



# Moon Base

*MESA Day Competition for 2021-2022*



# What makes a successful MESA Civil Engineering competition?

1. A project that is exciting for students who may be intimidated by other MESA competitions
2. Hands-on and integrates civil, mechanical, and construction engineering
3. Easy for Advisors to guide students
  - a. Accessible
  - b. The materials are not intimidating for students and teachers
4. Everyone feels accomplished
5. Family friendly - families can be engaged in the project

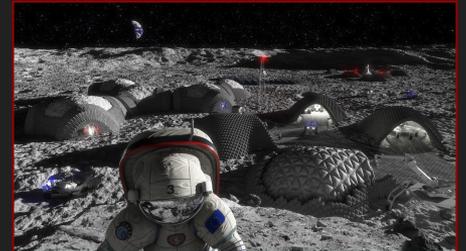
# Overview

Your task is to design a safe structure to house new moon-based research activities. Students will design and construct an original structure using only recycled cardboard that can withstand the highest amount of impact, is lightweight, and meets the specific size requirements outlined in the Rules.

Levels: Middle School & High School

Divisions:  
6th, 7th/8th, 9th/10th,  
11th/12th Grades

Composition of Teams:  
2-3 Students Per Team



# Materials

The only allowable material is deconstructed, post-consumer, not plastic coated, unpainted cardboard without seams with up to a maximum 5mm thickness

OR

Paper-based materials

*No other materials are allowed including polyethylene, wood, ceramics, metal, glue, etc.*



NO



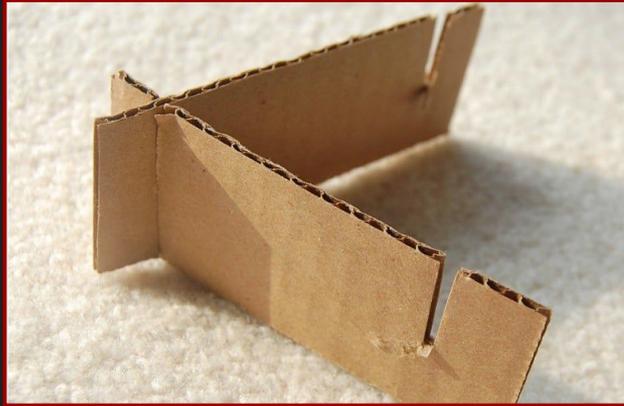
YES



# Joints and Connections

*What is allowed to create joints and connections?*

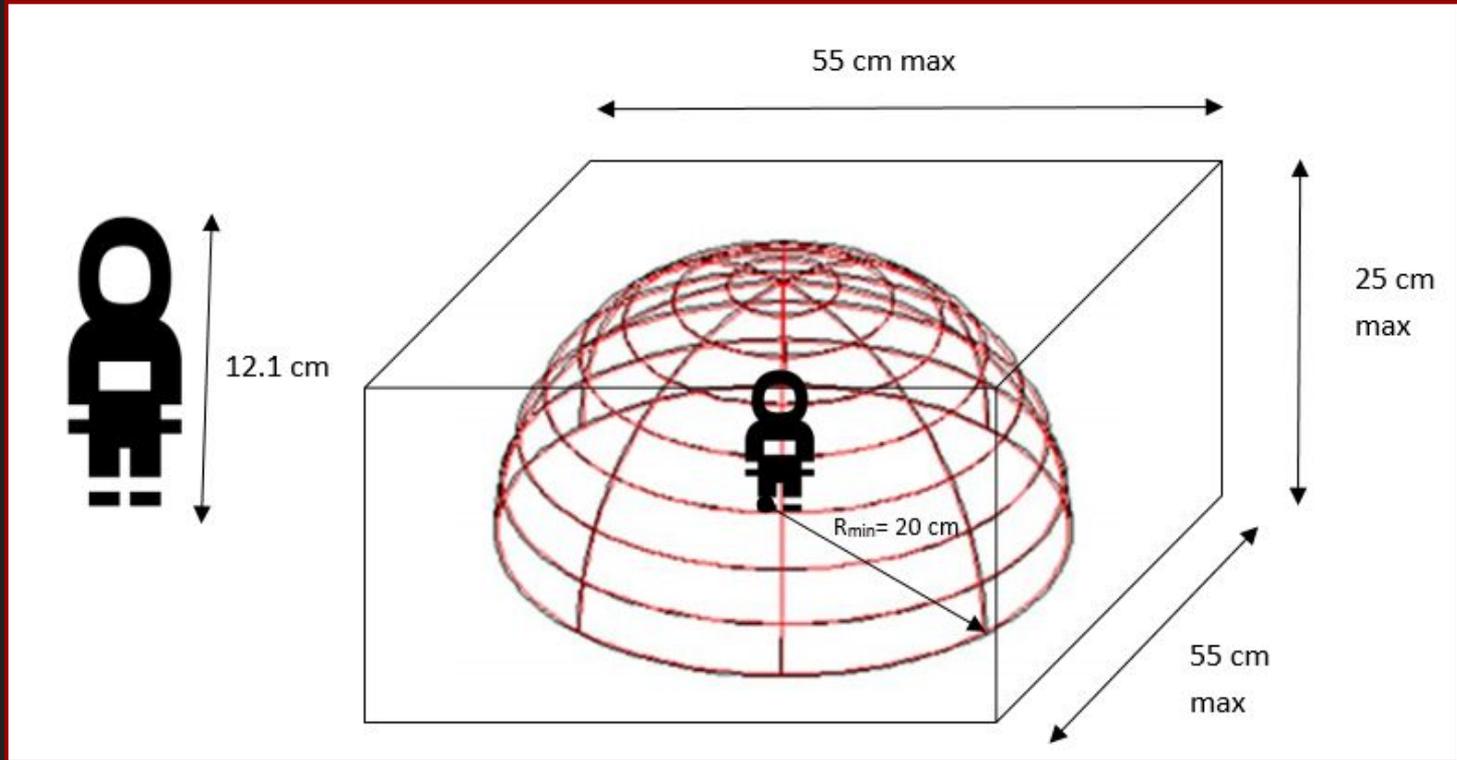
Carved, mortise, and tenon, or other systems using exclusively cardboard or paper products are allowed.



*What is NOT allowed?*

No glue, tape, or other external adhesive of any type can be used in any way or form.

# Structure Specifications



# Creative Structures



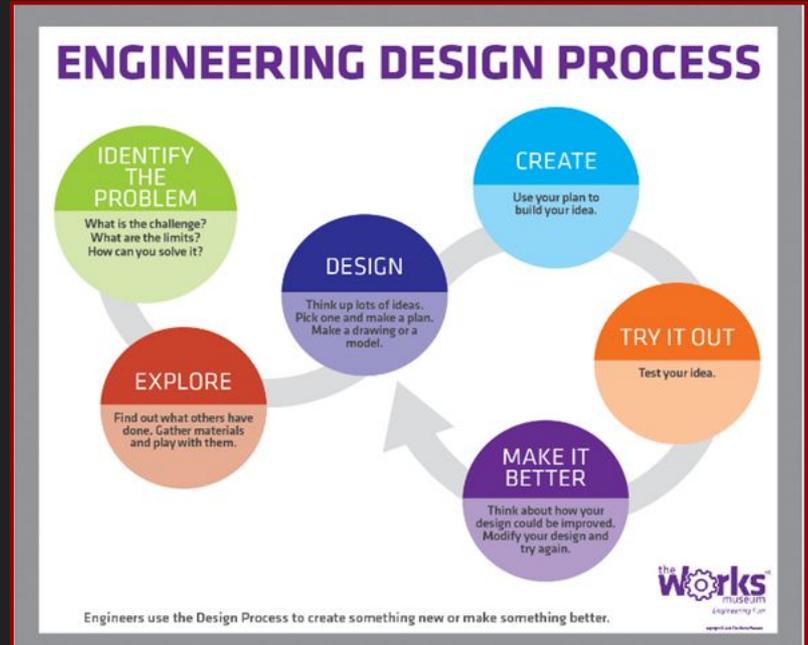
# Engineering Lab Book

The lab book is meant to clearly demonstrate and illustrate evidence of the application of the Engineering Design Process in the MESA project.

Electronic submissions will be required. Teams should use an electronic portal/application such as Google Docs to keep and maintain a lab book.

**Please check with your local MESA center for the deadline and submission platform to submit your team's lab book for local and for regional events.**

A deduction of 20% of the team score will be assessed for an incomplete lab book and a deduction of 50% of the final score will be assessed for a missing lab book.



# Engineering Lab Book continued...

Criteria	
A	Is the lab book properly labeled? ( <i>Names, Grades, School, MESA Center</i> )
1	<b>Identify the Need</b> (at least 2 sentences for each) <i>State what is the challenge being worked on? What are the limits/constraints? How do you think you can you solve it.</i>
2	<b>Explore</b> <i>Conducting research (one real world example, description, list 3 cited/referenced sources), gathering materials, try using materials</i>
3	<b>Design</b> <i>Brainstorming ideas (at least 3 iterations) each represented by a picture, sketch or drawing. Creating a plan for selected idea (at least 5 sentences). A list of materials for the prototype.</i>
4	<b>Create</b> <i>Building a prototype. Describing the building of the prototype (at least 5 sentences). Including a final picture of the project.</i>
5	<b>Try it Out</b> <i>Testing idea/prototype. Attempting at least 3 trials/attempts. Measuring each trial result (by specific performance criteria like distance traveled, time, etc.). Providing evidence of the use and application of at least 2 appropriate mathematical concepts in the tests.</i>
6	<b>Make Better</b> <i>Evaluate results. List at least five ways project can be improved</i>

# Day of the Competition

## Pre Specs Testing

- 1) The structure receives a specification check to determine whether it conforms to the weight, dimension, and construction rules.
- 2) The competing structure is weighed and its mass " $m_s$ " recorded in grams.



# Testing the Structures



# Judging

- 1) The structures will be judged by their Impact-to-Mass Ratio, “I/M” calculated as:

$$I/M = m_i * g * (H * 10^{-2}) / m_s$$

Where:  $m_i$  is the mass of the hitch ball in grams;  $g$  is the gravity,  $9.81 \text{ m/s}^2$ ;  $H$  is highest impact elevation in centimeters; and  $m_s$  is the mass of the competing structure in grams.

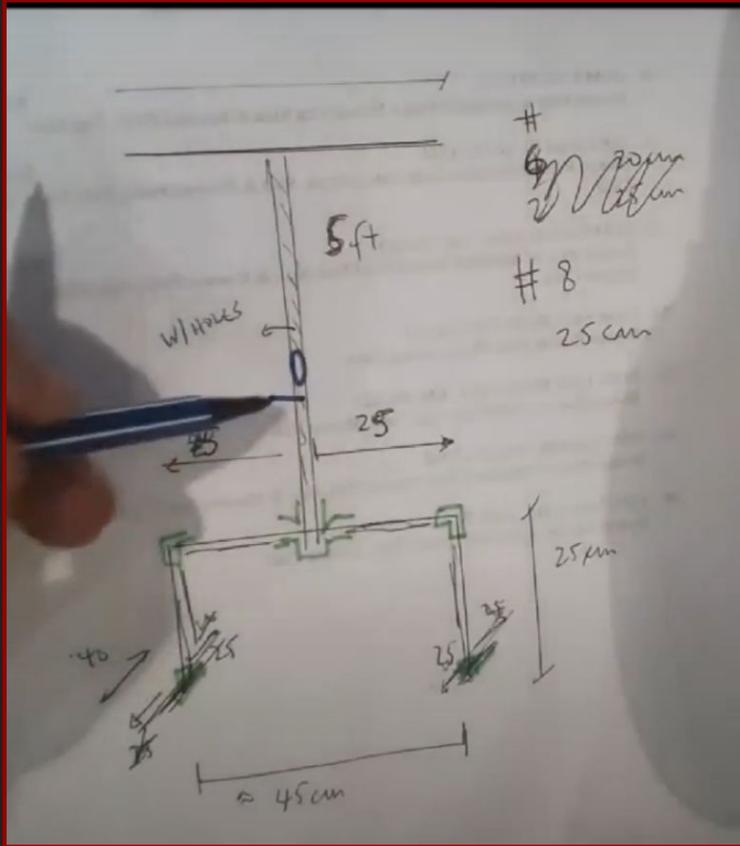
- 2) A deduction of 20% of the team score will be assessed for an incomplete lab book and a deduction of 50% of the final score will be assessed for a missing lab book.

# Post Specs Testing

After the project has been tested, there will be a forensic inspection to ensure that there are no additional materials used on the internal structure and no cardboard is thicker than 5mm. Structures that do not meet the requirements will not place.



# Testing Device



# Questions?

Also, before you go, please fill out our survey!

