

# Simulated Gravity—VR/AR

## Finalist List

### for

## NASA HUNCH

## Design and Prototyping 2021

Congratulations for being chosen as a Finalist for NASA HUNCH Design and Prototype 2021. Your design was chosen as a Finalist because your team has fulfilled all or most of the requirements for your project along with quality in design and manufacturing the prototype. Your team demonstrated good testing of your prototype and knowledge of the problems and extensive understanding of the environment for your project. There was a lot of really amazing competition for these spots and all people from the semi-finalist

By being a Finalist means that you are a winner but this does not mean your idea will fly to space. This is real engineering. Although it is possible the reviewers could see one design that is exactly what they want, it is more likely NASA may choose one or a few ideas from each team to incorporate into a different design. It is also very possible that requirements or needs have changed since the beginning of the school year and they are not interested in the idea at this time. This is the nature of engineering but it does not diminish your accomplishments.

### **Design to Flight**

The goal of HUNCH is to keep your names attached to these ideas and to have you assist with later developments of your projects when possible. Your projects and information will be provided to Mike Bennett who runs the HUNCH Design to Flight program that will coordinate the sending of your ideas to the engineers as they request it and working with your team to give engineers assistance whenever possible. This might include updating or making new CAD drawings, assembly of prototypes, choosing flight components and/or assisting with presentations. You will receive an email through your teachers in the coming days requesting specific information about your project.

### **Patents**

In general, NASA does not seek patents on materials that are only related to space, however, if there are other potential uses for the device or ideas related to Earth bound applications, HUNCH will ask NASA Tech Transfer to assist in working through patent process. It is our goal that students and schools are included in any patents with as much credit as possible. We do not anticipate this as an income generator but more as value to your resumes.

### **Presentations:**

#### **General:**

- Practice your presentation.
- Look sharp and professional.
- Everyone from the team should talk.

- Briefly introduce yourselves including your name and grade and school and state.
- Reviewers will already be aware of the problem and the constraints– I’ll take care of that.
- Start with a demonstration of your prototype and briefly describe the testing that has been done.
- Point out details that make your design innovative, more robust, cleanable, repairable or desirable.
- Mention one or two things that didn’t work initially but you were able to make changes and move forward.
- Briefly talk about how your prototype is different from the final product would be and include the materials you think will be used on the design that would fly to space.
- Answer questions quickly and concisely but completely so you can answer more questions and receive more comments. If you don’t know something, say that you will have to check on it and plan to get back with them with an answer by email.
- Relax. These people are interested in what you have to say and know what its like to be on the spot.

#### **Specific to Simulated Gravity**

- Show short clips that demonstrate how simulated gravity is different from what we experience and share any discoveries your team found that were interesting.
- Keep the observer motion slow so that it doesn’t look jumpy on the slow refresh of the meeting.
- What worked well and what was difficult with your software choice?
- You will be giving your talk with the other Finalists on **April 29— 12:30 to 2:00 CT**  
I will be sending out invites for a Microsoft Teams meeting in the next couple of days to the teams.

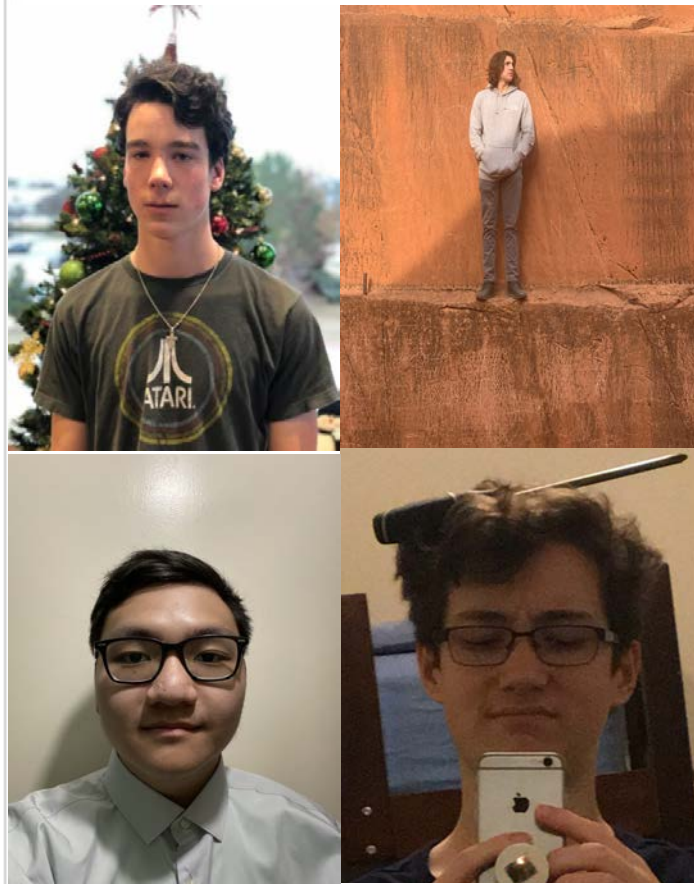
## Value Proposition:

“Artificial gravity is a needed solution that needs to be tested, however, it is too expensive. There is nothing like our virtual reality simulation on the market. It will showcase how artificial gravity could work, and what one could do in it realistically. Spinning from 3 m/s in the central module to around 8 m/s on the other, the simulation will be capable of producing forces equal to  $\frac{1}{3}$  g up to 1 g. Using the Unity Engine, the service is compatible with the Oculus Quest and Rift. This product has the potential to help NASA with creating the option for long-term space missions. Our goal is to aid Nasa with progression in space travel while spending less and getting more in return.”

Contact Us:

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Trey - [tg2882@students.responsiveed.com](mailto:tg2882@students.responsiveed.com)

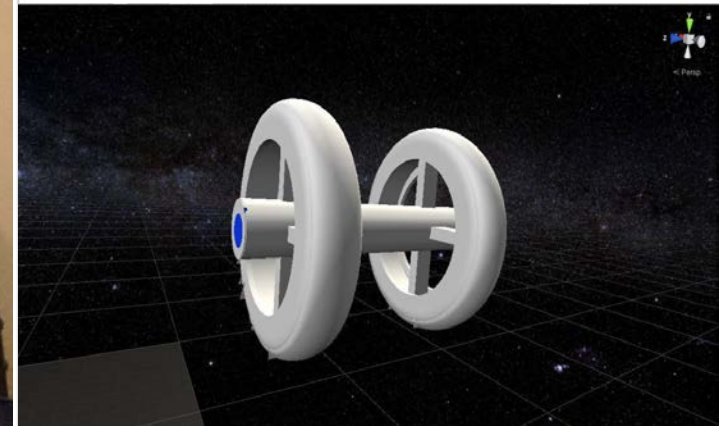
## The Team



**Pictured above:  
Tanner Lockhart,  
Tony Ngo, Trey  
Gower, and Camden  
Hobbs**

## Virtual Reality Simulation

By: Tanner Lockhart, Tony Ngo,  
Camden Hobbs, and Trey Gower  
(Group 7)



Website:  
<https://bit.ly/2N9wbj2>

## The Math

**Centripetal Force:** The force that pulls an object towards the center of rotation in circular motion.

Centripetal Force =  $m \cdot v^2 / \text{radius}$

This will act as the artificial gravity in the module.

### **Current Numbers:**

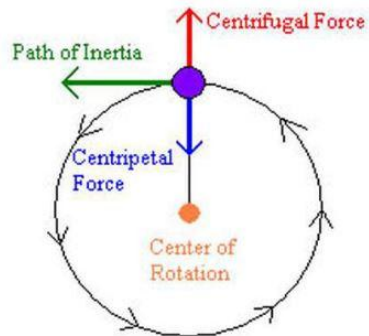
Radius: 15 meters

### **Speed of the Module:**

2.8 m/s inner module, 8.6 m/s outer module

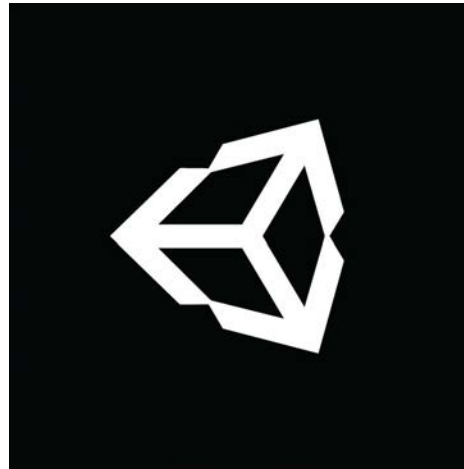
### **Force Achieved:**

3.8 m/s<sup>2</sup> inner, 9.8 m/s<sup>2</sup> outer



## The How

Built in Unity 2019.3.8f1



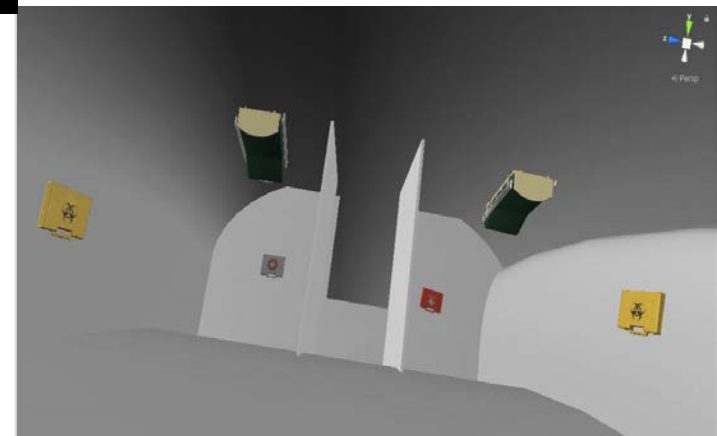
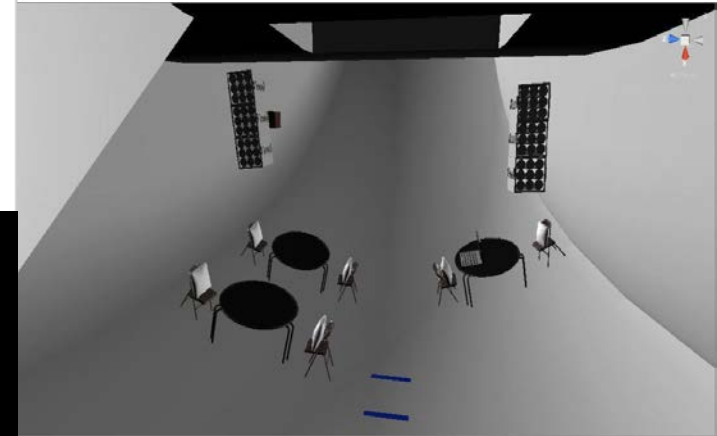
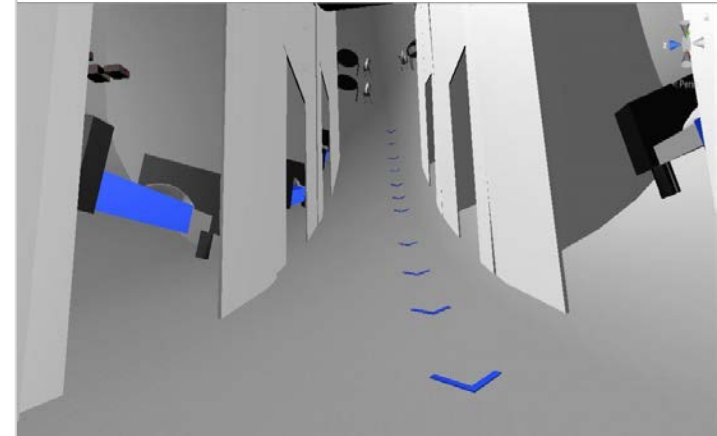
Models Created in Blender



Version Control - Plastic SCM

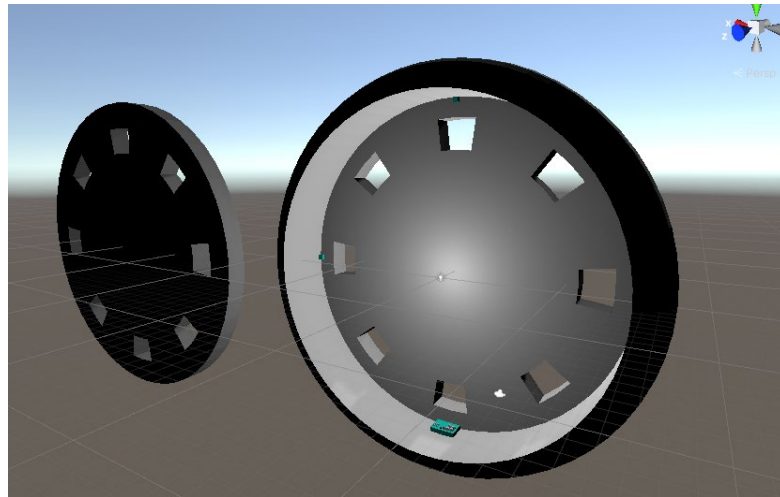


## The Inside



**VR Artificial Gravity Simulation**  
**Palm Bay Magnet High School**  
**R. Allen**  
**Jaedon Hight, Kaleb Anderson, Jacob Berry**

Our simulation utilizes a VR headset and tracking controllers to give the user an accurate depiction of what it is like to be inside a simulated gravity environment, as well as the behaviour of objects that are inside the environment as well.



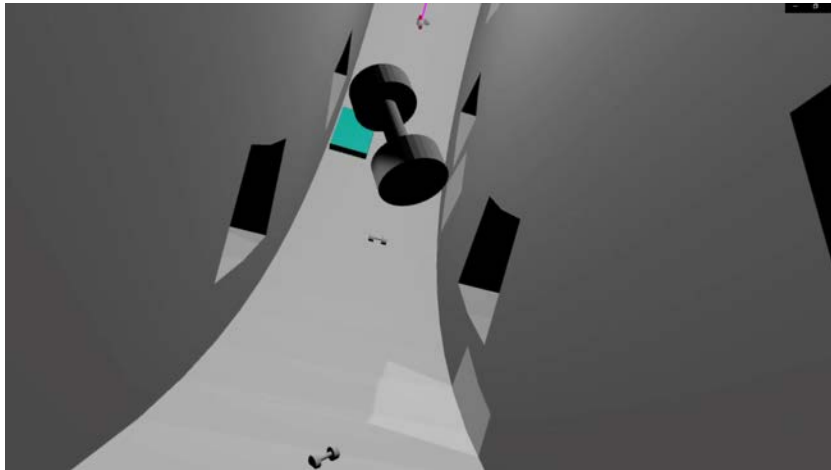
We used Unity and SteamVR to build our simulation, which is compatible with a wide variety of headsets although we used an Oculus Rift S to create and test the simulation in the classroom.



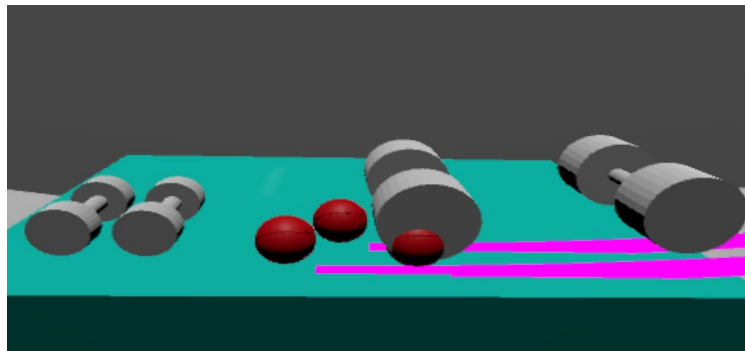
The simulation features:

- A rotating ring-shaped spacecraft to simulate gravity, 15m in diameter and 3m wide.
- Movement controls that allow the user to traverse the ring and its various areas.
- 3 Baseballs that the player can hold and toss, with trails that show the movement of the baseballs.
- Weights, which the player can also pick up and move around.
- Objects will fall to the floor when dropped, even while upside down

To traverse the craft, use the thumbsticks to walk around the ring. The directions don't orient with the headset, so make sure you point the stick the correct way.



To use the Interactable Objects, like the weights and baseballs, look towards the turquoise platform near where you start. Place your controller over them, and hold down the Grip Button on the side of the controller to pick it up. Let go of this button to drop them, or let go while you perform a throwing motion with the controller to toss them. While in motion, a purple trail appears behind the baseballs to show the path it moves.





## Simulated Gravity- VR/AR

Meridian Technology Center

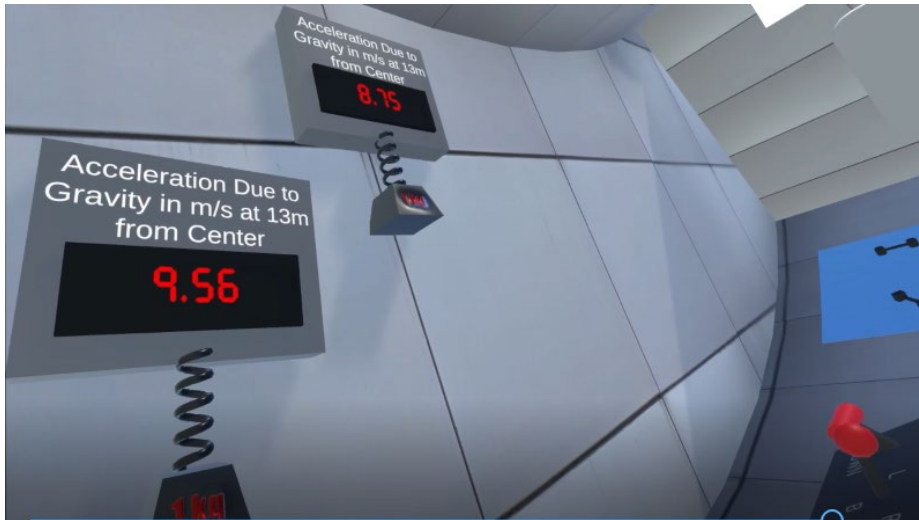
Mrs. Short

Brendan Bovenschen, Collin

Bovenschen, Emma Li, Kurt Sewell



"Our Artificial Gravity Simulation strives to demonstrate both practical and simulation-based components that could be applied to a real-world artificial gravity centrifuge. The physics within our program were created to emulate centrifugal force as well as Coriolis force. This simulation contains elements that have yet to be applied within an actual spacecraft, and this is due to the presence of gravity"



# VR Artificial Gravity Space Station

**School:** Miami Valley Career Technology Center

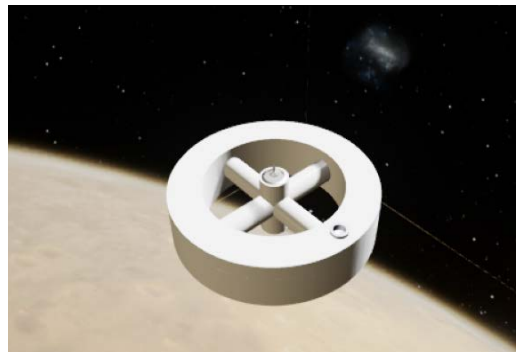
**Teacher:** Melissa Goodall

**Students:** John Li, Justin Butler, Ethan Howard



## Description:

We created a VR project made in Unreal Engine 4. Our project is a full physics simulation of a rotating space station and simulates the potential problems of such an approach.



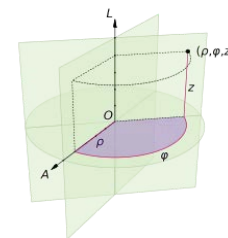
## Terminology

Left, right, up, and down weren't precise enough. We borrowed terminology from cylindrical coordinates.

Rho ( $\rho$ ) = radius, effectively "up" and "down"

Phi ( $\phi$ ) = angle along the circumference

Z = distance along the Z axis (rotational axis of station)





# Features

## “Flat” tables

Flat - a surface always perpendicular to “down”  
(+rho, in our case)  
Flat  $\neq$  zero curvature



*When the idea of “down” is curved, the surfaces must be also curved*

## Holding objects

Force is held constant, distance to cursor can be used to tell weight intuitively



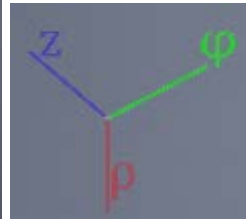
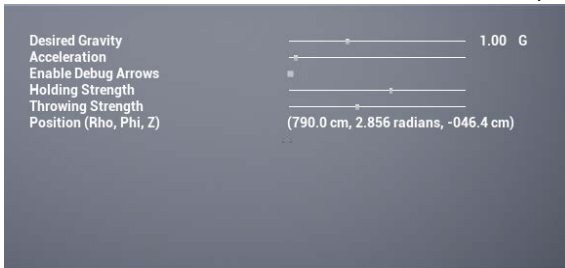
*1 kg cube*

*5 kg cube*



*5 kg cube  
0.8 G  
(slightly higher)*

## Settings Menu + Axis Display



## Coriolis

(a.k.a. inertia makes a mess)



As objects go up, they veer +phi  
As they fall, they veer -phi

This includes people climbing ladders!