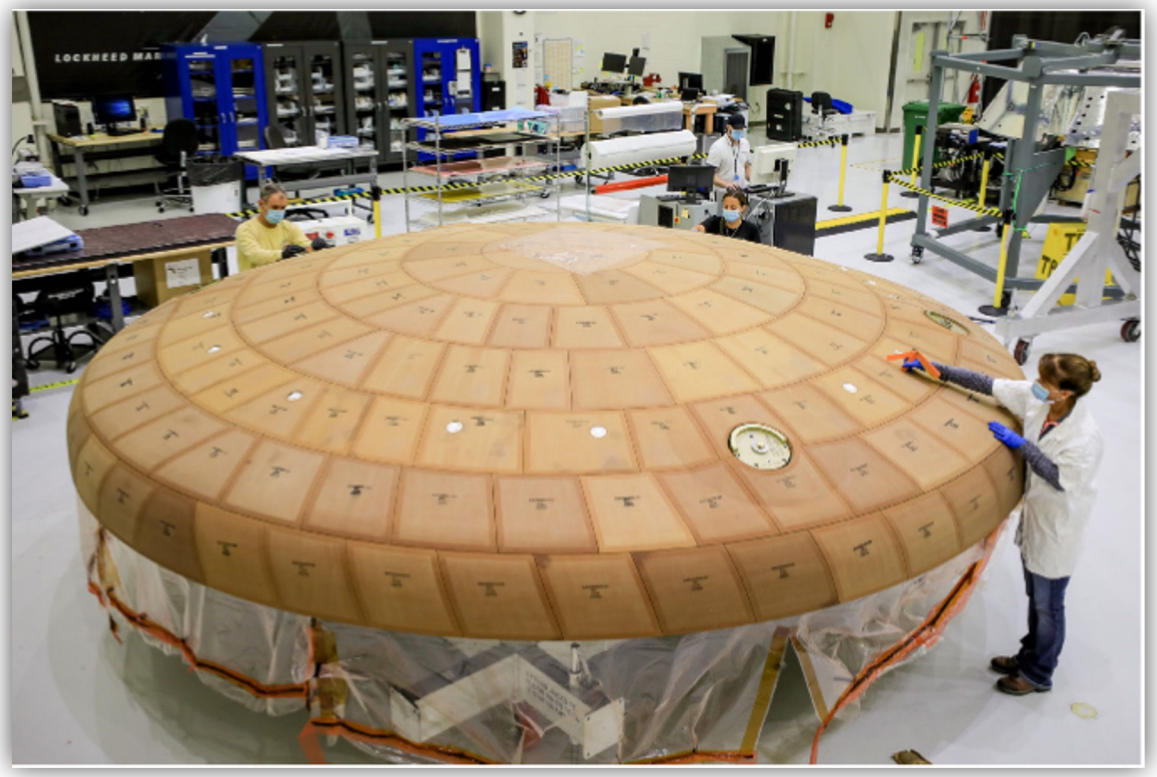
https://www.nasa.gov/stem/moontomars

**Your Challenge:** You will work together in teams to design and build a heat shield that will protect the contents (candy) of a crew module (paper cup) from a simulated atmospheric reentry (hair dryer).



# The Orion Heat Shield

Orion: Heat Shield https://www.youtube.com/watch?v=XH4VVpfr9Bs



- How fast do you think Orion will be traveling when it re-enters Earth's atmosphere?
- How hot will the atmosphere around Orion be during re-entry?
- What valuable key terms do you hear during this video?

# Materials



# Build a Heat Shield

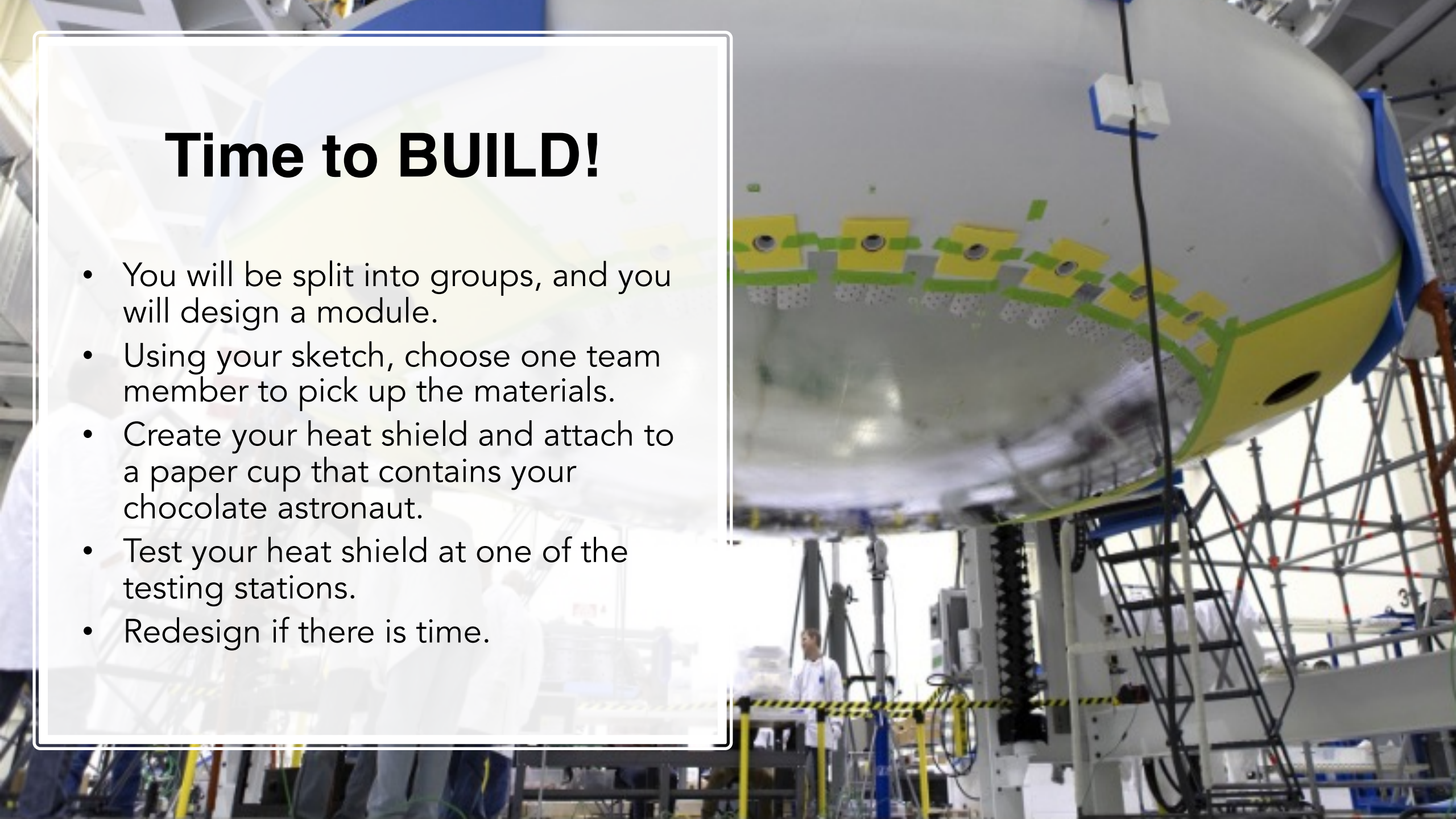
- **Design Criteria/Constraints**
  - The surface area of the heat shield cannot exceed 40 $cm^2$.
  - The heat shield must protect the interior contents of the crew module (candy) from heat and turbulence during the simulated reentry (hair dryer).
  - The contents must survive for 7 minutes without melting.

- **A heat shield is a crucial element of a spacecraft, especially one that carries people.**

# Build a Heat Shield



- What material characteristics will work best to protect the contents (candy) of the simulated crew module.
- Draw out your ideas for a heat shield and plan how you will conduct the testing.



# Time to BUILD!

- You will be split into groups, and you will design a module.
- Using your sketch, choose one team member to pick up the materials.
- Create your heat shield and attach to a paper cup that contains your chocolate astronaut.
- Test your heat shield at one of the testing stations.
- Redesign if there is time.


# How to Test:

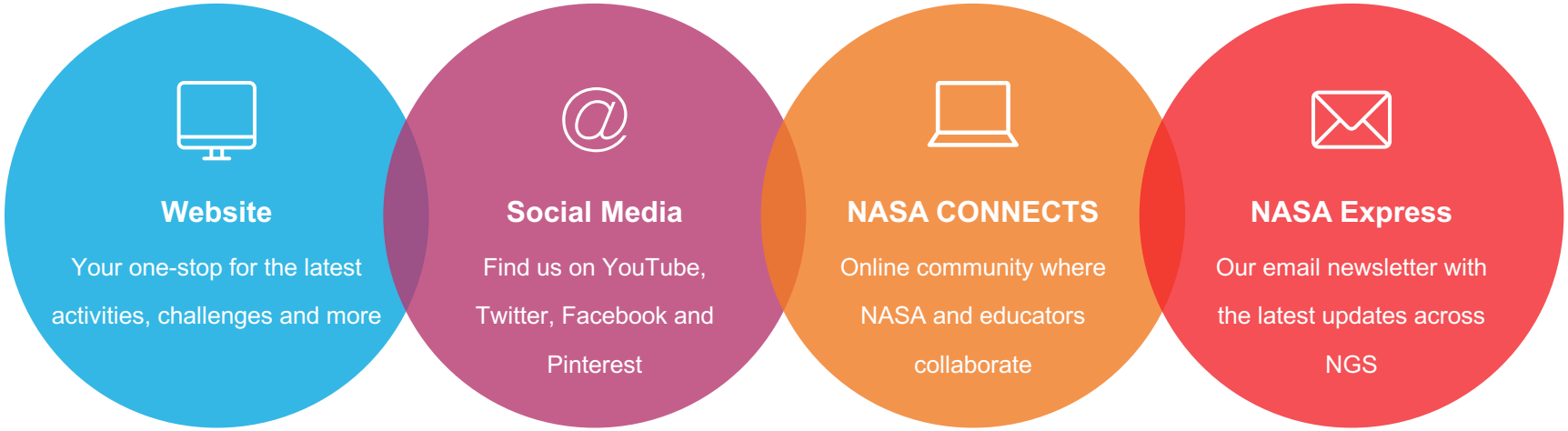
1. Each team will build the heat shield they designed, using the materials provided.
2. Once the heat shield has been built, your team will test the shield by holding a hair dryer no more than 10 cm away from the bottom of the shield, exposing it to direct heat and air for 7 minutes.
3. You will use a stopwatch and take thermometer readings in 1-minute increments. They will track their data on a data table.
4. After completing the first round of testing, your team can make modifications to your design to improve protection of the crew module contents (candy) based on the results of the testing
5. You can repeat the testing with your modified design if there is time.

# Our Data

| Time Increments (mins) | External Temperature (Fahrenheit) | Internal Temperature (Fahrenheit) | Observations |
|---|---|---|---|
| 1:00 | | | |
| 2:00 | | | |
| 3:00 | | | |
| 4:00 | | | |
| 5:00 | | | |
| 6:00 | | | |
| 7:00 | | | |

# Activity Wrap up And Discussion

# Stay Connected



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# Questions?

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