2022 Design and Prototype Semi-Finalists

Destiny Mock-Up

Students: Payton Wooley, Deven Ramos
Teacher: Robin Merritt
School: Clear Creek, Texas

Students: Jet Graham, Cade Scholtens, Caden Trefren
Teacher: Gary Duquette
School: Jackson Hole, Wyoming

Students: Joshua Guardiola, Gabriela Bonilla, Juan Fonseca
Teacher: Eric Canestorp
School: Conroe, Texas

Students: Cassidy Yehnert, Chloe Harris Kaedyn Martin
Teacher: Louis Reyes
School: Space Coast Jr/Sr, Florida

Students: Nathan Watson, Seth Lance
Teacher: Robert Burke
School: iSchool of Lewisville, Texas

Students: Quin Fredrickson, Tyler Rivera, Jesus Luevano
Teacher: Rebecca Allen
School: Palm Bay Magnet, Florida

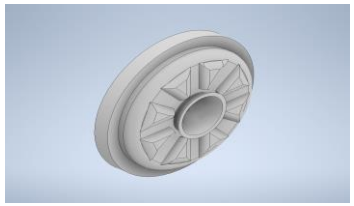
Students: Liam Sullivan, Alex Hill
Teacher: Ashley Pederson
School: Lakewood, Colorado

Students: Quinn Matteson, Everett Douglass, Johnathan Battey
Teacher: Ashley Pederson
School: Lakewood, Colorado

The guide line

Build a 1 to 33 scale model of a Destiny module to demonstrate how a full sized module would be built and transported from one venue to another.

HUNCH is interested in building a full scale mockup of the Destiny module that could be placed in an airport waiting are

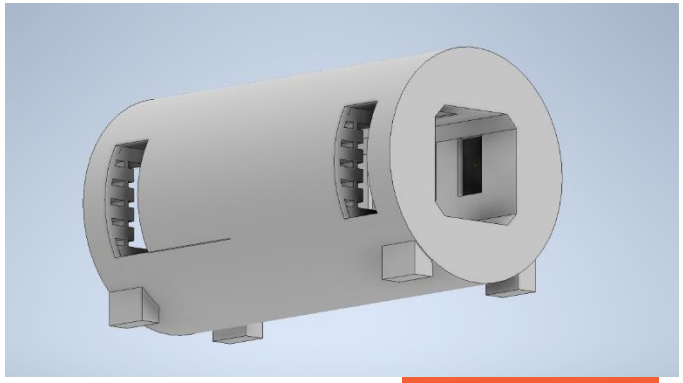


End part

Made of

My group decided to use aluminum alloy for the outer shell of the model this is due to the light weight yet durable properties, and for the inside wall of the mock up we decided to go with wood also due to the light weight and durability of it. And for the floor we went with aluminum.

Materials Only Price List



Our destiny mock up

Destiny Mock Up
By
Payton Wooley
Deven Ramos
For
Instructor
Mr. Merritt
Clear Creek High School
Clear Creek ISD

Your business tag line here.

NASA HUNCH
High school students United with NASA to Create Hardware

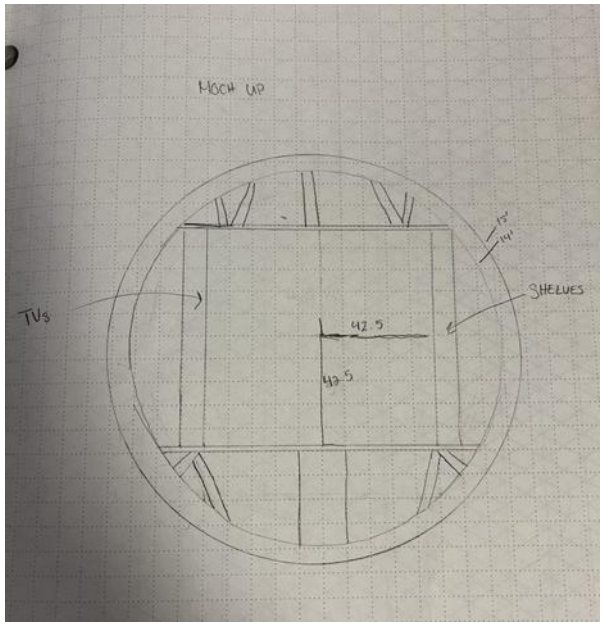
Problem statement

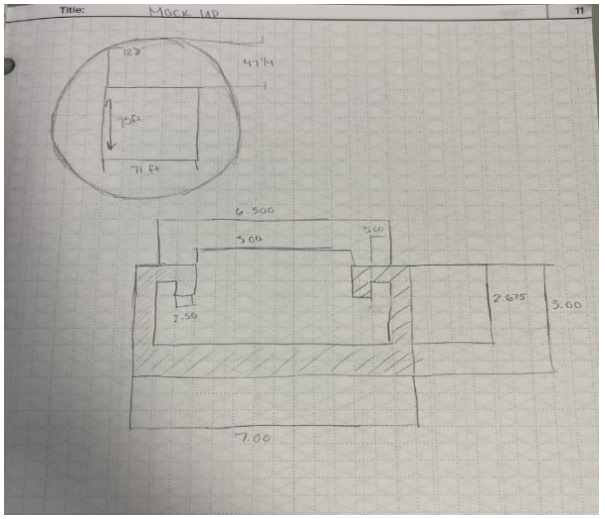
- Trying to get the MOCK UP space station into hobby airport. We have to make sure that the space station is easy to enter, especially for the handicapped.

Transportation

We are going to transport it in 3rds with that it would make it easier to get it into hobby airport and small enough to fit onto a trailer

INITIAL SKETCHES IN



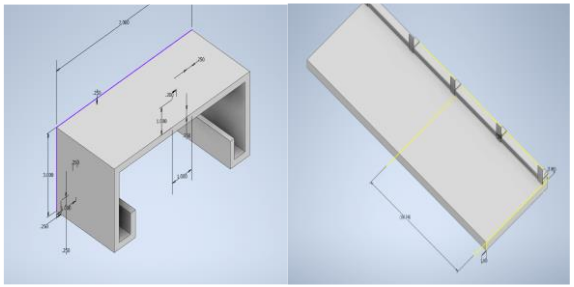


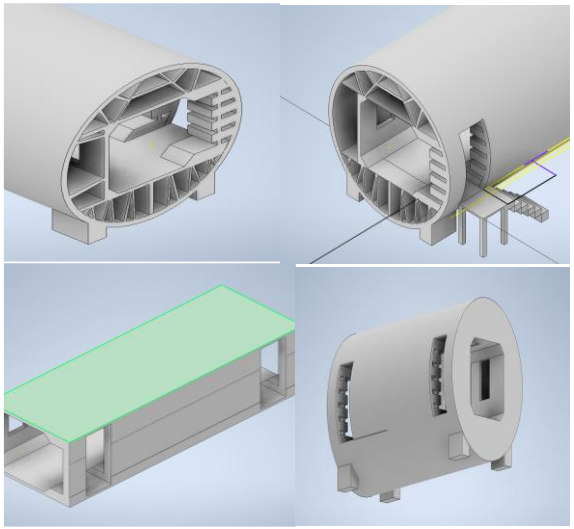
CONTACT US

Deven Ramos – 100113089@ccisd.net

Payton Wooley – 100025389@ccisd.net

Progress photographs





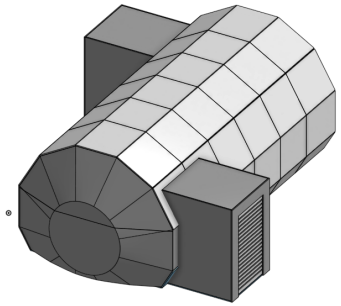
The Team:

Team Members:
Jet Graham, Cade Scholtens, Caden Trefren

Coach:
Gary Duquette

Mentor:
Flo Gold

Destiny Module Mockup



D.M.T.
Destiny Module Team

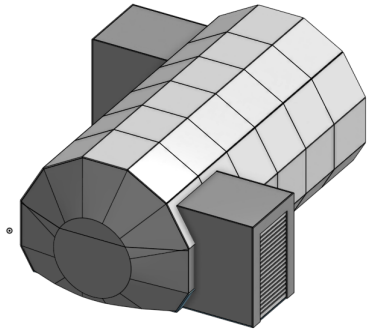
Jackson Hole High School
1910 High School Rd,
Jackson, WY 83001

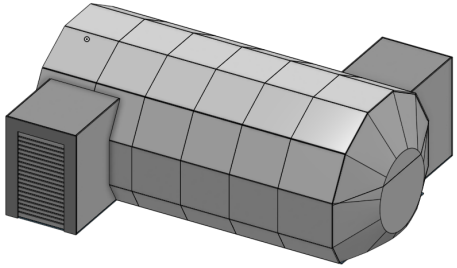
Constraints and Requirements:

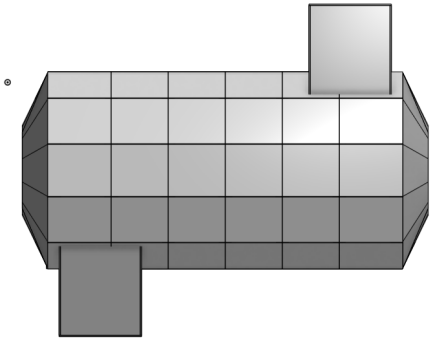
- The destiny mockup needs to be easy to transport
  - Fit in a airport waiting area
  - Easy load on a flatbed trailer
  - Needs to be modular

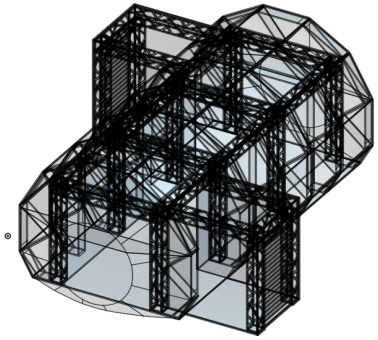
- Structure needs to support interactive TVs on the walls.
- Appropriate material
- One entrance and one exit
- Ramps for entry
- Handicap entrance

Overview of the DMM:









Problems we are currently solving

- Transportation on highways can't be possible as a whole
- Construction of the model must be separate pieces

Similar products that have been examined

- Bus Lifts
- Latches

CONROE

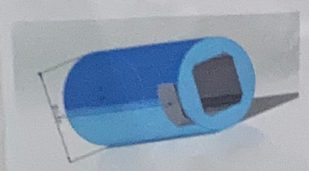
Destiny Mockup

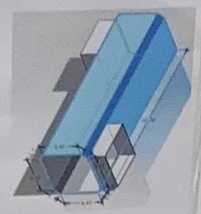
Conroe High School
Mr. Canestorp
Joshua Guardiola, Gabriela Bonilla,
Juan Fonseca

Problems solved while developing the prototype

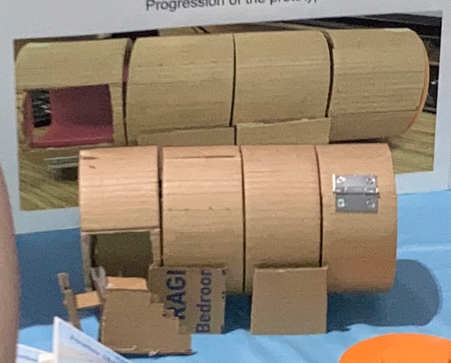
- Accessibility to the exhibit
- Overall design of the model

Solidworks Representation





Progression of the prototype



Materials used in the final design

- Plastic - Interior
- Aluminum - Exterior
- Concrete and steel rods - support beams
- Wheelchair elevator
- Stairs
- Vault Hinges
- Touch screens and Tvs
- Testing - Cost & Questions
  It will take 1 day and around 10-16 people for assembly
- 3 Flatbed trailers - $2,000 - $4,000
- Touch Screens - $2,100
- Wheelchair Lift & Stairs
  - $4,000 - $20,000
- Hinges (12) - $5,860

Nest steps

- Show the prototype to experts and wait for an evaluation of the final design of the model

Destiny Mockup

Conroe High School
Mr. Canestorp
Joshua Guardiola, Gabriela Bonilla, Juan Fonseca

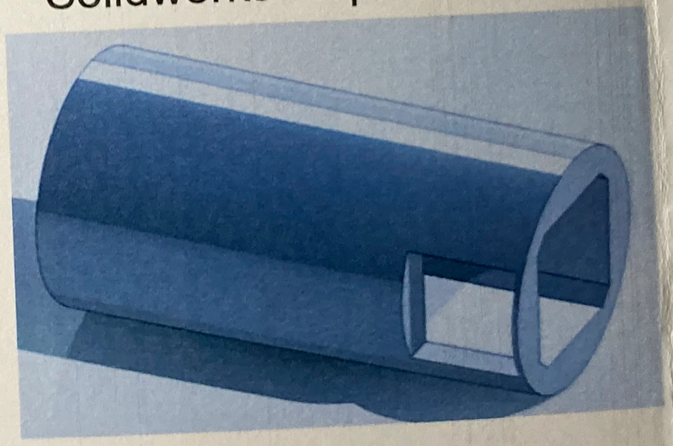
CONROE

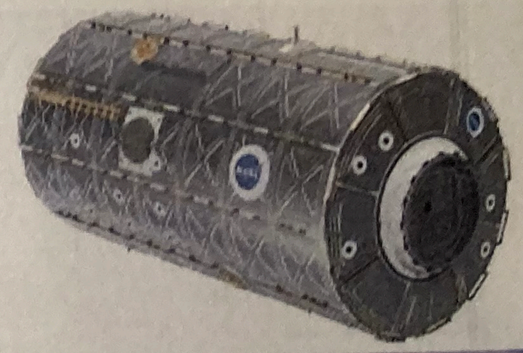
NASA HUNCH
High school students United with NASA to Create Hardware

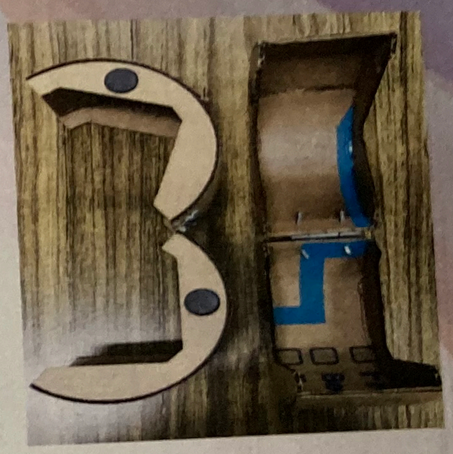
The destiny mockup will be featured in a public exhibit in airports around the country. The mockup will have a feature to detach and reattach itself from the other parts of the model to be transported. The model is also designed to collapse onto itself to be transported without an issue. Transportation is an issue because of the many requirements that the cargo has to surpass and follow to be hauled from one place to another.

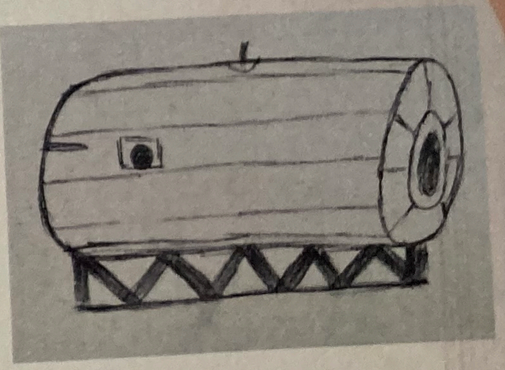
The overall accessibility to the exhibit is planned out so everyone can enter and exit safely. The design is to be an accurate miniature model of the destiny mockup. The exterior of the mockup will be constructed out of aluminum, while the wood will be used for stairs. In the interior, there will be wallpaper or plastic to represent the interior of the actual mockup in space.

Solidworks Representation










I ♥ TEACHERS
NASA
Partnering With Schools To Make A Difference
NASA
High school students United with NASA to Create Hardware
Destiny Module Mockup
Space Coast Jr/Sr High School
Mr.Reyes
Cassidy Yerrhert, Chloe Harris, and Kaedyn Martin
Estimated Cost and People:
For our design we are thinking that we will need electricians, HVAC, and construction workers to build the design. We are thinking that we will need about 10 electricians, 5 HVAC, and 30 construction workers.
Material | Cost
Aluminum | $42,000
Wood | $1,583
Steel Beams | $2,813
Screens | $75,000
Fans | $120
Lights | $25
Latches | $864
Batteries | $34
Nails | $267
Total: | $122,706
Progression Of Our Prototype:
STEAM ACADEMY

Destiny Mockup

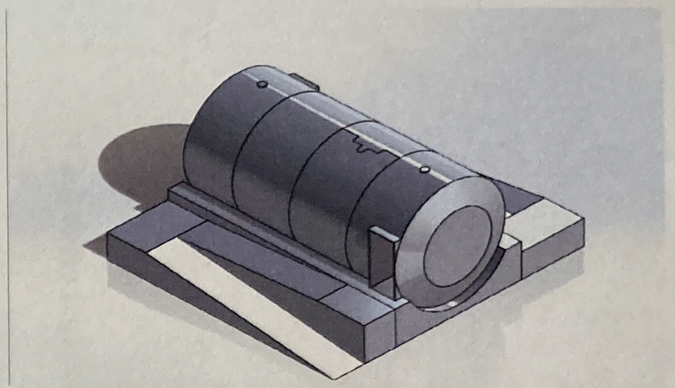
Problem We Are Trying to Solve:

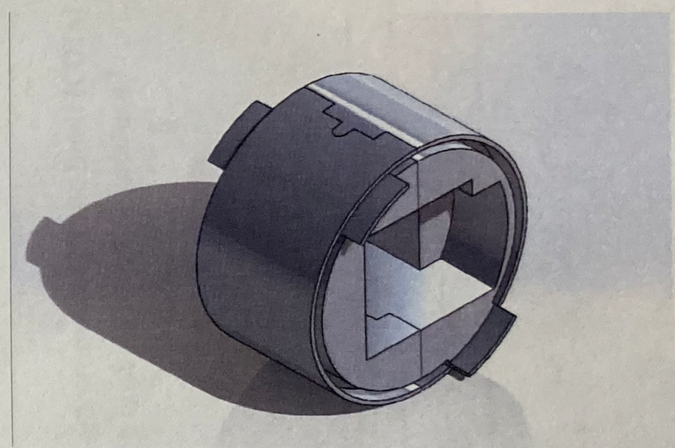
We are designing a mockup of the Destiny Module to demonstrate how to build and transport the mockup from one place to another.

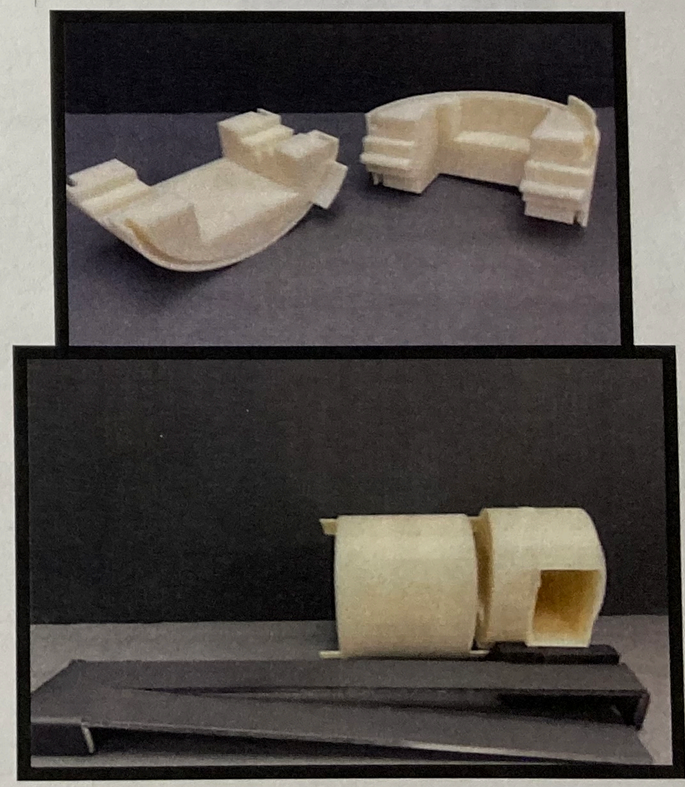
Description:

For our solution we plan to divide the module into 4 sections. The segmented pieces would be put back together with latches so it doesn't come apart. We would also use ramps at both the entrance and exit so it's easy to enter and exit for everyone. In the interior, the end hatches of the module will have touch screens or a video showing astronauts and other modules. On the floor there will be a photo facade. The ceiling is going to be one screen that will play a video on loop with the information on the Destiny Mockup. There will be touchscreens and racks on the interior sides to provide information about the equipment and module. There will also be some buttons or levers that move/light up for the younger children to keep them engaged in the Mockup. Lastly, we are going to show how the cables and cords are going to connect/disconnect for both set-up and transport.

Space Coast Jr/Sr High School
Teacher: Mr. Reyes
Cassidy Yehnert, Chloe Harris, and
Kaedyn Martin








The Truth will
Destiny Mockup
Brainstorming
Storyboard
Decision Matrix
About Us
Research
Telescoping Ramp
Folding Ramp
"Lego" Idea
Multi-Tier Ramp
Solid Base Approach
Wheel Chock V1 Approach
Leg Supports Approach
Wheel Chock V2 Approach
Tubes Design
iSchool
of Louisville

Today's Date: 2/25/22 School: Fisher

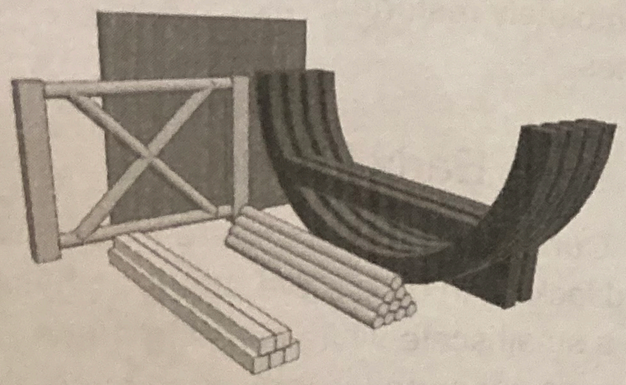
Teacher: Burke Name of NASA HUNCH Mentor: Zachary Mackey

Title of Project (must be the same on the presentation):

Print the First and Last Name of all NASA HUNCH Students on your team:

Assembly

We designed our prototype for quick, simple assembly. Simple shapes connected via simple attachments using simple, everyday tools.

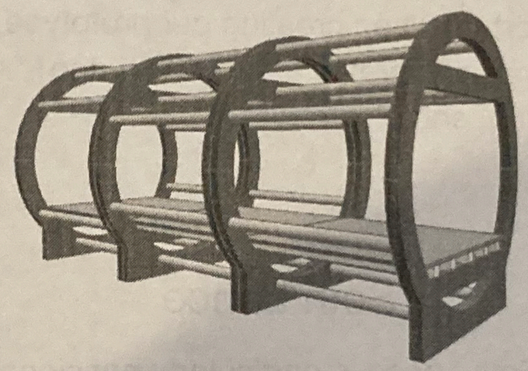


In order, assembly should follow the listed steps. For disassembly, these steps apply in reverse:

1. Assemble ring halves together.
2. Connect tubes between rings.
3. Lay floor beams across rings.
4. Lay floor panels across floor beams.
5. Attach walls to floor.
6. Install electronics.
7. Attach exterior panels and decoration.

Final Prototype

Our final prototype used a unique design from earlier designs. Pairs of steel rings are the main components of this design, which connect through steel tubes. The rest of the main components attach to either these rings, or to other subcomponents which are attached to the rings.



Floor support beams stretch from ring to ring, resting on top of hollow beams welded to the rings. Walls composed of metal tubing (not pictured) allow for touchscreen installation using screw clamps.

HDPE plastic, which is used in playground equipment and industrial applications, composes the exterior panels. These exterior panels absorb and distribute impact forces better than aluminum can and do not distort its shape as easily.

Structure

Many man-hours were put into the creation of our structural design. We considered many viewpoints *from* strength to stability to assembly to flexibility.

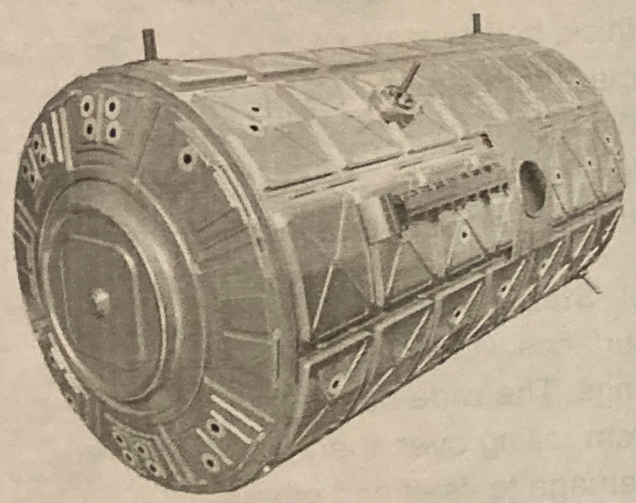
Strength was the most important aspect of our design. This design uses thick, hollow steel sections to allow for maximum strength at minimal weight. We took inspiration from airplane fuselages for the design, and used strong, vertical I-beams for floor support.

Stability was achieved by flat surfaces welded to the bottom of the rings. The wide base stops the replica from rolling over, thereby preventing damage to itself and others.

Flexibility, achieved by simple shaped with easily-altered designs, makes our design particularly unique. We understand that our team may have missed features and issues, so our design deliberately allows modification. As new requirements are added to the project in future, our design can change to fit them. For example, wall segments could be re-designed with more space for physical experiments.

Destiny Mockup

Our project's goal was to design a realistic replica of the Destiny (United States Laboratory) module from the International Space Station. It will act as an exhibition in airports and other high traffic areas.



People will walk through the replica and interact with touchscreens along the walls. These displays will present educational information about space and scientific work on the ISS.

The replica disassembles to allow transportation between locations in a box trailer. A trailer would not fit a fully-assembled replica due to its size and weight.

The Team

Nathan Watson

Nathan Watson was the engine to this project. He steered the process and motivated the team to accomplish project goals. His previous experience with miniature modeling proved to be important when creating our prototype. Nathan's interests are music, video editing, and electronics.

Seth Lance

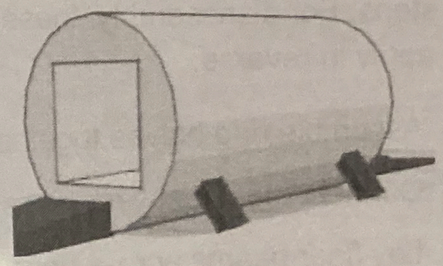
Seth Lance is particularly passionate about our project. He is a hard worker who is determined to bring quality work at the deadline. In this project, Seth acted as a major catalyst during our brainstorming sessions, as well as the main CAD user. His interests include anime, video games, and recreational vehicles.

Reaching The Goal

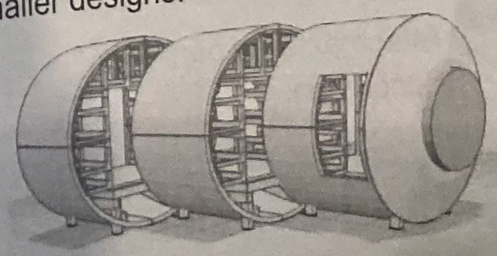
Accomplishing our project goals was far from simple. The many setbacks we encountered seemed to push the final goalpost farther away. In the end, we completely restarted our design multiple times.

Early Designs

Our earliest designs were simplistic and lacking in detail. We applied physics on a small scale while creating these designs, ignoring larger issues such as weight and gravity.



As the project progressed, we better learned how to use the tools provided to us. Our designs became more complex, accounting for larger issues than our smaller designs.

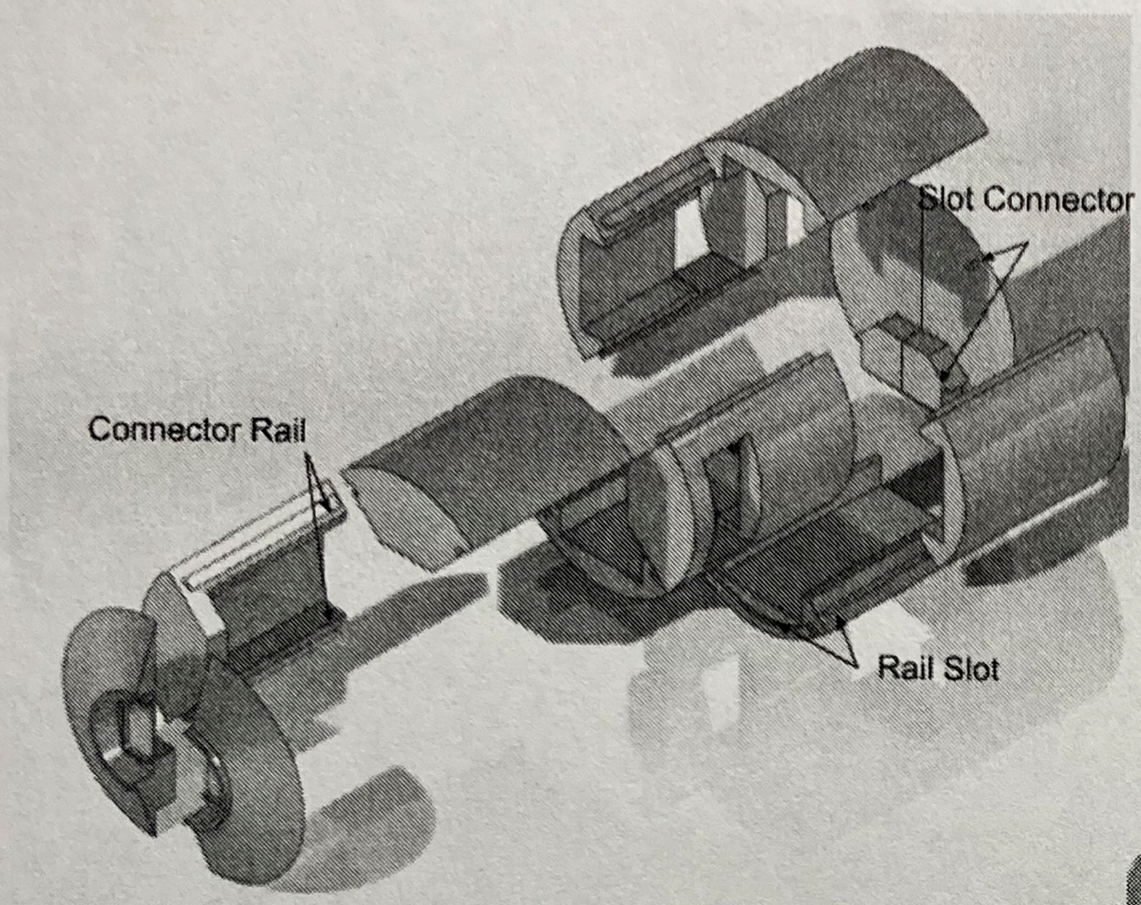


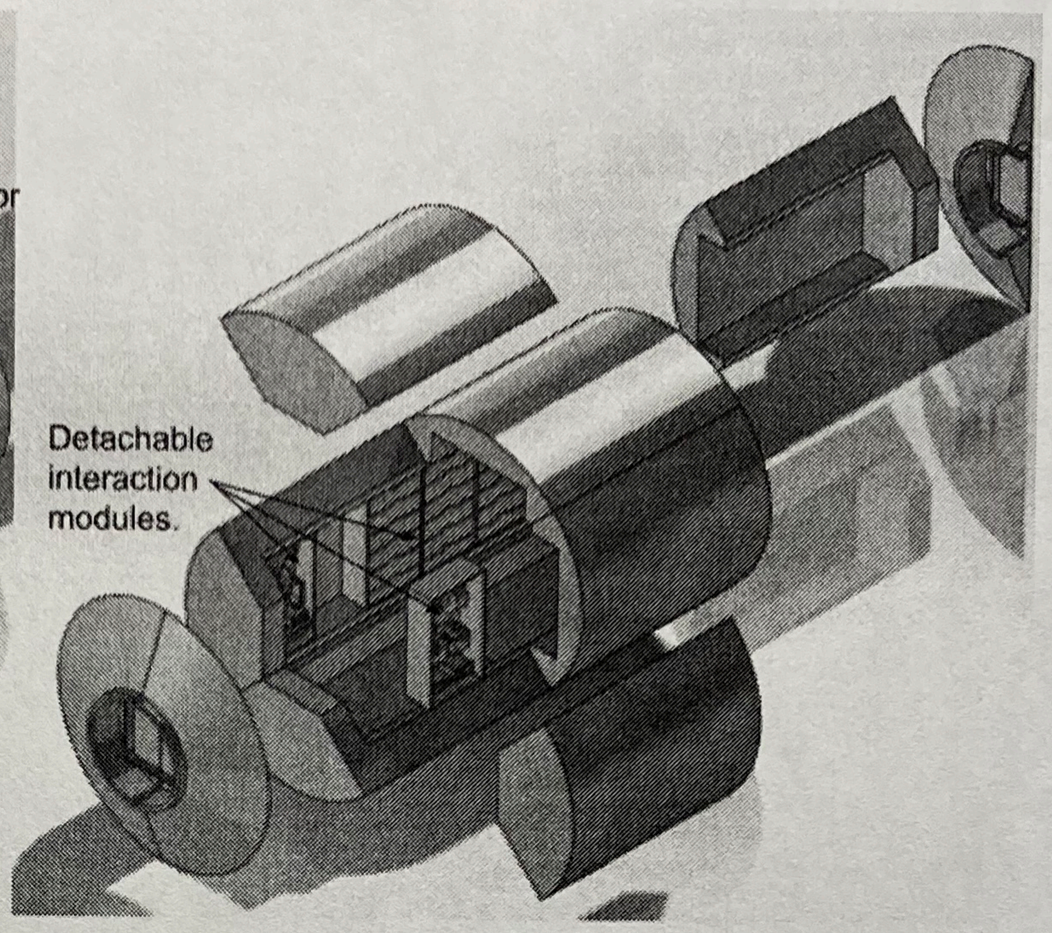
Destiny Module Mockup

School:Palm Bay Magnet High School

Teacher: Rebecca Allen

Team: Quin Fredrickson, Tyler Rivera, Jesus Luevano.





The mockup uses a set of rails for holding it together. After the bottom segments are connected the segments with the entrance and double rails should be attached then the double slot ones. Before it is fully assembled the interaction modules and fake modules should be installed by sliding them into the openings along the middle of each segment. The end cones have short extensions that fit into the openings of the floor and ceiling segment which holds them in place.

The Segments are mainly open space with a plastic shell on an aluminum frame. This greatly reduces weight allowing for the segments to be moved with a team of 4 people. If a forklift is available it should still be used despite this. Connecting the rails can be awkward when a group does it together and a forklift with a sling attachment makes the process much faster and reliable.

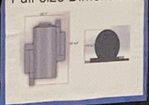
The interaction modules and fake modules are designed after installed racks on the real Destiny module. A few that will be included are the combustion rack, window module and the human test racks. The window and human test racks will include screens and touchscreens to allow for someone to try out an experiment such as finding out what the effect of zero gravity would be on them.

For transportation the interaction modules should be removed and fake modules may be removed for ease of disassembly. All parts are loaded onto a flatbed with a rack toward the back holding wall segments on either side at an angle to keep a thin profile. The end cones are stacked on each other and to one side with the removed racks on the other. The ramp should break into segments that can be folded onto each other to make a thin but tall assembly toward the front.

Brainstorming

Brainstorming started with finding out the maximum dimensions parts of our model could be to fit on a flatbed semi-trailer, the biggest form of transportation reasonably available. These dimensions, which were 8.5ft wide by 8.5ft tall by 53ft long, was the major focus point of our design. We also researched multiple different building codes, as those codes could help with making an easily accessible and safe exhibit. Major ones which have influenced our prototype are door dimensions and stair and ramp codes/standards.

Full-size Dimensions



Procedure

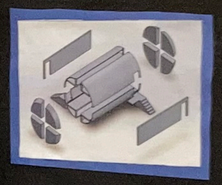
1. Set up portable stage.
2. Position the walls 7.865ft apart and 1ft away from the edges of the stage. Attach with specified bolts.
3. Attach the roof via the chamfers at the top of the walls with specified bolts.
4. Next, mount the interactive displays on the insides of the walls.
5. Run the electrical supply for these monitors through the wall to the outlets on the opposite side of the wall.
6. Distribute ribbing in even intervals around the wall/roof assembly. Attach to stage with specified bolts.
7. Connect aluminum sheet to ribbing with specified bolts.
8. Attack access dividers with specified bolts.
9. Position and secure stair & ramp assemblies with specified bolts.
10. Attach endcones to the ribbing, base, and walls using specified bolts.

Destiny Mockup

Liam Sullivan, Alex Hill

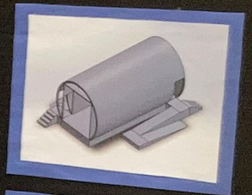
Prototyping

Iteration 1



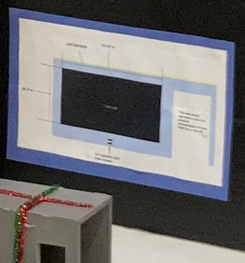
Iteration 1:
1. Design focused around having the least possible parts that were both functional and within the given constraints for size.

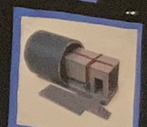
Iteration 2



Iteration 2:
1. This design took into account the shortcomings of Iteration 1
2. Addition of a base sparked research into portable stages for both the base and stair/ramp assemblies.
3. The want for prefabricated parts or easier to design and produce parts made the model split into many more specific parts, which also came with a basic materials list.

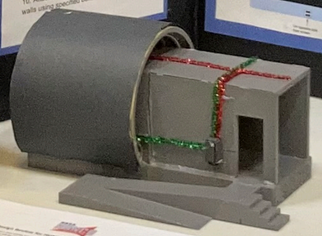
Iteration 3

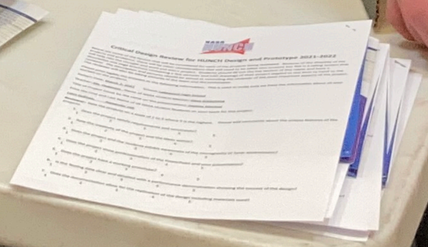




Materials

Process





Materials list

Part of model and amount	Material	Approximate weight
Walls 4x	Plywood 1/2in	Approx 200 lbs
Ceiling 2x	Plywood 1/2in	Approx 190 lbs
Shell 4x	Aluminum 6061, 2.5mm	Approx 127.5 lbs
Base	Portable stage	Approx 1440 lbs Approx 57000 lbs weight limit
Ramp 2x	Prefab ramps	Approx 150 lbs
Stairs 2x	Prefab portable stairs	Approx 55 lbs
end cones 2x	milled aluminum 6061, 2.5mm	Approx 264 lbs
Ribbing 10x	Aluminum square tubes	Approx 30.33 lbs
Tv 4x	101.07 x 59.77in touch screen display	
		Total weight: approx 4375

PROCEDURE

1. Set up portable stage.
2. Position the walls 7.865ft apart and .66ft away from the edges of the stage attach with specified bolts.
3. Attach the roof via the chamfers at the top of the walls with specified bolts.
4. Next, mount the interactive displays on the insides of the walls.
5. Run the electrical supply for these monitors through the wall to the outlets on the opposite side of the wall.
6. Distribute ribbing in even intervals around the wall/roof assembly. Attach to stage with specified bolts.
7. Connect aluminum shell to ribbing with specified bolts.
8. Attack access dividers with specified bolts.
9. Position and secure stair & ramp assemblies with specified bolts.

video of model

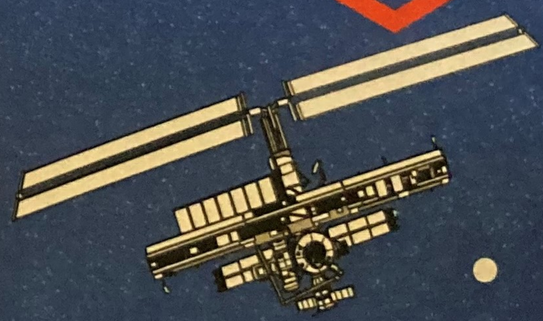
COMMITMENT TO EXCELLENCE

DESTINY MOCKUP

Lakewood Highschool
NASA HUNCH

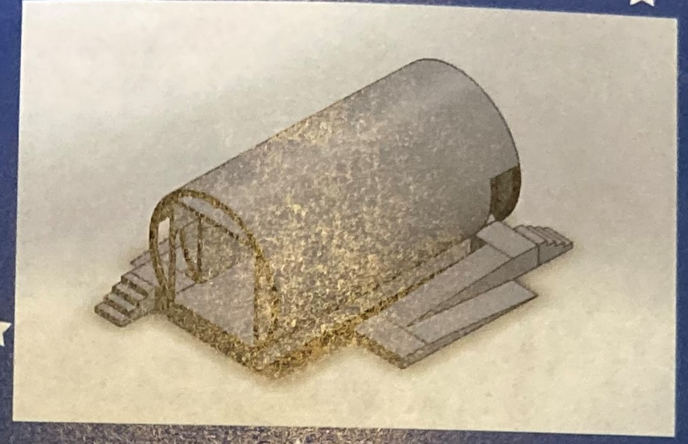
Team Members: Liam Sullivan, Alex Hill

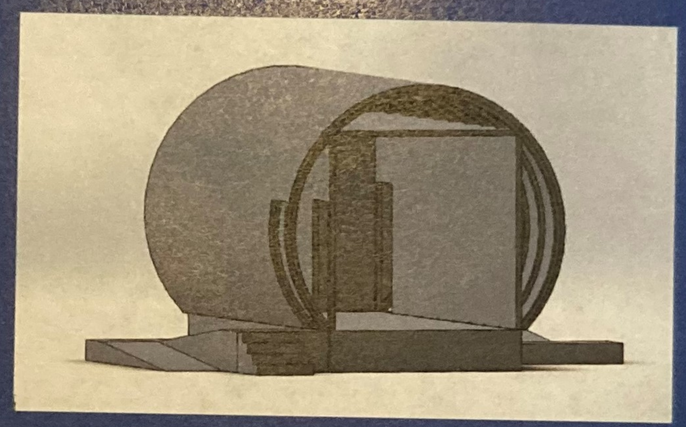
Teacher: Ms. Pederson

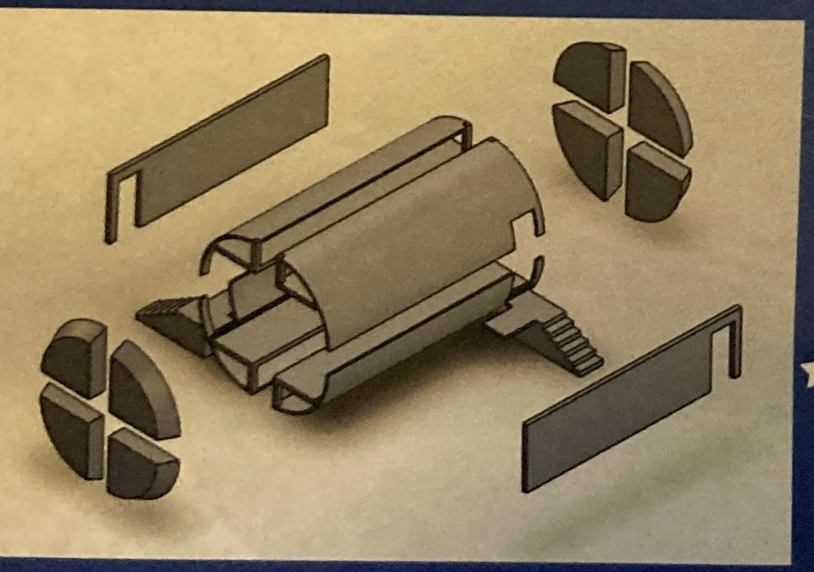


ITERATION ONE

Our first iteration experimented with how a structure shaped like the Destiny Module might break apart for transport. A few reasons why this design did not work is it seemed impractical in terms of production, as well as lacking a stable base and fleshed out interior and inner workings. What we learned from our Destiny Mk. 1 was that we should focus more on what the exhibit might actually be constructed out of, and a better understanding of how to support a cylindrical object.





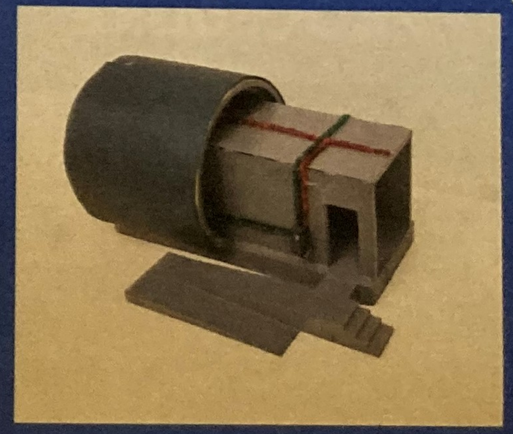


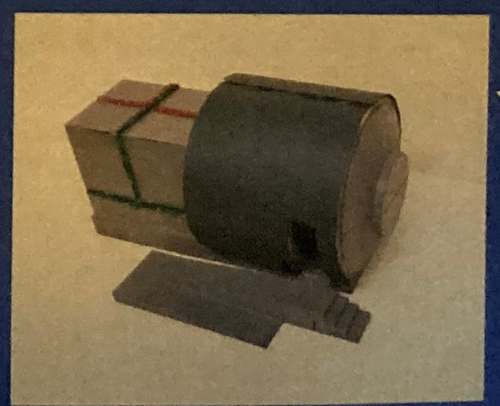
ITERATION TWO

Our second Iteration, which we dubbed Destiny Mk. 2, massively improved upon both the exterior and interior elements. Starting with the exterior, we opted for more parts in lieu of ease of assembly. This allows for a better understanding of the many components and materials which would be used. The large block which the model sits on is a placeholder for portable/modular staging, which is both practical to get and easy to erect during construction. What lacked with this iteration was a thought out interior with electrical and interactive elements, and a materials list and construction procedure

ITERATION THREE

Iteration three, our current model, has taken into account all of the criticisms we have been given. While continuing a very similar shape to Iteration two, this Mk. 3 variant has been converted to use differing construction materials than the prior to better exemplify the real world construction of the model. With this model, we have better designed the interior and electrical, as well as created both a possible construction materials list and a procedure for constructing the mockup.





DESTINY

Quinn Mattison, Everett Douglass, Johnathan Buttry

Materials Statistics:

Main Materials:
Aluminum 6061: 293233 in^3 - 3500 lbs

Plastic [assuming hollow with two inches thick]: 54.888 in^3 - 2788 lbs [PVC]

Ramps: 122 lbs each - 244 lbs

More details

There will be a total of 27 flatscreen displays, with one large display on the top that could possibly be interactable. On the endcaps, there will be two displays that could show live views of the other modules in the ISS.

There are a total of twelve support legs that will attach through a locking system. These legs will be made out of Aluminum 6061 and will be eight inches wide, hollowed with structural support on the inside.

There is a fan ventilation system on either side of the module in order to maximize the airflow in and out of the module and reduce claustrophobia. However, we are unsure if we really need two fans on either side, and if we do not, they could simply be replaced with more interactive screens or experiment racks.

This is said in the brochure, but in order for an assembly, two forklifts or a small crane will be needed for a day and someone certified to operate the machinery will need to be present. As well, since the dimension of each part of our module is 10x14 feet, approximately four flatbed trucks would be needed - however it could more than likely be done with three trucks. The wiring, as well, would probably only take approximately two hours.

U.S. LABORATORY MODULE

Figure 2.1-1. U.S. Laboratory module ("Destiny") views

Changes:

Originally, our project came only in two parts, and had no ventilation, support, and only connected through the links - with no ideas for how to light the project or what specific materials would be needed. We have models of what our project looked like in the past (made green plastic). Eventually, we decided that we would need more screens, a larger entrance, more places of attachment, better wiring systems, as well as more structural integrity. On our previous model, [illegible] was too thin, and there were several [illegible] points of failure - such as the entrance [illegible] and the overall thin walls.

Additionally, [illegible] screen sections - [illegible] screens there are [illegible] to interact [illegible]

Top View:

Side View:

Floor/support = Aluminum 6061/7075

Pros 6061: Corrosion resistance; Made and sized mostly for floors, and stairs; Heat treated and precipitation hardened great toughness; High to moderate Strength; less expensive than 7075

Cons 6061: mostly aluminum, less strong then 7075

Pros 7075: Used in airplanes for integrity, and corrosion resistance; Construction common material.

Cons 7075: more expensive

Walls = Carbon Fiber

Strong and lightweight, but very expensive

PVC (or other poly based plastics)

Pros Cheaper than Carbon fiber and better than polycarbonate

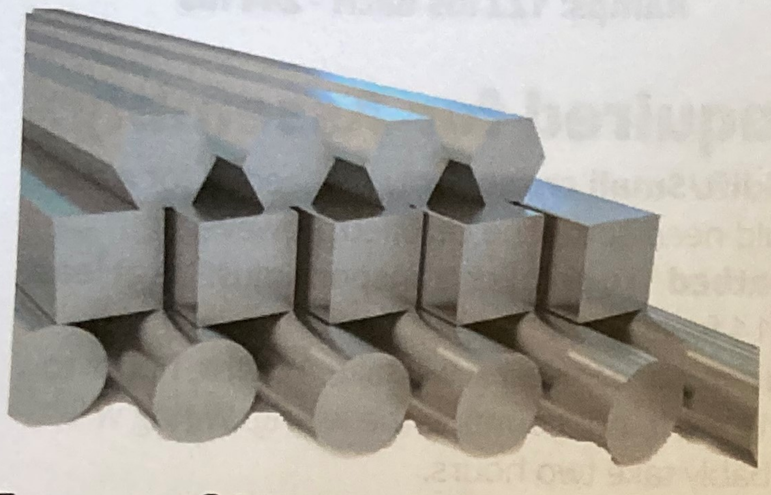
Cons Possibly breaking, not strong enough? Only 1225 pounds of tensile strength.

Lights = General Luminosity LEDS

Already used on ISS

If used on our project will be good representation of what it really looks like on the actual ISS

Materials



Types of Materials:

<u>Floor/Floor Support:</u> Aluminum 6061

-Approximately 14280 cubic inches are needed - 1400 pounds.

-Able to take up to 8000 PSI (elongation of 25-30%)

-Medium to High strength, good corrosion resistance, weldability, brazability, workability, and machinability.

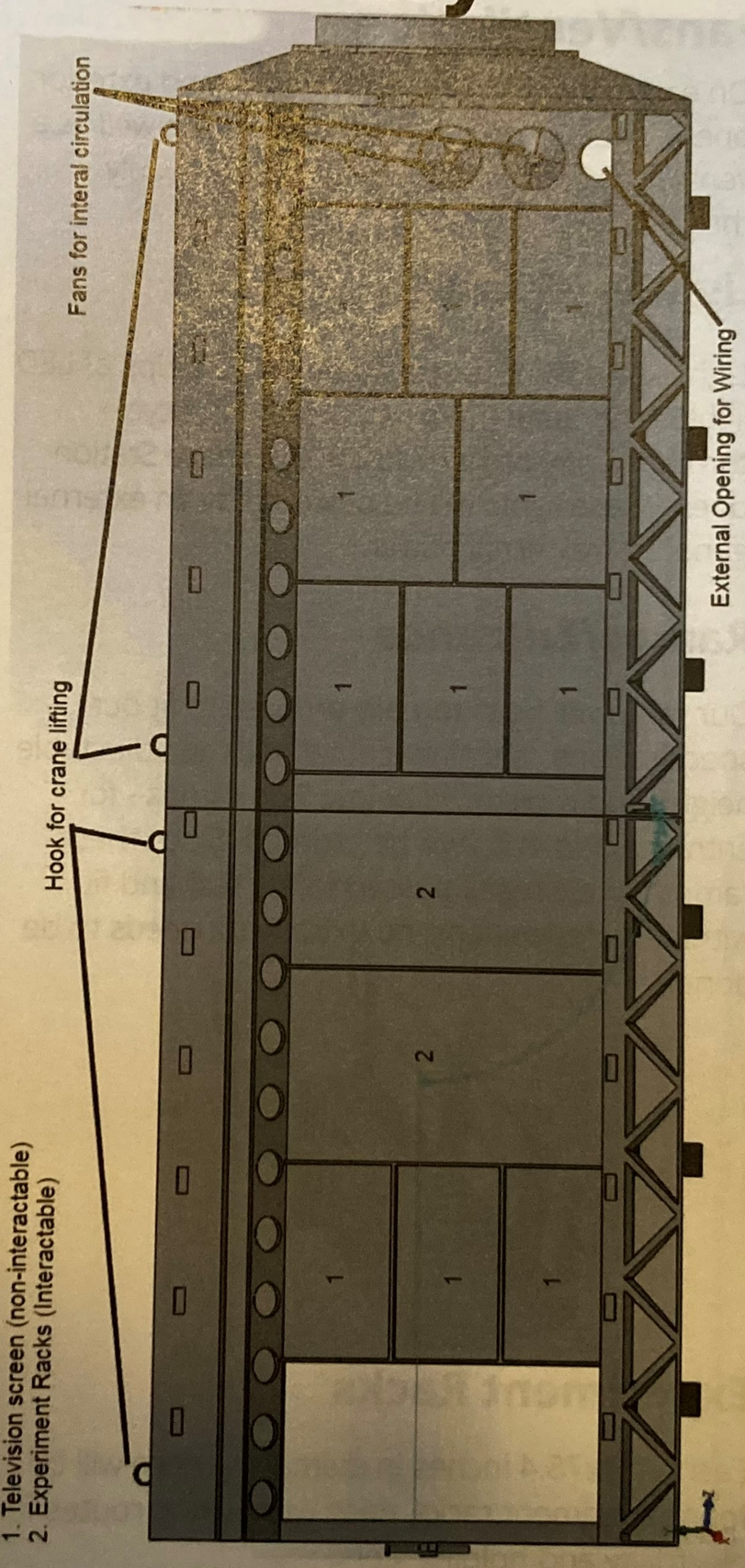
<u>Walls/Rest of Module:</u> Miscellaneous

Aluminum 6061 Support: the walls and externals will be lined with a cage out of 6061, in order to maintain extra structural integrity.

Poly-based plastics: the rest of the module will be made of poly-based plastics, in order to preserve weight while also not sacrificing structural integrity.

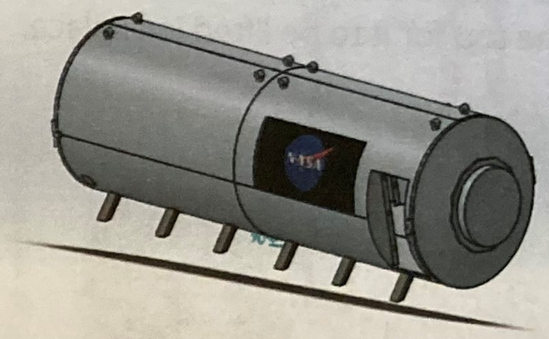
However, this is very expensive and there are other, cheaper options that are not as structurally sound.

Interior View: Key



Lakewood High School

NASA HUNCH



Destiny Module Exhibit

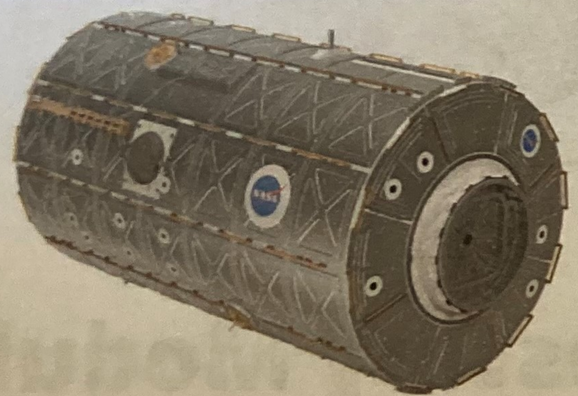
John Battey, Quinn Matteson, Everett Douglass

Ashley Pederson

Main Parts:

Separate Body Parts:

The module will be separated into four main parts that will fit together with a system of latches. On the end, the caps will be attached through bolts and screws, totaling six large parts. There are a couple ways that we have allowed for these to be transported - there are holes in the parts and hooks on the top for it to be lifted into place.



Interior:

The interior is 84 inches tall, with each entrance being 76 inches tall, and the inside of the module being 74 inches wide (accounting for the space taken up by the touchscreens and experiment racks. On the floor with the photo facade, we are possibly considering putting grip tape or another grippy surface in order to avoid incidents.

Smaller Parts

Fans/Ventilation

On each side, there will be two fans, and exterior opening for air circulation and wiring, as well as a ventilation system that distributes air evenly through the module.

Lighting System

Lighting up the module, there will be strips of LED lights - the same ones on the ISS - that cycle through a day-night cycle like the Space Station does. These lights will be powered by an external generator/external power.

Ramps/Entrance

Our ramp will be externally ordered to fit our specifications. It is nine feet tall with an adjustable height, and is pictured below. Two ramps - for entrance and exit - will be ordered. Since these ramps have already passed safety test and fit within the regulations, no extra work needs to be done.

Experiment Racks

Each 44.3x76.4 inches in diameter, there will be four experiment racks, each with wiring routes for electricity and holding slots.

Materials List:

Aluminum 6061: 29320 in^3 - 2800 lbs
Plastic (assuming hollow with two inches thick): 54,000 in^3 - 2700 lbs (PVC)
Ramps: 122 lbs each - 244 lbs

Required for Assembly:

Forklift/Small crane: Only be needed for a day, would need someone certified, however.
4 Flatbed Trucks: For transport, must be at least 10x14 feet.
Four to Six Workers: will take 4 to five hours to complete it, not counting the wiring. Wiring will probably take two hours.

Unsolved Problems/Unfinished Parts

Vandalism Prevention

Of course, due to the fact that there will be up to 28 touchscreens and three experiment racks, the possibility of property damage and theft - property damage moreso - is ever present. In future iterations, we might consider putting security cameras, locks, and more anti-vandalism devices in the airport.

Accident prevention

More present than vandalism is the possibility of accidents. People tripping into screens, jumping over railing, and climbing the module itself is something that we have been unable to come up with a solution to. For now, our best preventative system is the location of the module in the middle of an airport.