#### 2022 Design and Prototype Finalists

#### **Destiny Mock-Up**

Students: Daniel Noble, Caleb Lewis, Nick Schilling, Will Shoemaker

Teacher: Olympia Stein School: Grafton, Virginia

Students: Cory, Josh, Tim, Thomas

Teacher: Kristin Magas

School: Tri-County Regional Vocational, Massachusetts

Students: Abigail Hall, Abner Soriano, Aeriana Conway, Arthur Garcia,

Enrique Medellin, Isaac Colon, Santiago DelValle, Tony Bailey,

Victoria Gonzalez

Teacher: Malcolm Hollingsworth School: Cypress Ridge, Texas

Students: Muhammad Wadiwala, Ashton East

Teacher: Robin Merritt
School: Clear Creek, Texas

Students: Matthew R, Kai L, Jackson P, Kristina M, Jack F, Marina F, Caleb R, Oscar F, Sami P

Teacher: Andrew Woodbridge School: Olympia, Washington

Students: Molly Schmitt Teacher: Nate Olsen

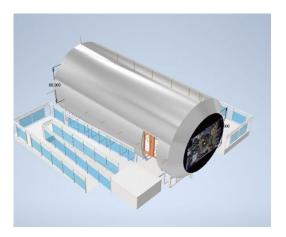
School: Warren Tech Central, Colorado

#### Our Problem Statement

For our NASA Hunch Project, we sought out to create a full-scale module of the Destiny Module that could be easily transported and reassembled among airports. In this model, guest interaction would be encouraged through touchscreen displays and a photo floor. The goal of our model is to inform guests of this important component of the International Space Station as they wait for their flights.

#### Destiny Module Mockup

Grafton High School – Mrs. Stein's Architectural and Advanced Technical Drawing Classes – Daniel Noble, Caleb Lewis, Nick Schilling, Will Shoemaker





#### **Features**

#### **Exterior**

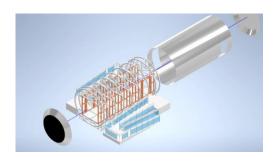
On the outside of our model, we have included two ramps to accommodate wheelchair access, floor trusses that help support the model, and aluminum sheeting to represent the looks of the Destiny Module Exterior.

#### **Interior**

In the inside of our model there will be a glass floor that will allow NASA to create a photo floor, touchscreens to allow for interactive experiences, and pictures that represent the experiment racks. The touchscreens will attach to the ceiling trusses.



Our main purpose in creating the model was to allow for ease of transportation and assembly, so we decided to consider the Destiny Module in 3 parts: The two end cones, the main body (the part of the module without the end cones), and the two ramps. In transportation, the two end cones would be separate parts, the wall and circular frames and the floor and ceiling trusses would be disassembled, and the ramps would remain in one piece. This would not only allow for better spacing on the flatbed truck, but for the improved ability to get each part through the airport doors as well.



#### **Testing**

For testing, we believe that a stress analysis test in Autocad Inventor would best analyze the load of our model, so we can have an idea of how safe it would be in an airport. This test would also confirm whether our means of assembly would be suitable to meet the design requirements.



#### **Destiny Mockup**

School: Tri-County RVTHS

Teacher: Mrs. Magas



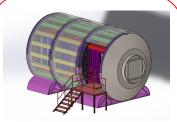
This is our physical model of the Destiny module.



If it was disassembled and loaded onto a flatbed, it would be done like so. Here is the disassembly video.

Our Mockup of the Destiny Module is created to break down as far as possible to make it fit on the bed of a flatbed trailer. We utilize heavy duty hinges, quadrant based circular frames, and long support beams to make our concept a reality. This project was divided into 4 sections, these sections are as follows: The inner frame, the in-between frame, the outer frame, and the outermost layer. Each layer connects to each other through reversible methods. These reversible methods include bolts, pins, and slots. To keep the module from moving, we have designed stabilizers that cradle the exhibit and restrict it's movement in all axes. The cost estimate projects our product to be approximately \$124,000.00, and we plan on using Aluminum, 6061 Aluminum Alloy, Polypropylene, and Steel for our materials. Out of the 16 listed parts on our cost estimate, a total of 11 parts already have real world equivalents that may be purchased to create our required designs. Wiring for all electronic equipment will be routed through the wall; and when the mockup needs to be taken down, we take down the wiring along with it using 6 terminal wiring harnesses.





Here is the full CAD model for our mockup.



These are our design notes for the internal wiring.

Item Name	Decription	Material	Unit Cost	Total #	Total Cost	Link to EP
Outer to Inner Support Brace	RM	6061 Aluminum	\$261.99	32	\$8,384	Scrap 6061
Circular Frame	RM	6061 Aluminum	\$704.62	16	\$11,274	Scrap 6061
Long Support Beam	EP	Steel	\$1,311.20	10	\$13,112	Steel Tubing
Short Support Beam	EP	Steel	\$1,311.20	8	\$10,490	Steel Tubing
Inner Wall (Door Frame)	EP	Steel	\$3,846.75	2	\$7,640	Steel Tubing
Inner Wall (Sides)	EP	Steel	\$3,846.75	2	\$7,694	Steel Tubing
Inner Wall (Floor / Ceiling)	EP	Steel	\$3,487.88	4	\$13,952	Steel Tubing
Frame Hinges	EP	Stainless Steel	\$295.95	8	\$2,368	Heavy Duty Hinges
Staircase	EP	Aluminum	\$1,290.00	2	\$2,580	Staircase
Handicap Lift	EP	Aluminum	\$6,199.99	2	\$12,400	Handicap Lift
Lights	EP	Many	\$122.19	3	\$367	Light
End Cap	RM	Aluminum	\$480.00	8	\$3,840	Aluminum
Ventilation	EP	Ventilation	\$1,900.00	1	\$1,900	Ventilation
Industrial Fan	EP	Many	\$145.95	1	\$146	Fan
Touch Screens	EP	Many	\$1,985.00	7	\$13,895	Touch Screens
Outer Layer	RM	Polypropylene	\$348.00	5	\$1,740	Polypropylene
Stabilizers	RM	6061 Aluminum	3,225	4	\$12,900	Scrap 6061
	RM = Raw Material			TOTAL ->	\$124,679	
	EP = Existing Product					

This is our final <u>cost estimate</u>, with a grand total of \$124,679

#### **Our Team**

Members: (Left to Right)

Cory - Journal Manager

Josh - Prototype Manager

Tim - CAD Manager

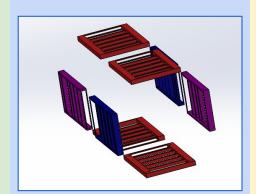
Thomas - Document Manager



#### **Features**

- Easy to assemble
- OSHA safe
- Intuitive design
- Fits on Flatbed
- Accurate Size
- Sturdy
- Few part variations

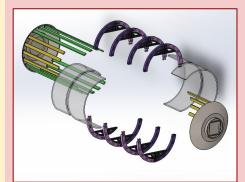
#### **Interior**

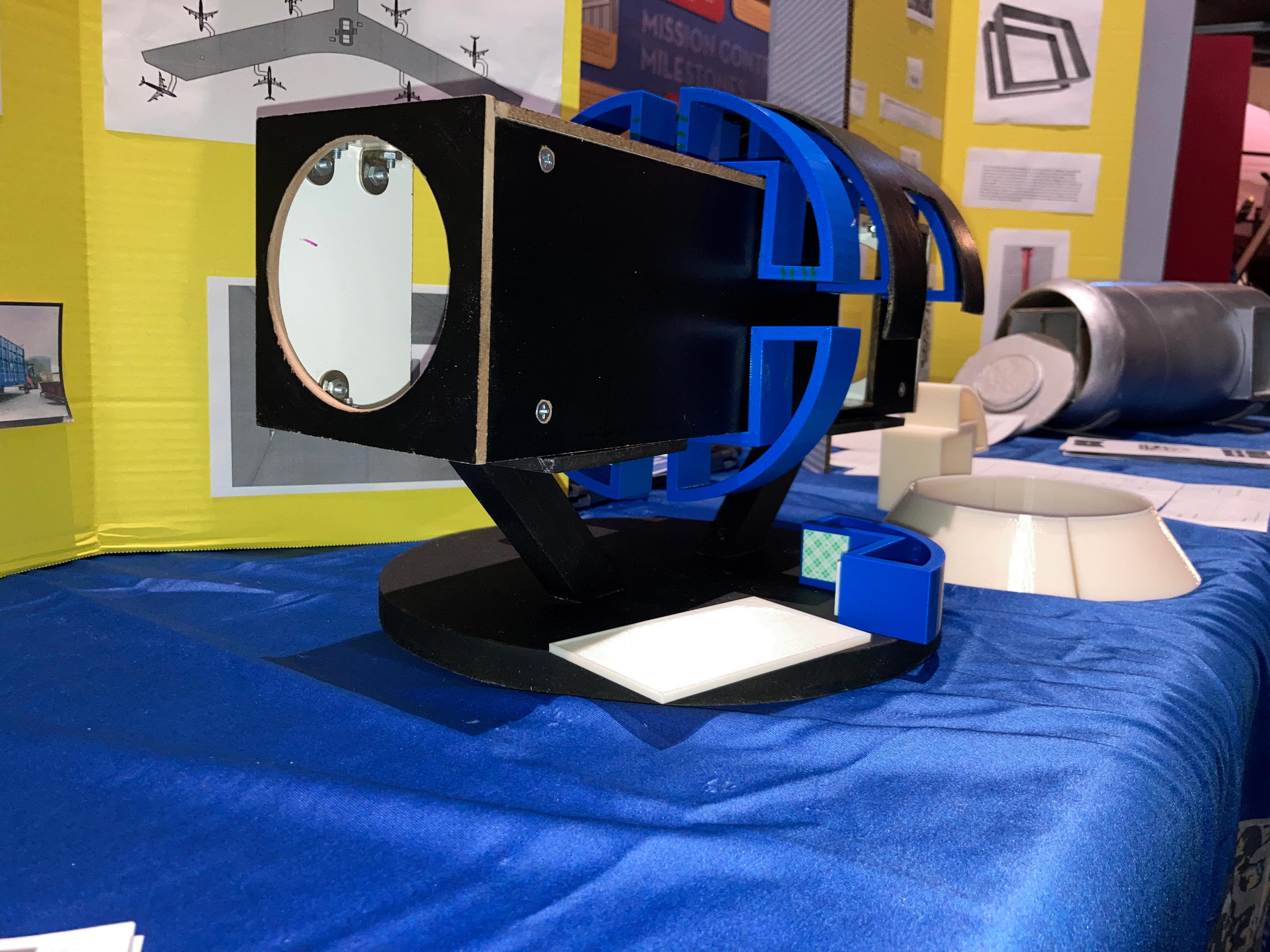


#### **Future Designs**

- Improved design for outer layer
- Better connection for end cap
- Find a better vendor for 22 feet 10x4s

#### **Exterior**







## Hallway View Medical Experiment Rack Experminet Rack

#### Guests' experince

#### The Interior

The interior of this mock-up includes seven interactive TVs displaying educational programs. Our design stays true to the design of the Destiny Lab, provideing a learning experince for guests of all ages.

#### Saftey

Our mock-up includes two air purifiers and has a 15 person capacity in order to keep our guests healthy. We also have wheelchair acess so everyone is able to enjoy this learning opportunity.

#### Cypress Ridge Highschool

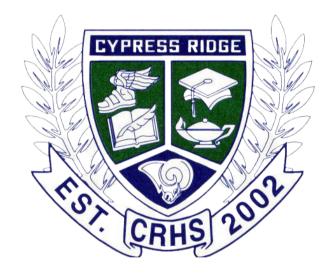
Mr. Hollingsworth
Abigail Hall
Abner Soriano
Aeriana Conway
Arthur Garcia
Enrique Medellin
Isaac Colon
Santiago Del Valle
Tony Bailey
Victoria Gonzalez



More about us on https://aerianaconway.wixsi te.com/cypressridgenasa

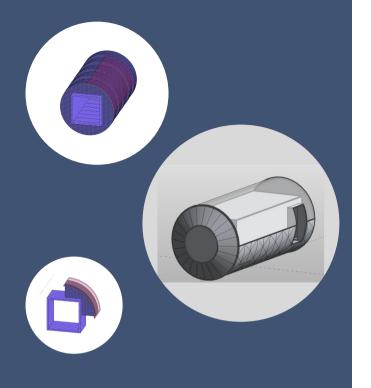






#### NASA Hunch Destiny Mockup

Architecture Design Workforce Dual Credit



#### **NEW IDEAS**

#### 360 air conditioner

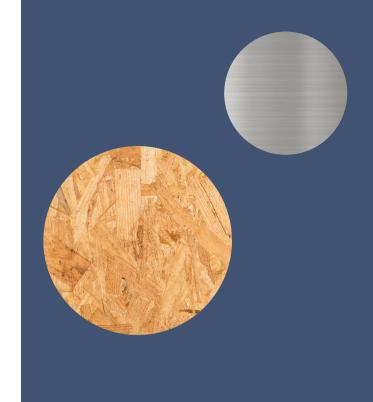
The Daikin New Round Flow Cassette has the ability to sense heat, meaning cool air will flow towards the guests as well as the TV screens.

#### Air Purifyer

This air purifier will protect the health and safety of all visitors. We have prepared to handle COVID in advance for public saftey.

#### Rear Projection

Our rear projection will be placed at the hatches at the end of the mock-up and will display views of the Quest Airlock as well as Harmoney [Node 2].



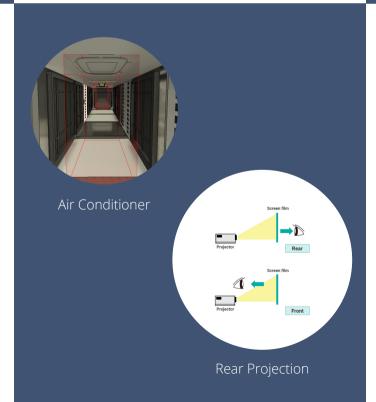
#### Massing on Revit 2021

#### The Outer Shell

In our mockup, we decided to use the Revit Massing template to represent the outer shell. Our massing represents the dimensions of the exterior of our mockup as well as the MMODs on the exterior panels.

#### Transportation

The Kenworth t680 truck will transport the mock up the most effectively. This aerodynamic truck is beneficial because of the limited air resistance against our model on the way to its destination, We would also use an extra semi in order to transport the framing of the mock up.



#### The Basics

#### Cost and Materials

We have chose the most durable as well as cost effective materials for our mock-up. The interior walls will be approximately \$56,812.38 (excluding shell)

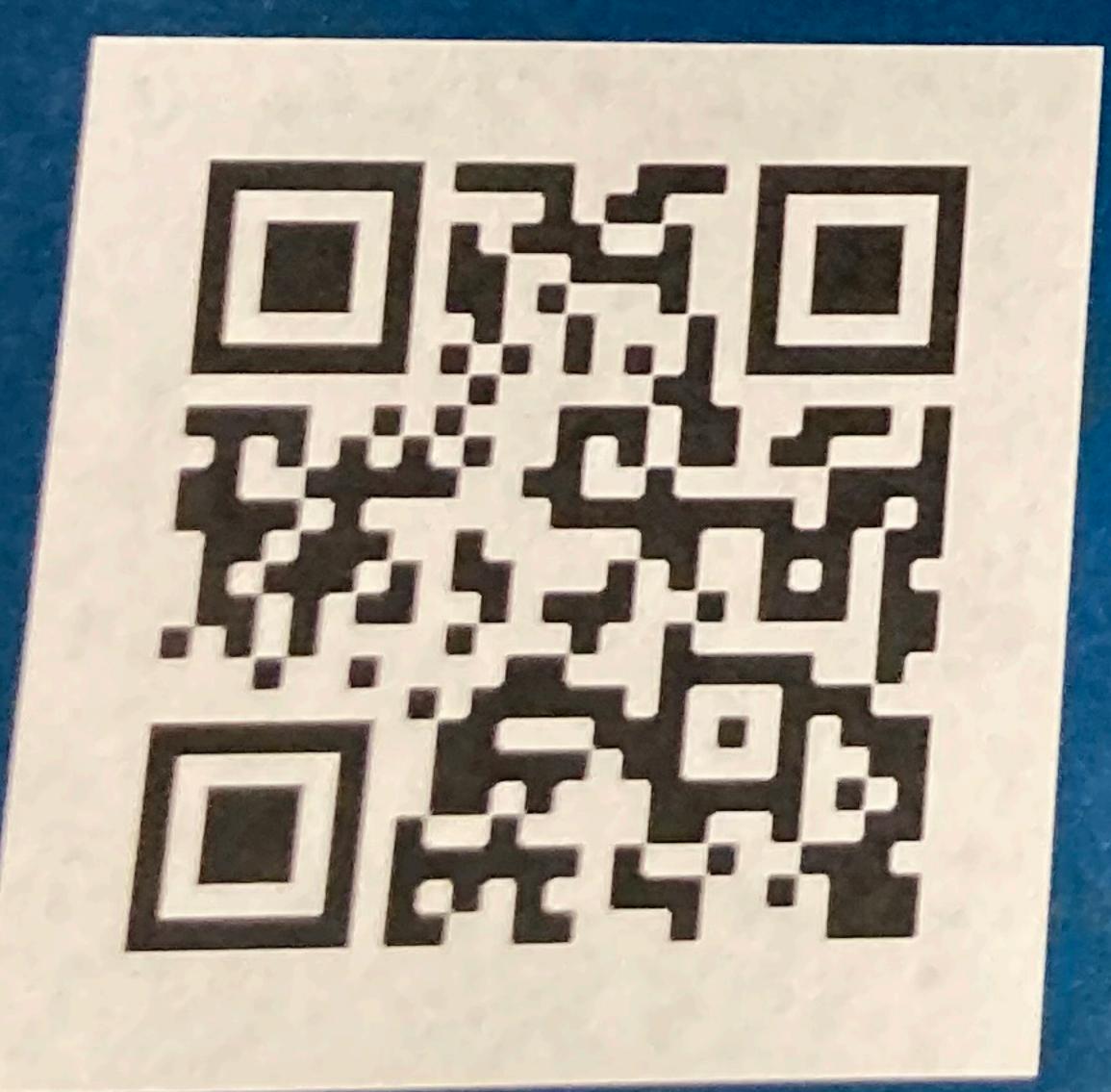
We'd be using materials such as 1/2 inch OSB plywood and 1/2 inch aluminum for the interior walls. For the floors we decided to use 1 inch oak plywood and 1/2 inch of aluminum.



## PROBLEM STATEMENT

Trying to create a to-scale model of the Destiny Lab Module to add to Hobby Airport proves difficult due to the many problems faced when doing so. The diameter of the Destiny Lab is 14 feet, which makes it unable to fit through any doors. The Destiny Mock-up must be able to fit through the doors of the airport, which is 7 feet tall; therefore, it needs to be separable so it's able to be transported into the airport.

## PROJECT DEMO





## Contact Information

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Ashton East

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281-746-0819



## Destiny Module Mock-Up

By Muhammad Wadiwala & Ashton East
Clear Creek High School
CCISD

For
Instructor Mr. Merrit
Architecture & Civil Engineering

## Truss System

The Truss System is a key part of our design, it helps the Destiny Module keep its circular shape, and while also providing structural support. The truss system also supports the weight of the interior corridor which is the part of the module in which people walk through. The truss system also supports the 8 touch screen TVs while line the walls and ceiling of the interior corridor. The system itself is made of Southern Yellow Pine Wood, allowing it to be light in weight, while still being able to support the entire tube.

#### Project Progression



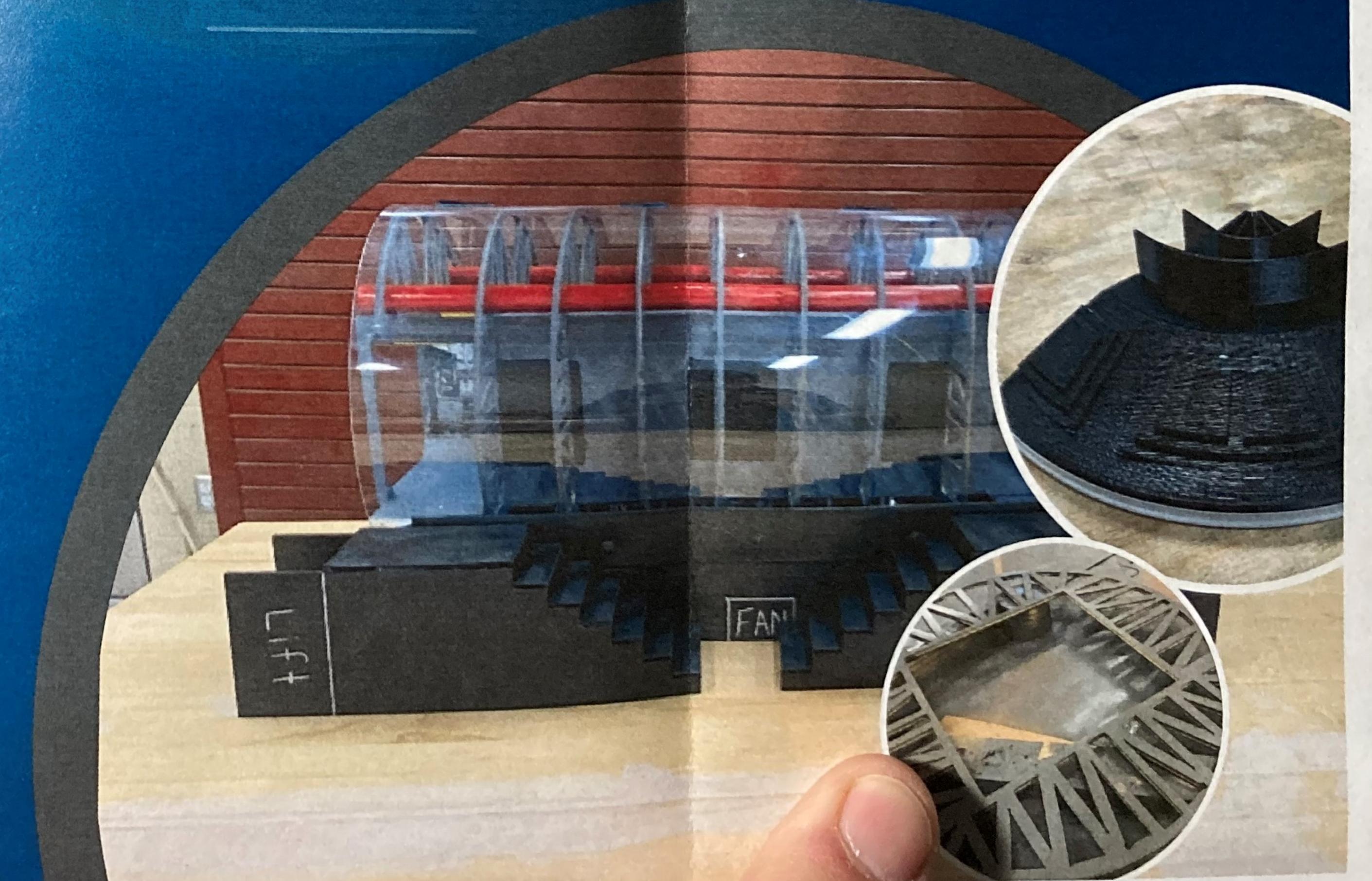
## Project Design

#### End Cones

These are designed in a way to break apart into 4 pieces, to provide for easier transportation into the airport. Once inside these 4 pieces can be conjoined together in an almost Lego-like way, thus creating the fully assembled end cone. These end cones are to be made out of plywood and are supposed to be layered together to create the curvature needed for the end cone.

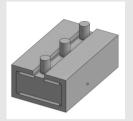
### Exterior System

The Exterior System is a integral part of our design, its the platform on which the entire module rests on. The base of the System is made of wood, which is then covered by a piece of sheet metal. This was done in order to make the system light enough to transport, while also being strong enough to provide even structural support to the entire tube.



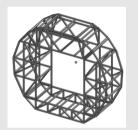
#### **UNIQUE ELEMENTS**





#### CONNECTING RAIL DESIGN

Optimized for minimal surface friction, they help make each connection easier.



#### INTERNAL FRAMEWORK

Heavier structure and materials on bottom, support frame goes all around.



#### **COFFIN LOCKS**

Coffin locks, like the ones used for theater, latch the parts together securely with a turn key.





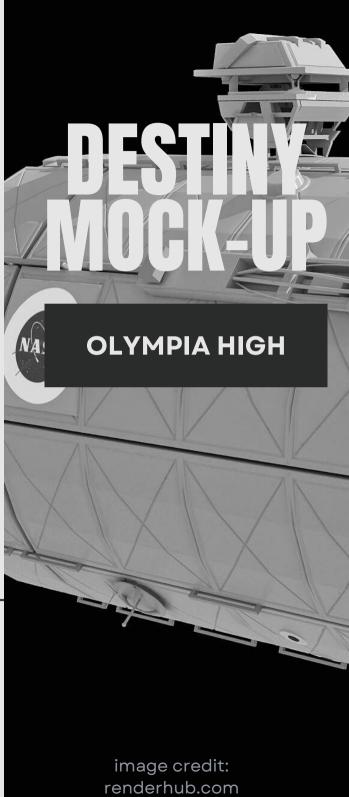
For the smaller model, we are using miniature magnets as placeholders for nuts and screws for the actual larger model. These will be used to join each individual segment.



(left to right) Matthew R, Kai L, Jackson P, Kristina M, Jack F, Marina F, Caleb R, Oscar F, Sami P

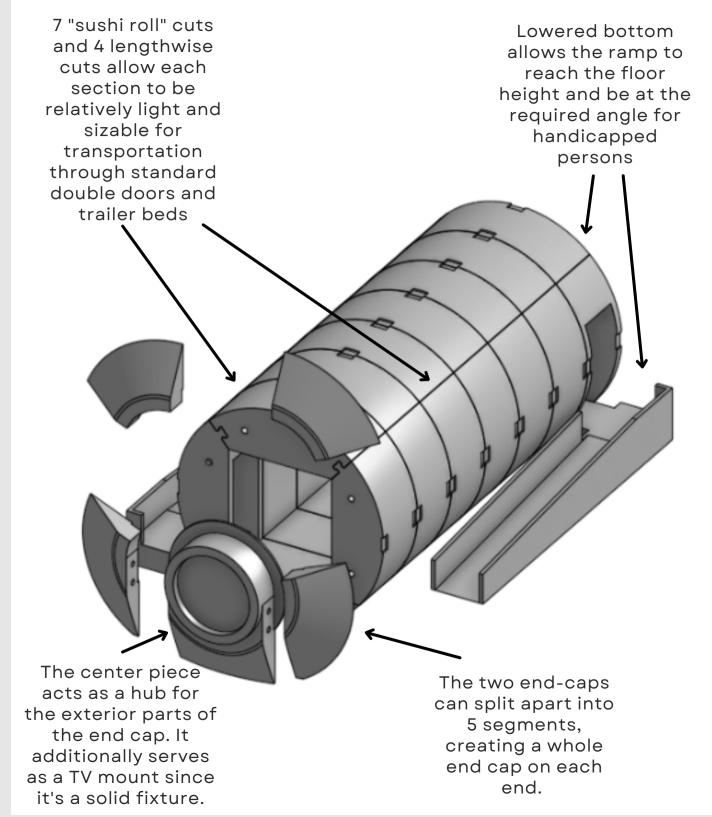


DESIGNED FOR COST, TRANSPORTATION, AND AUTHENTICITY



#### **Material Costs**

Material	Singluar Unit	Total cost estimate (\$)	
Yellow pine	1 sq ft	6893.67	
SPF lumber	2" x 4" x 8'	12063.92	
HDPE	0.5" x 12" x 12"	2648.35	
E. PVC	0.51" x 12" x 12"	2262.62	
3003-H14 Aluminum	0.05" x 1' x 1'	15066.70	
Podium style touch- screen	43"	3,857.40	







## Materials and Budget





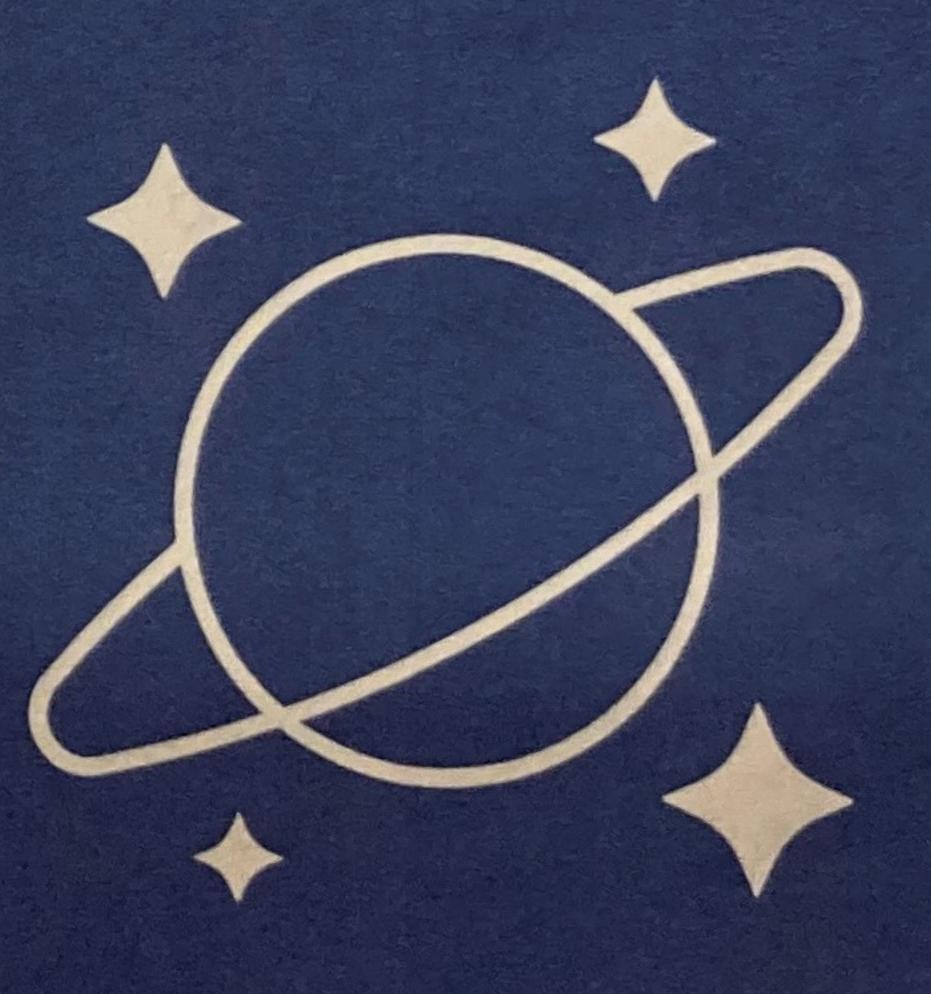
Prototype Video





# DESTINY MODULE

NASA HUNCH PROJECT



Warren Tech Central Mr. Olsen Molly Schmitt

## DESTINY MOCKUP



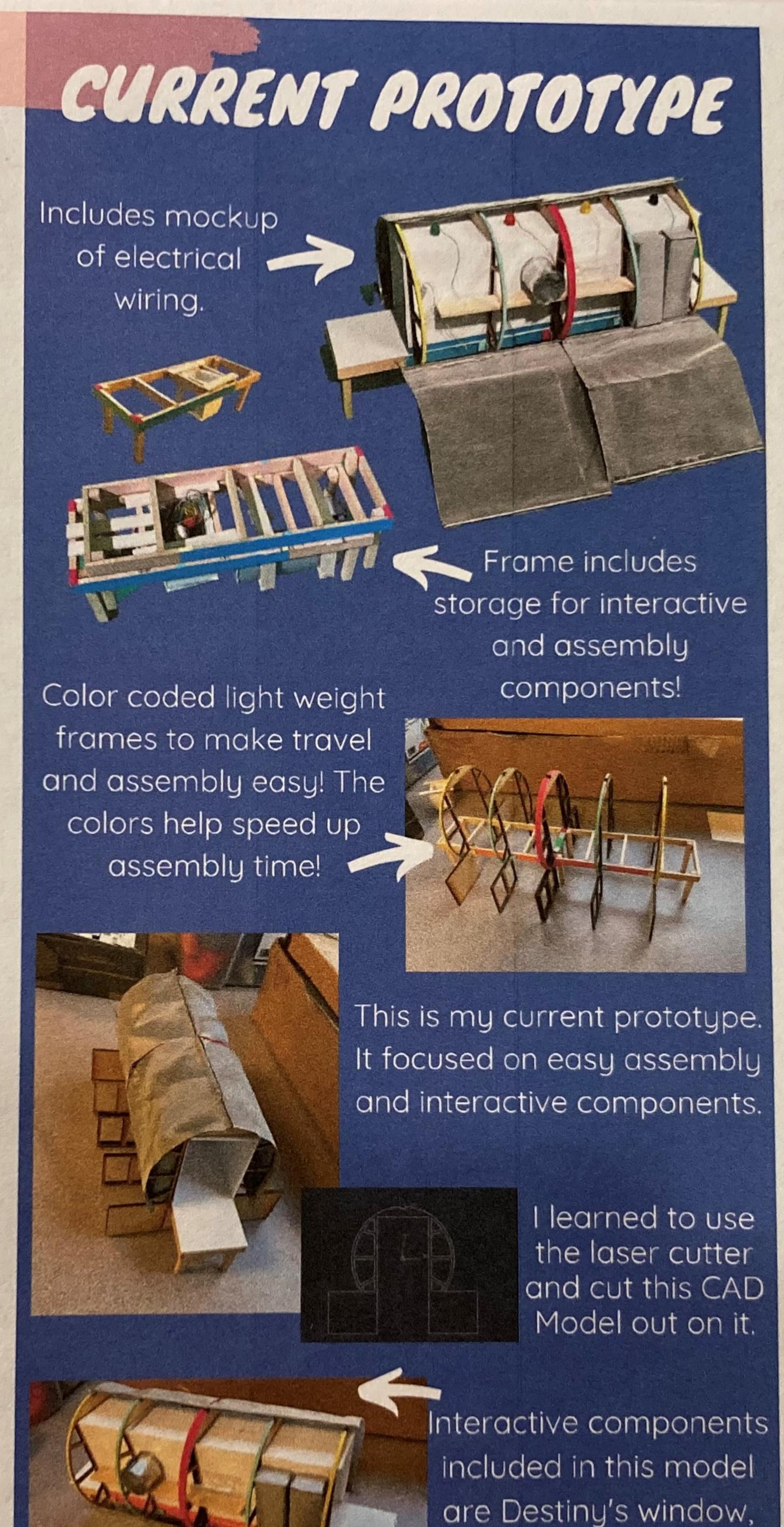
This was my first prototype of the destiny module. It focused on the shape and how to travel.



This is my third prototype. It is made of more materials close to how it would actually be built.

This is my fourth prototype. It is focused on realistic materials and how the full size mockup would come together.



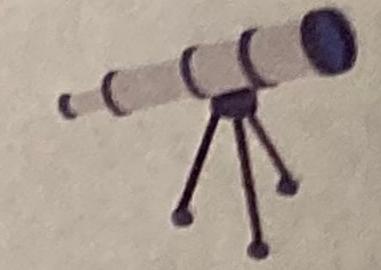


Nadir, Experiment racks

and a mockup

astronaut glovebox.

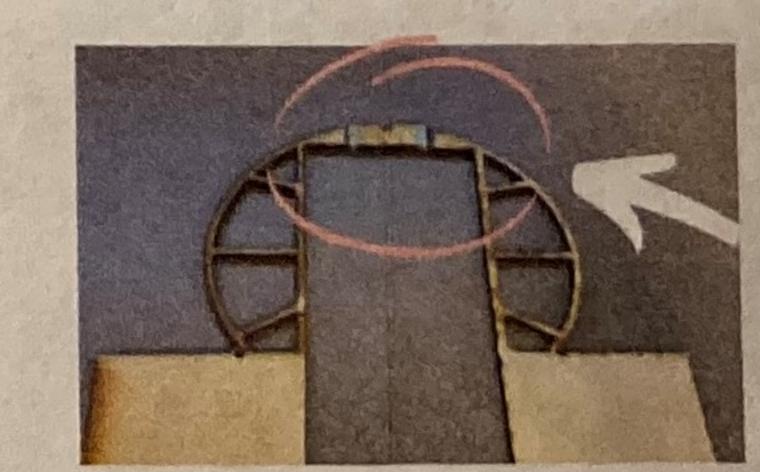
## MY GUALS



- 1. Make it feel like the visitor is a scientist on the International Space Station
- 2. Get kids excited and engaged in STEM
- 3. Create an easy to travel, realistic, and engaging mockup

## MANUS TRANS

- Demonstrate electrical lighting and components for immersive ISS experience.
- 2. Interactive components: QR Code Scavenger Hunt for Kids
- 3. Hands on experiments to get kids engaged in STEM!
- 4. Comprehensive Construction plan for full size mockup.





This frame shows how a larger frame could be put together. It includes a connecting piece of wood at the top and what would be concealed joist hangers.