# *OEF SEE Project*
# Engineering Notebook

Cody Jones, Khylee Marshall, Maria Vanderputten,
Ayden Loven, Gage Danielwicz

# Lights, Sounds, Code!
# Software Engineering Extravaganza

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a different opinion

## Foreword

This contest is limited to four entries per school. Working in teams is encouraged but individual participants are allowed. The maximum team size is five participants.

Each school MUST complete a Fair Registration/Competition Entry Form and return it to the Oklahoma Engineering Foundation Office (OEF) office by Jan. 19, 2024. Prizes will be awarded to winning entries from registered schools (entries from unregistered schools will NOT be eligible for prizes).

## Design Statement and Objective

Prior to the competition, use the provided basic programable logic controller to create a unique automated display using visual and audio components that is triggered via a physical input. The overall objective is to create an entertaining automated show. For example, a model home holiday display with light and sound. Code should be well documented, readable and bug free. Code should incorporate SOLID principles when practical (https://www.educative.io/answers/what-are-the-solid-principles-in-java).

## Materials and Restrictions

American Fidelity will provide the programable logic controller kit to be used for this competition. A materials allowance of $50 will also be provided. The total project budget (excluding the materials provided) cannot exceed $250.

## Requirements

- Max dimensions of the completed display are 3ft x 3ft x 3ft.
- There needs to be an interactive trigger to start the display.
- There needs to be the ability to pause the display. Pause will stop the show and pushing start will continue from where the display was paused.
- There needs to be the ability stop the display. Stop will end the show and pushing start will re-start the show from the beginning.
- There should be a minimum of one motion component, one light component and one sound component in the display.
- The show must be a minimum of one minute and a maximum of five minutes.
- The model creation and the programming must be completed by members of the team.
- Upload code and supporting documentation to a public GitHub repository and provide the link to OEF by Feb. 19. Supporting documentation should include but is not limited to:
    - A design document explaining the logical operation and physical construction of your display
    - Parts list including source and cost of materials used

## Judging and Scoring

1. Prior to the competition, each display will be inspected by the judges to determine compliance with the contest requirements and specifications.
2. Any project that does not meet the above requirements will be ineligible for prizes.
3. Each team is responsible for the security of its entry. No time will be spent looking for or waiting for teams that are not present when it is their turn. Teams not present will go to the end of the queue if time permits.
4. Decisions of the judges are FINAL.
5. The competition area will be off limits to everyone except the competitors and officials.
6. Each team is responsible for providing batteries, supplies and tools as required.
7. This display will be judged on the following criteria and rubric:
    - Creativity
    - Quality of finished product
    - Code Quality

| **Creativity** | Weight | Score (1-10) |
|---|---|---|
| General | 10% | |
| Complexity of Show | 15% | |

| **Quality of Finished Product** | Weight | Score (1-10) |
|---|---|---|
| Physical Display | 15% | |
| Design Documentation | 10% | |

| **Code Quality** | Weight | Score (1-10) |
|---|---|---|
| Well Documented | 15% | |
| Readability | 10% | |
| Bug-Free | 10% | |
| SOLID Principles | 20% | |

| Total Score | |
|---|---|

## Prizes and Distribution

Contest winners will be announced on the Engineering Fair web page at https://www.oef.org. Participants that win prizes will be notified through their teacher of record via email. First, second and third place winners will receive awards. In the event of a tie, prizes will be equally distributed between winning entries.

# Team Roles

Maria Vanderputten - Team Leader

Cody Jones - Engineering Notebook Manager

Khylee Marshall - Coding Manager

Gage Danielwicz - Logical Thinker

Ayden Loven - Building Manager

# Brainstorming

# Themes and Brainstorming

Here are our theme ideas for the SEE category at the OEF.

**Theme Ideas**

- Circus
- Snoopy/peanuts
- Space travel
- Zoo
- Minecraft
- Pac-man
- Concert
- Pop culture
- Party animals
- Dinosaurs
- Macy's parade
- Talent show
- Magic
- Castle and dragon
- Aquatic life
- Robot invasion
- Apocalypse
- Dia de los Muertos
- Disney
- End of the Rainbow
- Train Ride
- Clue (Murder Mystery)
- Board Game (Monopoly)
- Car Racing
- Star Wars
- Emergency Calls
- Vikings Voyage
- Willy Wonka
- Candyland

**Making a Decision Matrix**

1.) List all ideas.
2.) Develop multiple criteria.
3.) Create a scale for grading each idea.
4.) Rank each idea on the scale for each criteria.
5.) Sum all ranks for each idea.
6.) Compare final scores and choose an idea

Signature: Cody Jones Date: 12/4/23

Witness: Khylee Marshall Date: 12/4/23

# Finished Decision Matrix

Here is our finished decision matrix and the themes we decided on.

| | Cost | Code Complex | Build Complex | Wow Factor | Time | Fun | Total |
|---|---|---|---|---|---|---|---|
| Snoopy V-Day | 4 | 4 | 3 | 4 | 3 | 4 | 22 |
| Circus | 2 | 3 | 3 | 4 | 3 | 5 | 20 |
| Aquatic Life | 2 | 1 | 1 | 3 | 2 | 3 | 12 |
| Dinosoar Extinction | 4 | 3 | 4 | 4 | 4 | 3 | 22 |
| Party Animals | 4 | 4 | 4 | 2 | 3 | 3 | 20 |
| Dog Show | 2 | 2 | 3 | 2 | 3 | 1 | 13 |
| Americas Got Talent | 4 | 5 | 5 | 2 | 4 | 3 | 23 |
| Parade | 4 | 2 | 4 | 3 | 3 | 4 | 20 |
| Fantasy | 5 | 4 | 5 | 5 | 5 | 4 | 28 |
| Robot Invasion | 4 | 4 | 4 | 3 | 4 | 3 | 22 |
| Wishing on a Star | 3 | 3 | 3 | 2 | 3 | 3 | 17 |
| Disney? | 3 | 3 | 3 | 3 | 3 | 3 | 18 |
| 4 Seasons | 4 | 3 | 3 | 3 | 2 | 2 | 17 |
| Murder Mystery | 5 | 4 | 5 | 5 | 5 | 4 | 28 |
| 3D Monopoly | 4 | 2 | 5 | 4 | 4 | 5 | 24 |
| Car Race | 2 | 1 | 4 | 2 | 3 | 3 | 15 |
| Vikings Voyage | 4 | 4 | 4 | 3 | 4 | 4 | 23 |
| Candy Land | 3 | 2 | 3 | 2 | 3 | 4 | 17 |
| Science Fair/Museum | 4 | 3 | 4 | 3 | 4 | 4 | 22 |

SEE Decision Matrix - Cody Jones - 12/5/23

- Fantasy and Murder Mystery are our favorite themes, so we are merging them into one big show.
- They are both fairly difficult, expensive, and time-consuming, but we think that we will be able to do it! It will just have to be a challenge.

Signature: Cody Jones Date: 12/5/23

Witness: Khylee Marshall Date: 12/5/23

# Fantasy Plot Ideas

Here are our ideas for the story/plot of the SEE project.

**PLOT IDEA ONE**

**Characters**

- Peasants
- Knight
- King and Queen
- Dragon
- Wizard
- Jester

**Setting**

- Castle
- Kingdom
- Dragon's Lair

**Things to Remember for a Good Story**

1.) Good Guys
2.) Bad Guys
3.) Conflict
4.) Resolution +

= PLOT

Story Formula

1.) Jester entertains King and Queen in the Main Room.
2.) King and Queen go to bed.
3.) King wakes up to see that Queen is missing.
4.) King calls in Knights and orders them to search for Queen.
5.) Knights discover that Queen has been stolen by Dragon.
6.) Knights battle Dragon and save Queen.
7.) Knights and Queen return to Castle and King is overjoyed.
8.) Kingdom celebrates by holding a feast.

Signature: Cody Jones Date: 12/6/23

Witness: Maria Vanderputten Date: 12/6/23

# Fantasy Plot Ideas

Here are our ideas for the story/plot of the SEE project.

**PLOT ONE**

**Characters**

- Peasants
- Knight
- King and Queen
- Dragon
- Wizard
- Jester

**Setting**

- Castle
- Kingdom
- Dragon's Lair

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5.) Knights discover that Queen has been stolen by Dragon.
6.) Knights battle Dragon and save Queen.
7.) Knights and Queen return to Castle and King is overjoyed.
8.) Kingdom celebrates by holding a feast.

Signature: Cody Jones Date: 12/6/23

Witness: Maria Vanderputten Date: 12/6/23

# Fantasy Plot Ideas

Here are our ideas for the story/plot of the SEE project.

**PLOT TWO**

**Characters**

- Dragon
- Townspeople
- “Little Timmy”
- Knights
- Wizard (possibly)

**Setting**

- Medieval Village

**Things to Remember for a Good Story**

1.) Good Guys
2.) Bad Guys
3.) Conflict
4.) Resolution +

= PLOT

**Story Formula**

1.) Townspeople are going about their day as normal – singing, dancing, gathering in the town square, etc.
2.) Dragon flies through and breathes fire down on the village.
3.) People run away into their homes
4.) Little Timmy casually discovers gravity.
5.) Timmy goes to the knights and tells them about how to shoot the dragon.
6.) Shoot the Catapult
7.) Kill the Dragon
8.) Celebrate

Signature: Cody Jones Date: 12/6/23

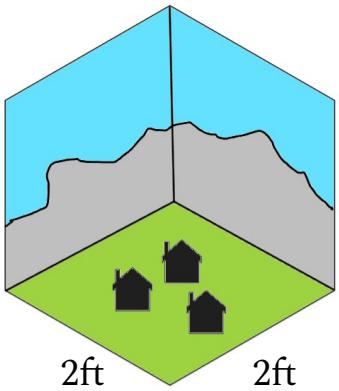
Witness: Maria Vanderputten Date: 12/6/23

# Generate Concepts

## Technical Ideas

Here are our technical ideas for the SEE project, including moving parts, sketches, and other general brainstorming ideas

This model would be open diagonally to the judges, making it seem more open with 2 open sides instead of 1.




We hope to have a rotating system similar to a ski lift at the top of the box that moves the dragon around. The dragon will hopefully 'fly' through the mountain or clouds.

We will add boxes on the other side of each inner wall and the base to accommodate wiring, speakers, lights, and motors.

We are building most of the walls and structure from 0.2" plywood that will be cut with the laser cutter.

Possible Idea: We move characters around using LEGO treads, because they are affordable and will work perfectly for moving around minifigures.

Signature: Cody Jones Date: 12/7/23

Witness: Khylee Marshall Date: 12/7/23

## Tasks for Gantt Chart

Now that we have a plan for how we will make this display, we need a schedule, also known as a Gantt Chart in this case.

**Tasks:**

- Brainstorm Themes and Ideas
- Make Gantt Chart
- Sketch Ideas and decide on one
- Brainstorm Plot Sequence
- Storyboard/Script
- Design Everything in CAD
- Build Base (with room for wiring)
- Build Walls
- Paper Mache Mountain
- Build Houses/other Props
- Design Characters
- Program/Code
- Install Wiring and Hardware
    - Motors, Lights, Speakers, Wires
- Record Sounds (Voices, Music, SFX)
- Paint and Decorate
- Test
- Present

This chart is almost completely in order, but the final Gantt chart should definitely have the correct order.

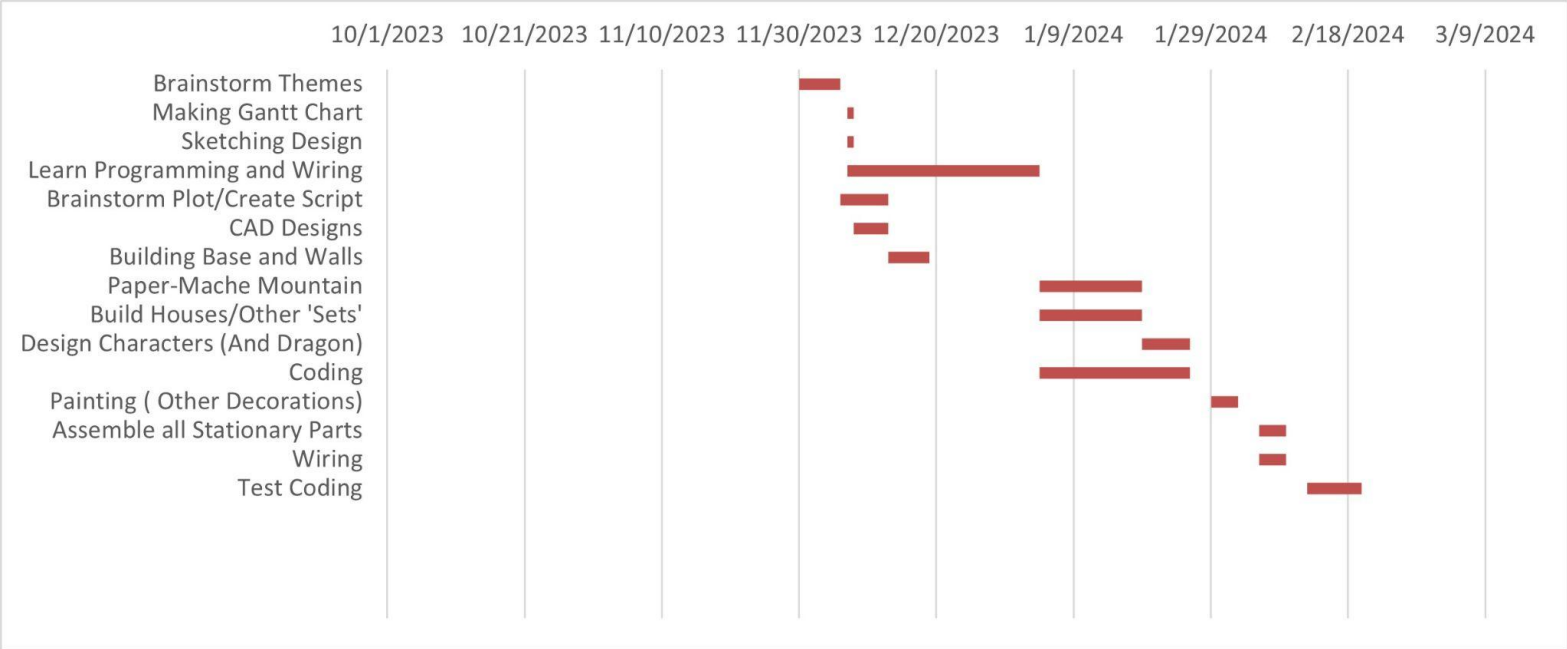
On our excel sheet containing the Gantt chart, we will also have a list of which team members are to do each task (depending on specified team roles).

Signature: Cody Jones Date: 12/7/23

Witness: Khylee Marshall Date: 12/7/23

## Tasks for Gantt Chart

Now that we have a plan for how we will make this display, we need a schedule, also known as a Gantt Chart in this case.




SEE Gantt Chart - Cody Jones - 12/8/23

### How We Made the Gantt Chart

1.) Create a chart in Excel with a data set for task names, start date, end date, and (calculated) duration.
2.) Create a 2D stacked bar chart.
3.) Create a data set out of the start dates for each task.
4.) Create a second data set of the durations of each task that will stack above the first set on the stacked bar chart.
5.) Make the first data set invisible for color.

Signature: Cody Jones Date: 12/8/23

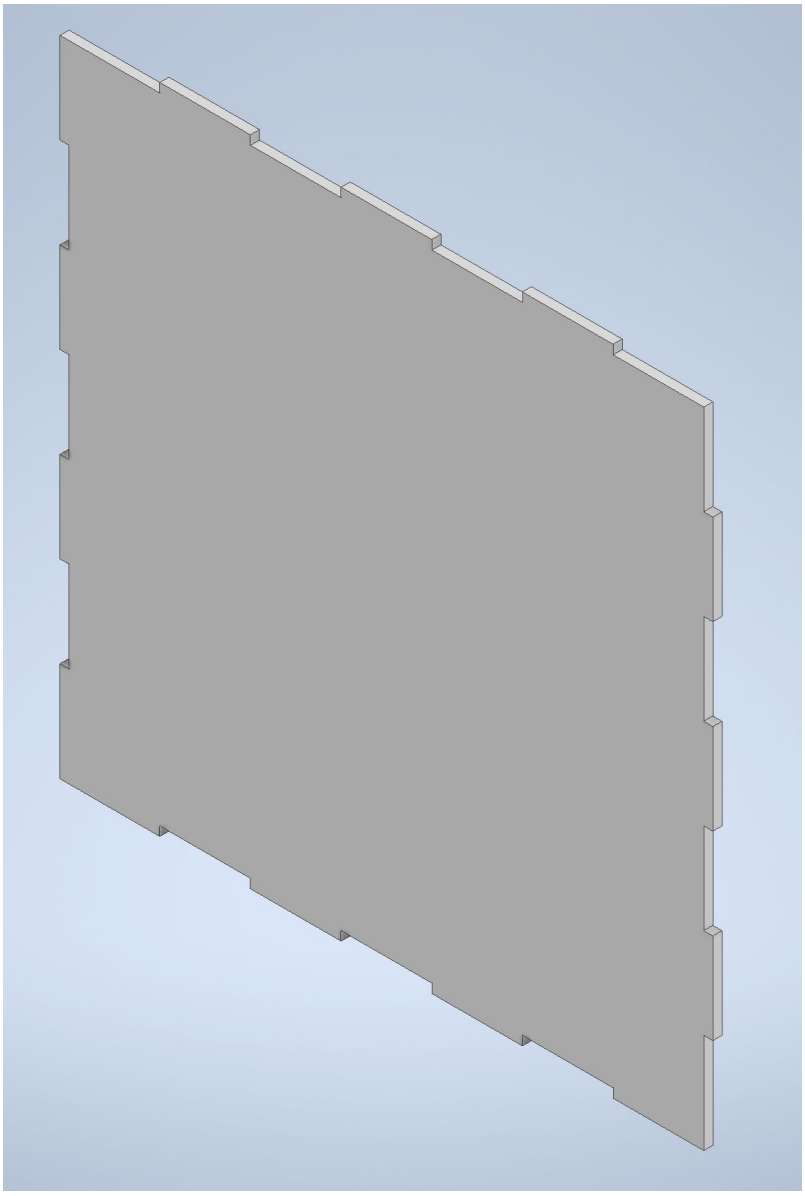
Witness: Khylee Marshall Date: 12/8/23

# Developing a Product / Constructing a Model

# *Display*

# Inner Left Wall

Here is the CAD file for the inner left wall of our display.



Inner Left Wall Part File

Cody Jones

1/11/24

This part was designed by Ayden and Gage, but the whole group provided input on how the part should look.

We planned this part to be made with 0.18” thick plywood.

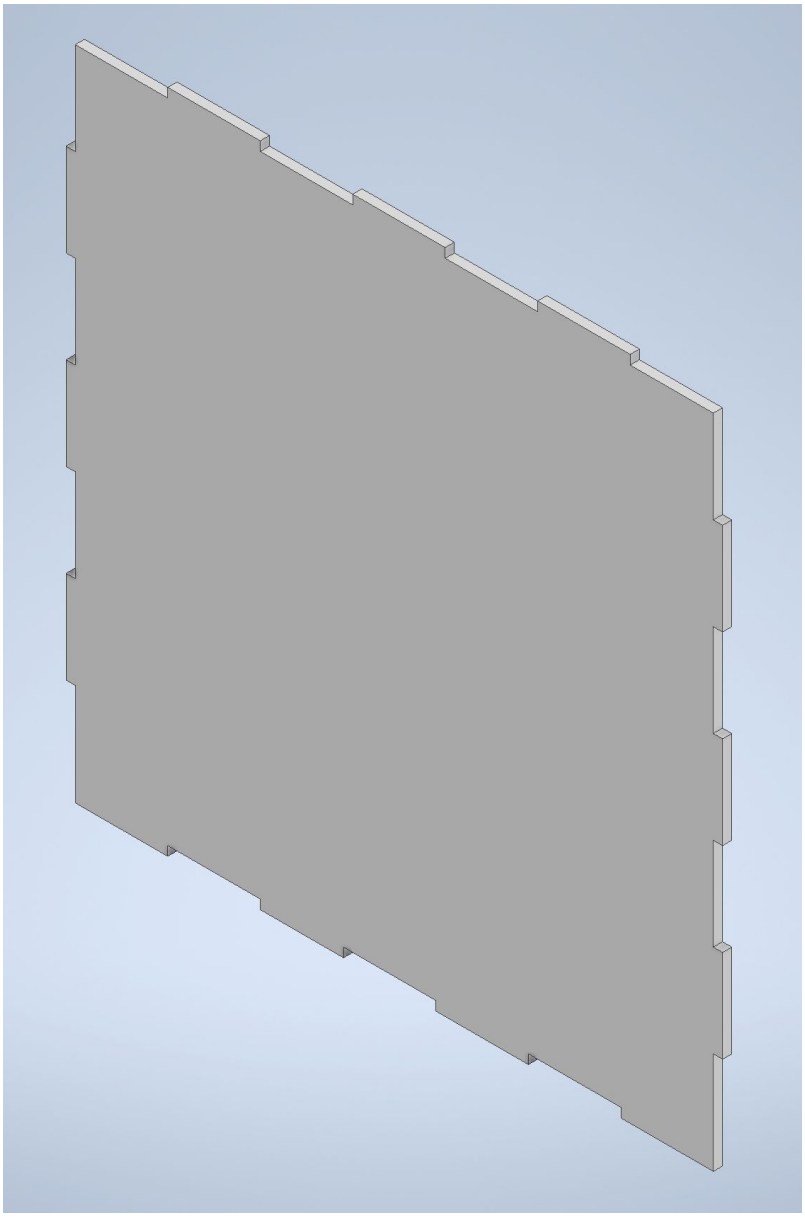
Each of the parts in the display assembly connects up with finger joints.

We cut this part with the laser cutter in the shop.

| | |
|---|---|
| Signature: Cody Jones | Date: 1/11/24 |
| Witness: Ayden Loven | Date: 1/11/24 |

# Inner Right Wall

Here is the CAD file for the inner right wall of our display.



Inner Right Wall Part File

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1/11/24

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Each of the parts in the display assembly connects up with finger joints.

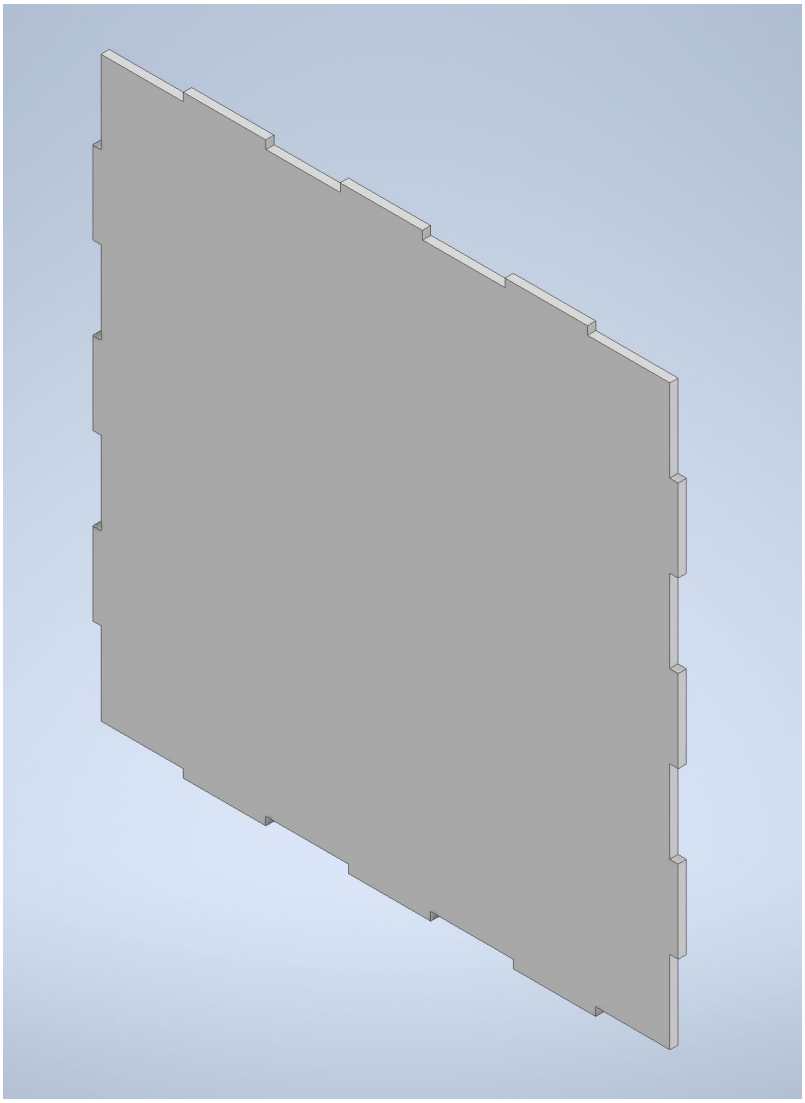
We cut this part with the laser cutter in the shop.

Signature: Cody Jones Date: 1/11/24

Witness: Gage Danielwicz Date: 1/11/24

# Floor

Here is the CAD file for the floor part of our display.



Floor Part File

Cody Jones

1/12/24

This part was designed by Ayden and Gage, but the whole group provided input on how the part should look.

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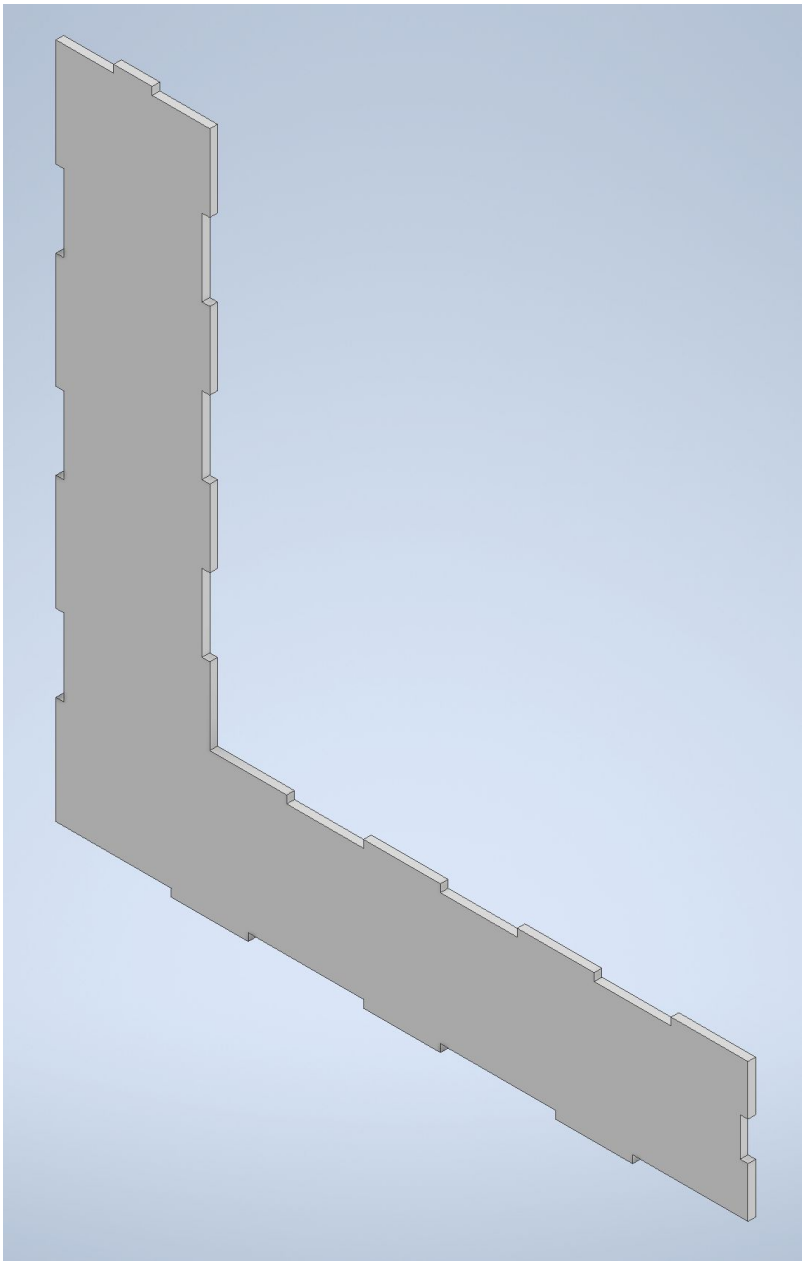
Signature: Cody Jones Date: 1/12/24

Witness: Khylee Marshall Date: 1/12/24

# Left ‘L’

Here is the CAD file for the left ‘L’ part of our display.



Left ‘L’ Part File

Cody Jones

1/12/24

This part was designed by Ayden and Gage, but the whole group provided input on how the part should look.

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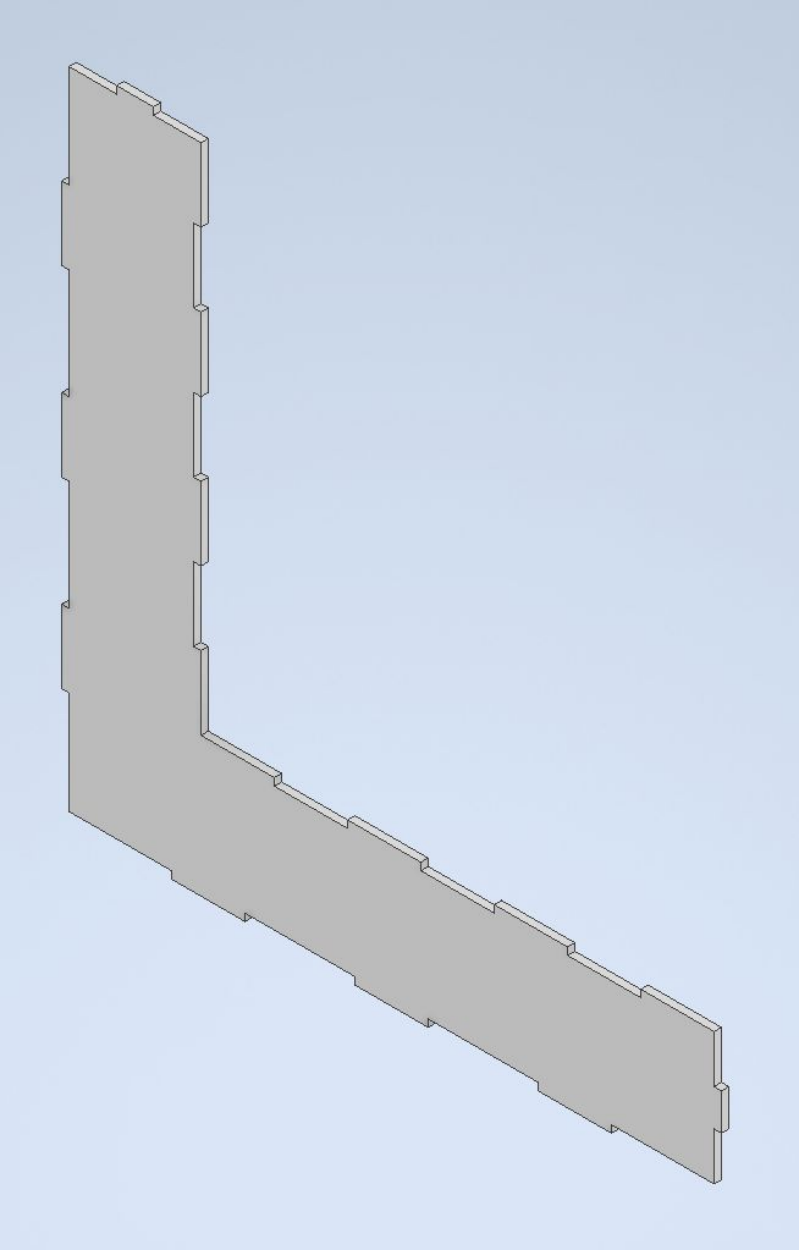
We cut this part with the laser cutter in the shop.

Signature: Cody Jones Date: 1/12/24

Witness: Gage Danielwicz Date: 1/12/24

# Right ‘L’

Here is the CAD file for the right ‘L’ part of our display.



Right ‘L’ Part File

Cody Jones

1/12/24

This part was designed by Ayden and Gage, but the whole group provided input on how the part should look.

We planned this part to be made with 0.18” thick plywood.

Each of the parts in the display assembly connects up with finger joints.

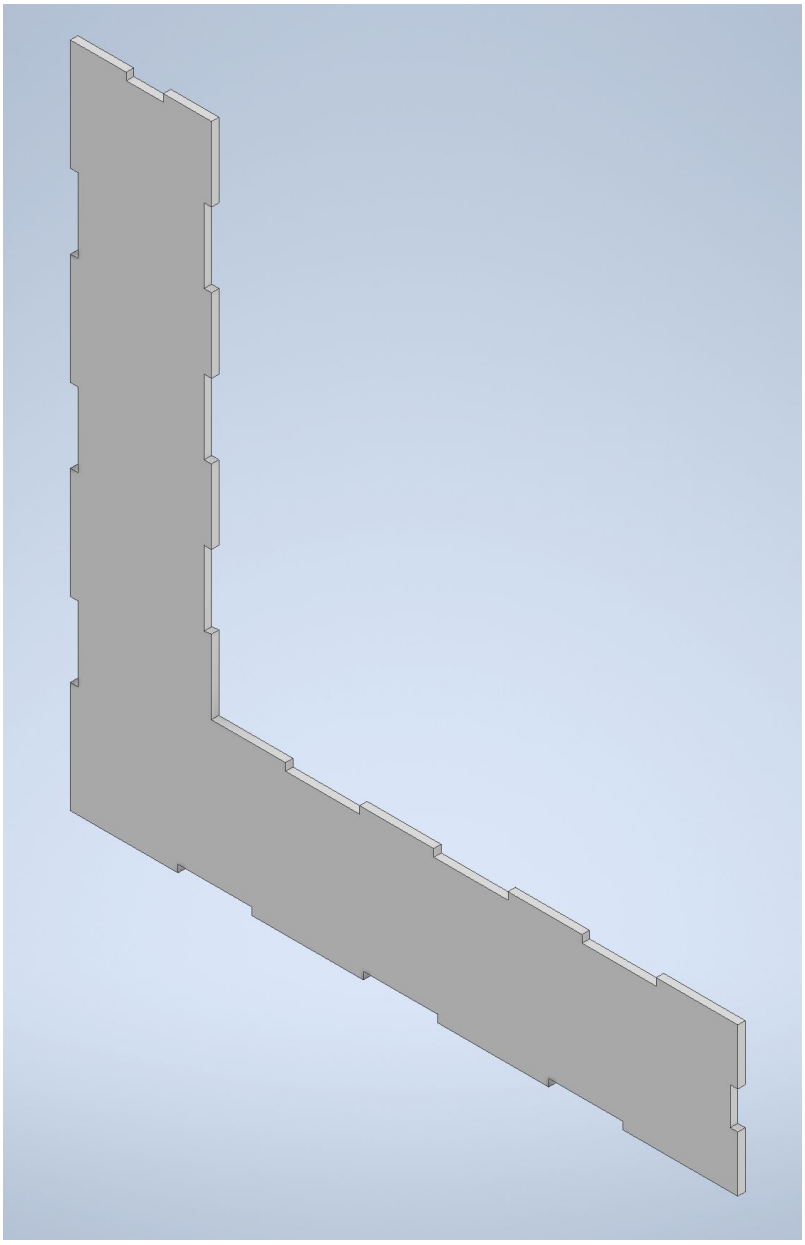
We cut this part with the laser cutter in the shop.

Signature: Cody Jones Date: 1/12/24

Witness: Maria Vanderputten Date: 1/12/24

# Top ‘L’

Here is the CAD file for the top ‘L’ part of our display.



Top ‘L’ Part File

Cody Jones

1/12/24

This part was designed by Ayden and Gage, but the whole group provided input on how the part should look.

We planned this part to be made with 0.18” thick plywood.

Each of the parts in the display assembly connects up with finger joints.

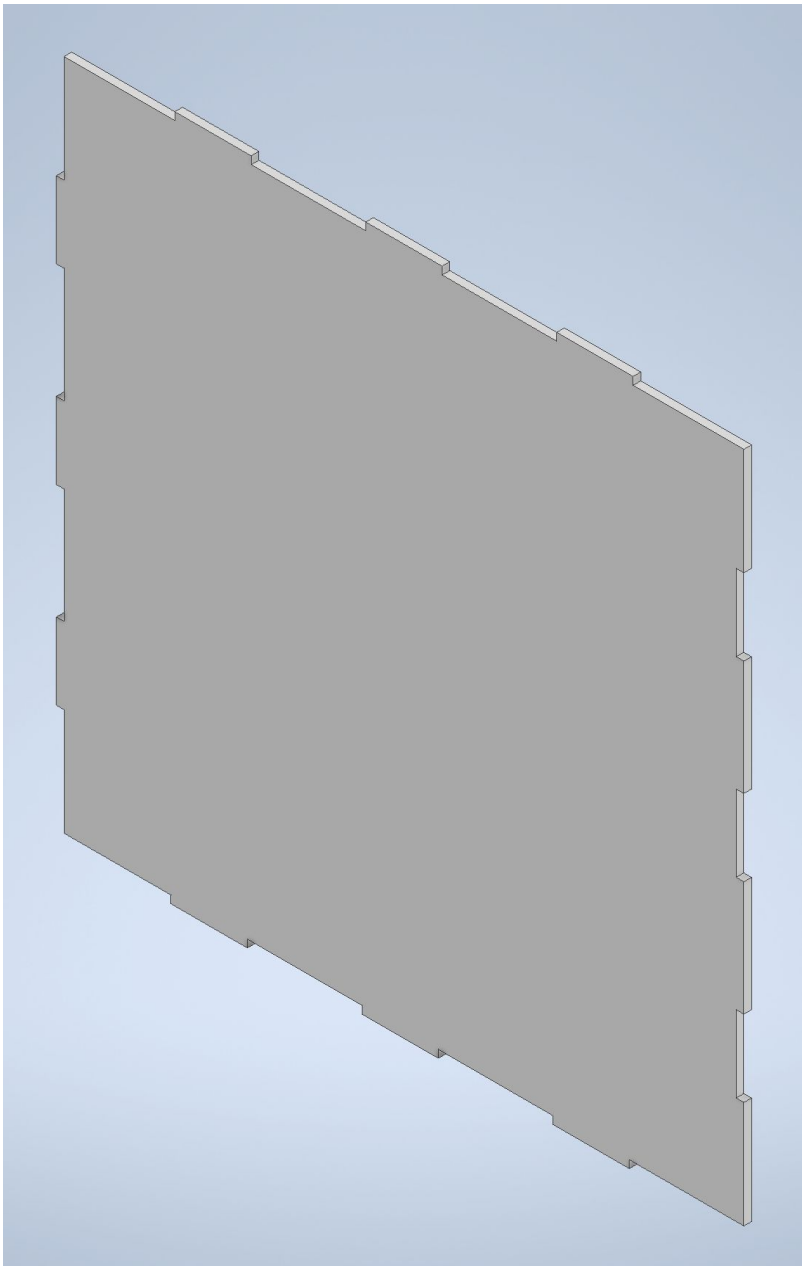
We cut this part with the laser cutter in the shop.

Signature: Cody Jones Date: 1/12/24

Witness: Gage Danielwicz Date: 1/12/24

## Outer Left Wall

Here is the CAD file for the outer left wall of our display.



Outer Left Wall Part File

Cody Jones

1/11/24

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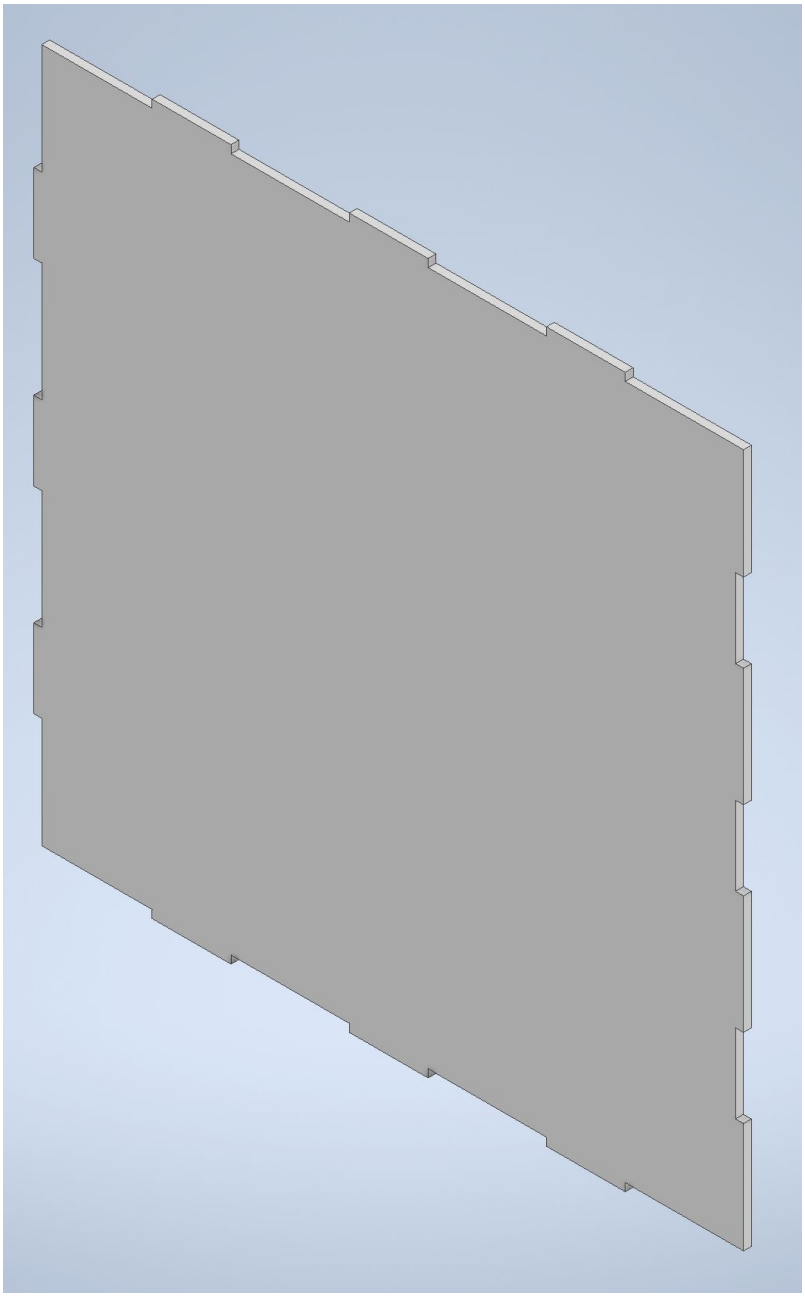
We cut this part with the laser cutter in the shop.

Signature: Cody Jones Date: 1/12/24

Witness: Gage Danielwicz Date: 1/12/24

## Outer Right Wall

Here is the CAD file for the outer right wall of our display.



Outer Right Wall Part File

Cody Jones

1/12/24

This part was designed by Ayden and Gage, but the whole group provided input on how the part should look.

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Each of the parts in the display assembly connects up with finger joints.

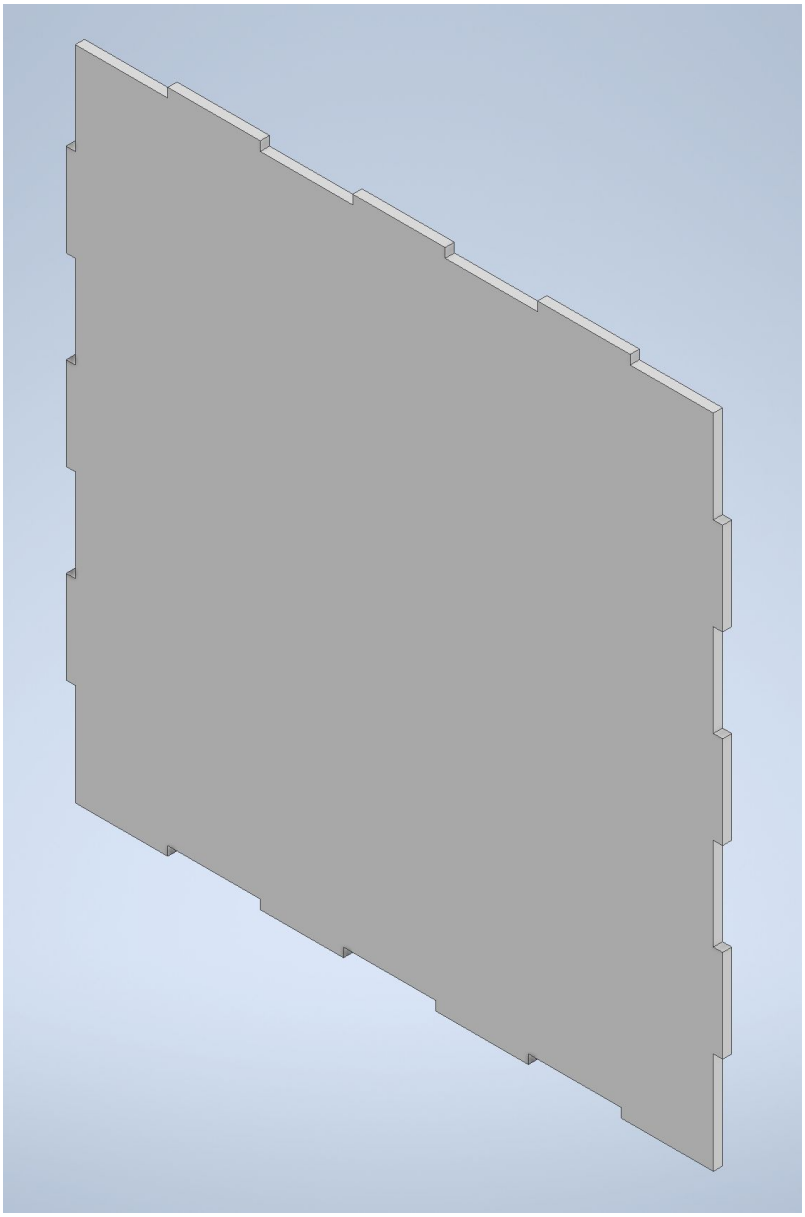
We cut this part with the laser cutter in the shop.

Signature: Cody Jones Date: 1/12/24

Witness: Khylee Marshall Date: 1/12/24

## Base

Here is the CAD file for the base of our display.



Base Part File

Cody Jones

1/13/24

This part was designed by Ayden and Gage, but the whole group provided input on how the part should look.

We planned this part to be made with 0.18” thick plywood.

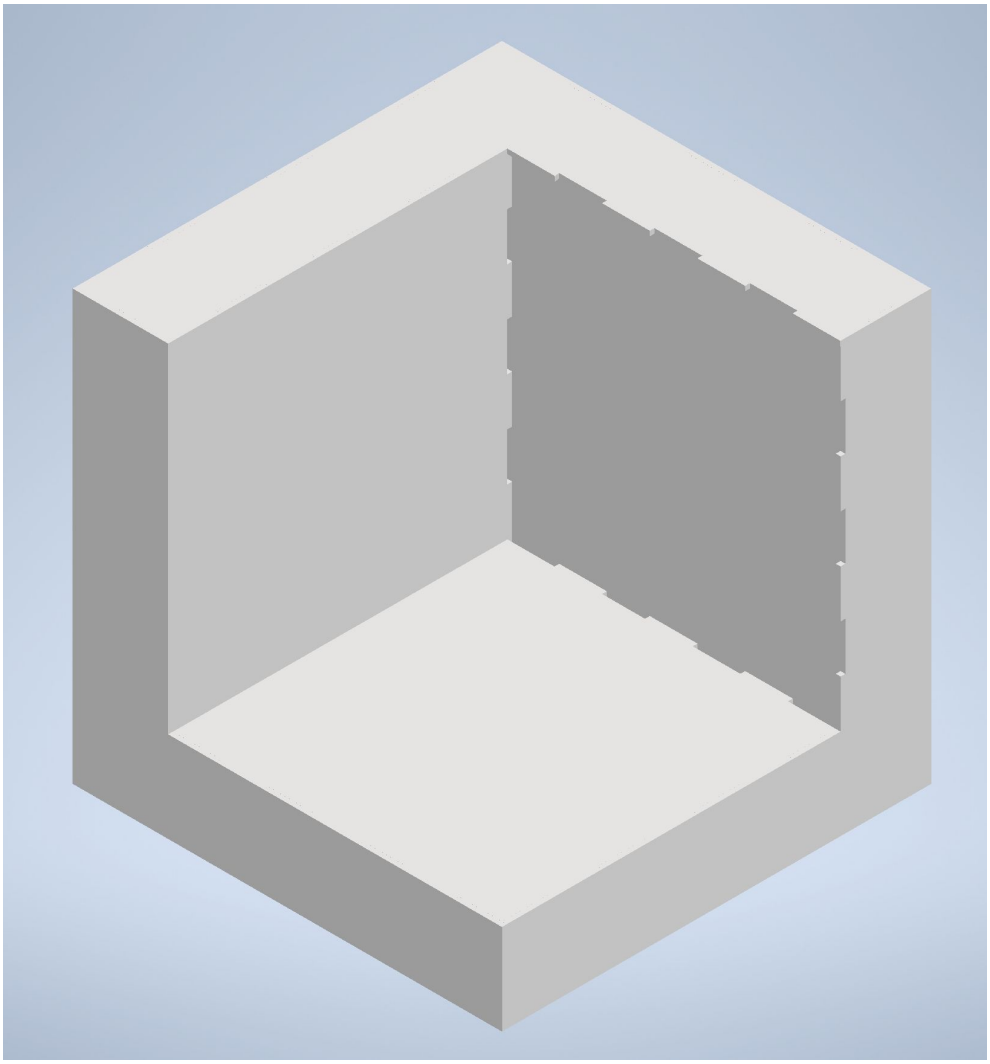
Each of the parts in the display assembly connects up with finger joints.

We cut this part with the laser cutter in the shop.

| | |
|---|---|
| Signature: Cody Jones | Date: 1/13/24 |
| Witness: Ayden Loven | Date: 1/13/24 |

## Completed Display Assembly

Here is the completed CAD assembly file for the SEE display project.



Display Assembly - Cody Jones - 1/18/23

This assembly was particularly more difficult than most because there were a lot of finger joints that we had to match up perfectly.

| | |
|---|---|
| Signature: Cody Jones | Date: 1/18/24 |
| Witness: Khylee Marshall | Date: 1/18/24 |

## Physical Display

Here is an update on the background of our display.

- We originally intended for the display to be 28” by 28” on the outside, with an interior of 24” by 24.” Wall thickness would have been 4”.
- In the end, our box was 18” by 18” with an interior of 14” by 14.” Wall thickness was 4.”

Image of Completed Box - Cody Jones

1/20/24

Signature: Cody Jones Date: 1/20/24

Witness: Khylee Marshall Date: 1/20/24