

WIND TUNNEL BUILD PROCESS

WHY BUILD A WIND TUNNEL?

My STEM Racing team needed a way to physically test our car aerodynamics (we did not have a test track at the time). Before our Regional Competition, I decided to take matters into my own hands by building a miniature wind tunnel using off-the-shelf hardware and a CPU fan.



MATERIALS LIST

- 1.Aluminum Angle (Rails)

2.Air Humidifier/Atomizer

3.Computer Fan with AC Plug and Variable Speed Controller

4.Wood

5.Plastic Straws

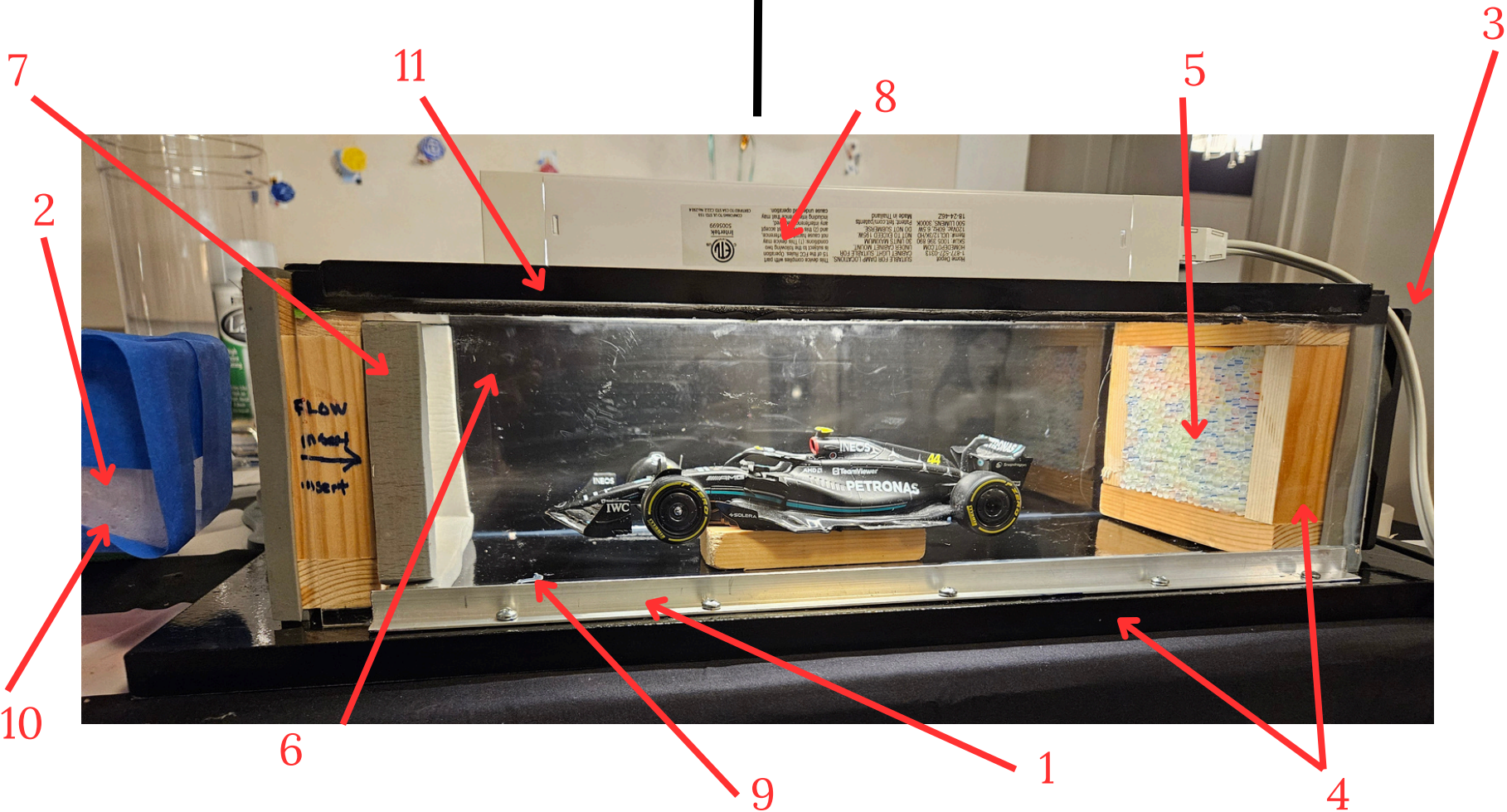
6.Clear acrylic panels
- 7.Foam Weatherstrip Tape

8. Extension Cord

9.Silicone Sealant

10.Plastic Water Container

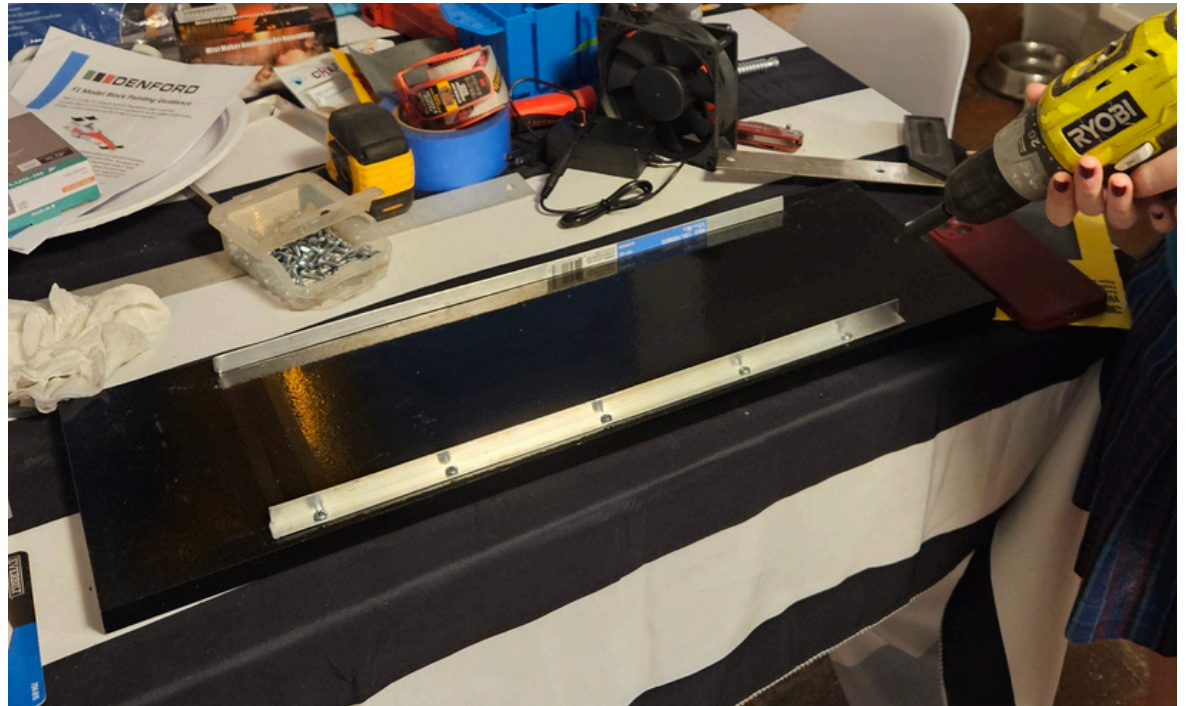
11.Black Spray Paint



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BUILDING THE BASE

1. I cut the wood base (23.625"x 8.0"x 0.75") with a table saw.
2. Next, I cut aluminum rails (17.0" in length) using an angle grinder and screwed two of them into the base.
3. Afterward, I cut the three acrylic panels on the table saw for the sides and top.



4. To assemble the acrylic panels, I used silicone sealant and the remaining two aluminum rails at the top corners.



PAINTING

In order to make the fog visible, I painted the back acrylic panel and base with black spray paint.

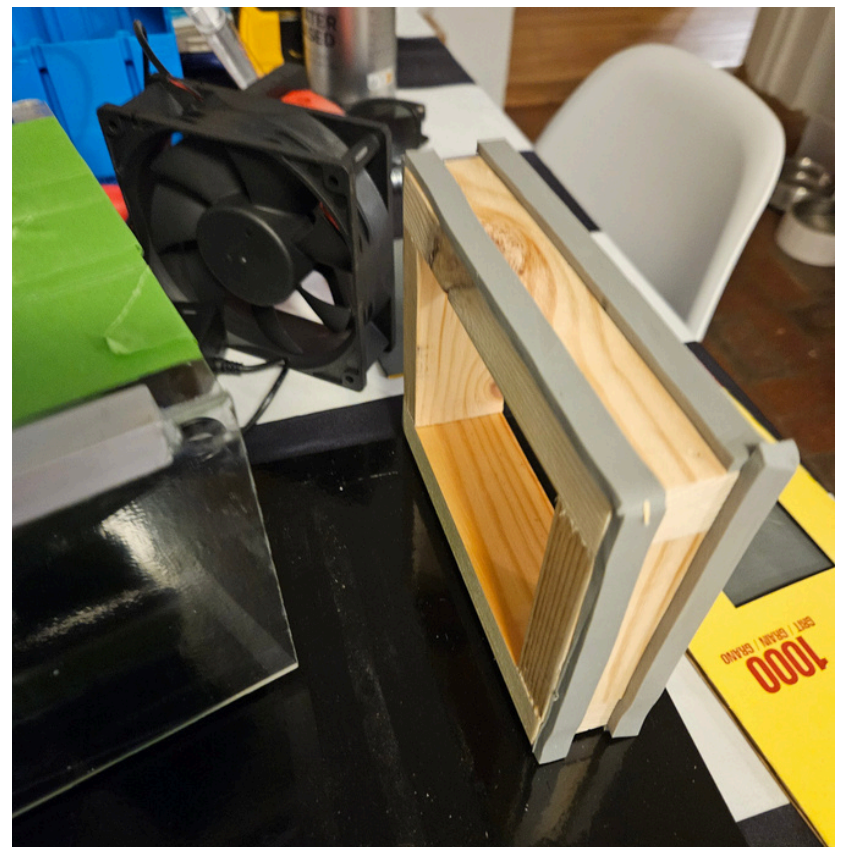
I left a clear section at the top to view airflow patterns from above and shine a light inside.



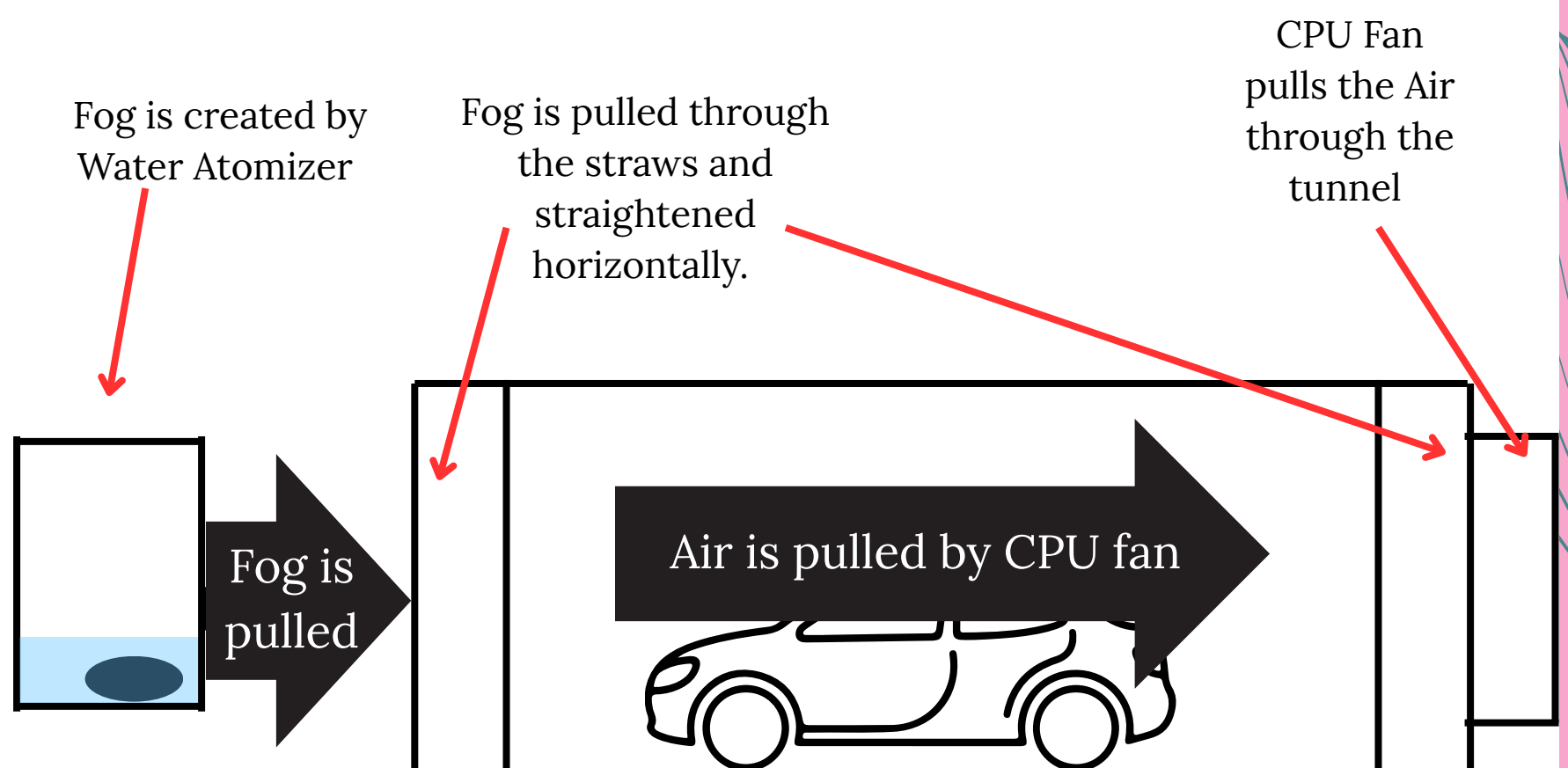
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FAN AND REMOVABLE FRAME (AIR STRAIGHTENER)

1. I screwed the fan into the base wood panel at one end of the tunnel. Then, using silicone sealant and weatherstripping tape, I created a tight seal.
2. To straighten the fog flow horizontally through the tunnel, I glued straws together inside a wooden frame. I measured the frame to fit the openings on both sides of the wind tunnel.
3. The frame in front of the CPU fan is glued in place permanently. The frame in front of the fog machine is removable to allow me to insert and remove the vehicle from the tunnel.
4. The CPU fan is placed at the end of the tunnel to create suction that pulls the fog over the vehicle.



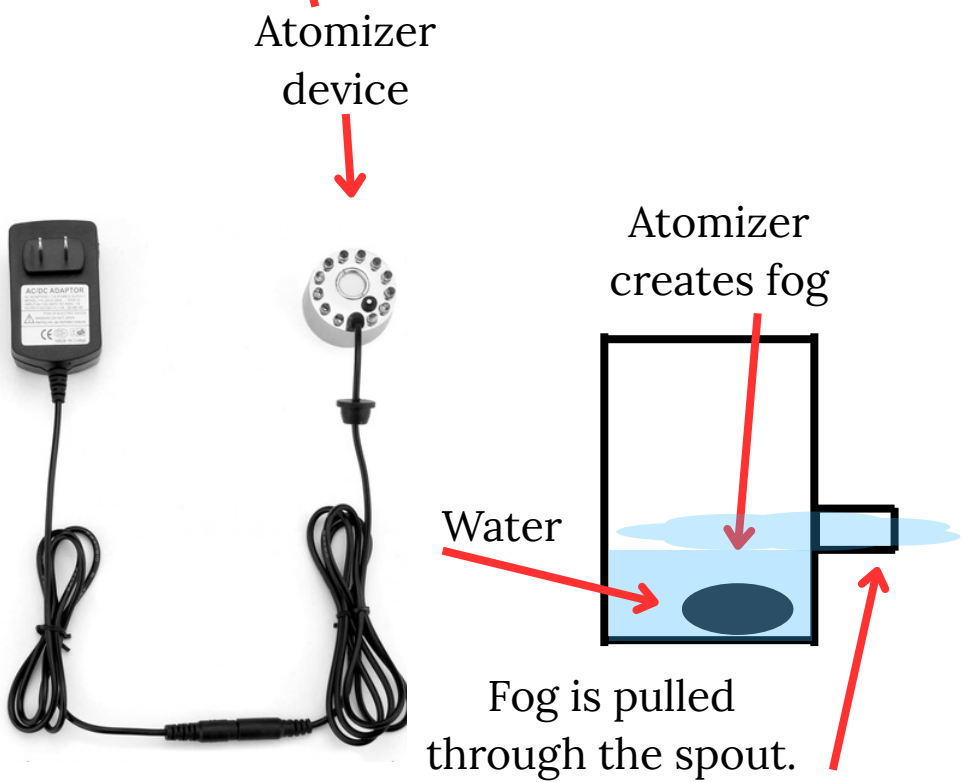
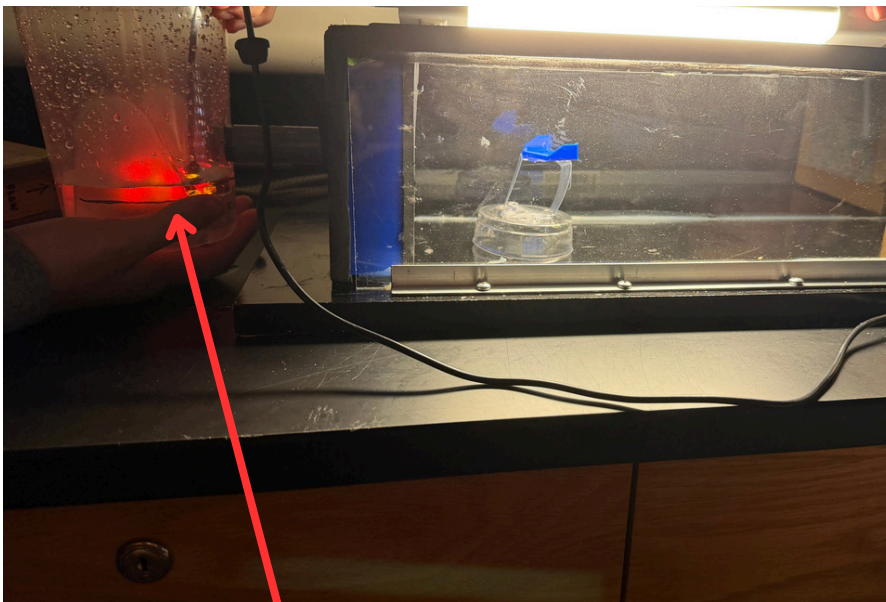
AIRFLOW DIAGRAM



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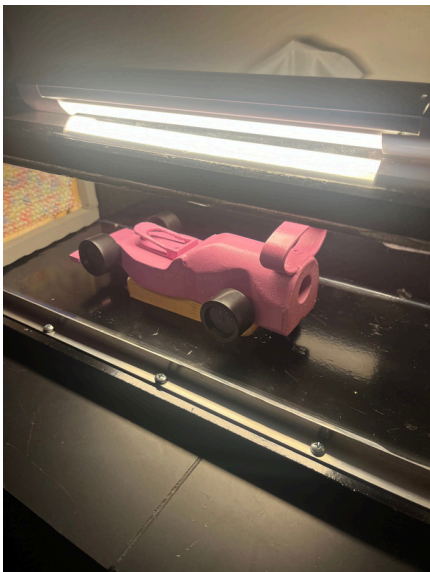
WATER ATOMIZER

- 1. In order to view the wind pattern, I had to create fog that would be pulled through the tunnel. I did this using an atomizer.
- 2. The atomizer creates fog using a disc vibrating at an ultrasonic frequency. The device sits in shallow water, and the disc's rapid movement creates intense microscopic pressure waves. Because the droplets created are so small and light, they float into the air as a cool fog.

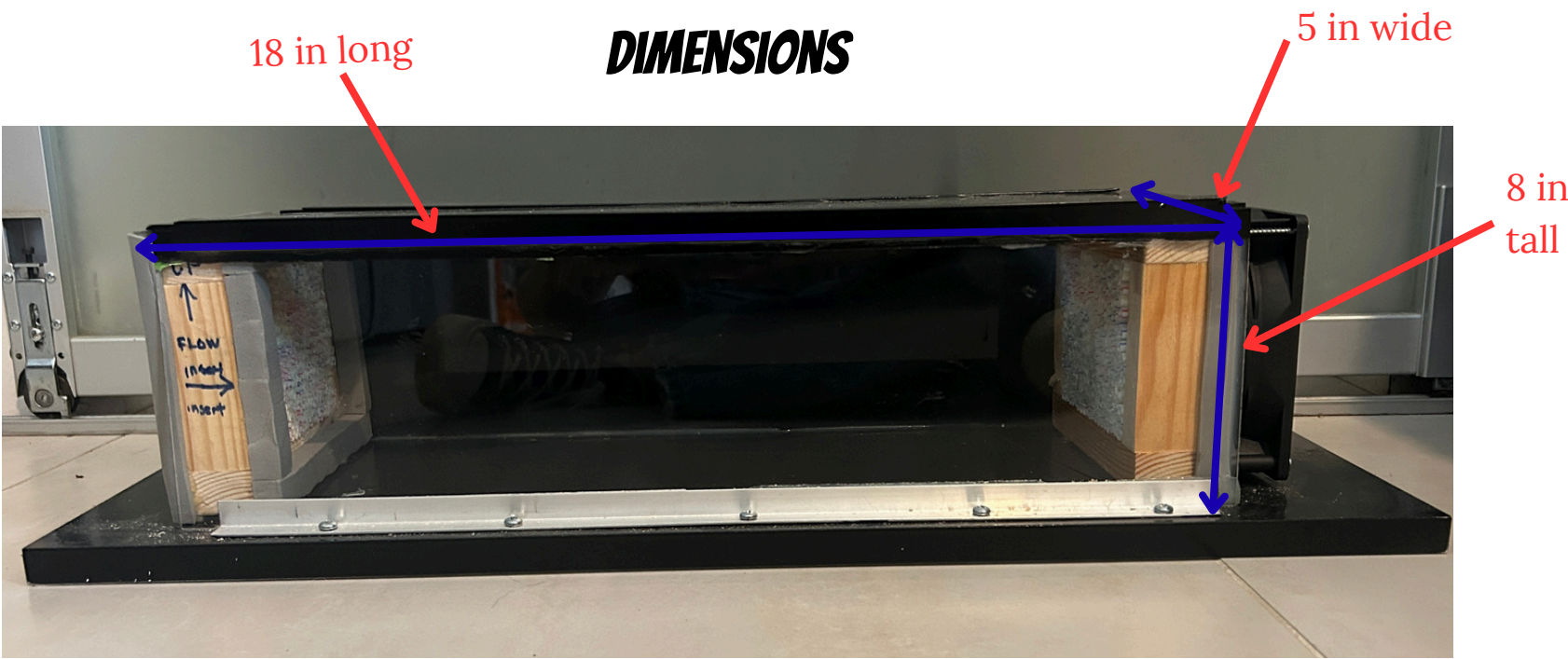


LIGHTING SYSTEM

To make the fog visible, we used black walls and a light source to reflect off the fog. We used a plug-in LED light bar to illuminate the inside.



DIMENSIONS

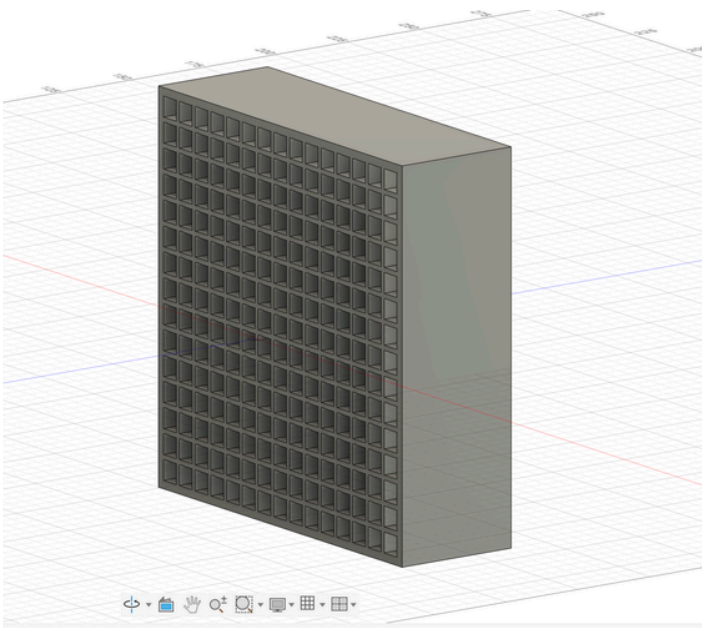


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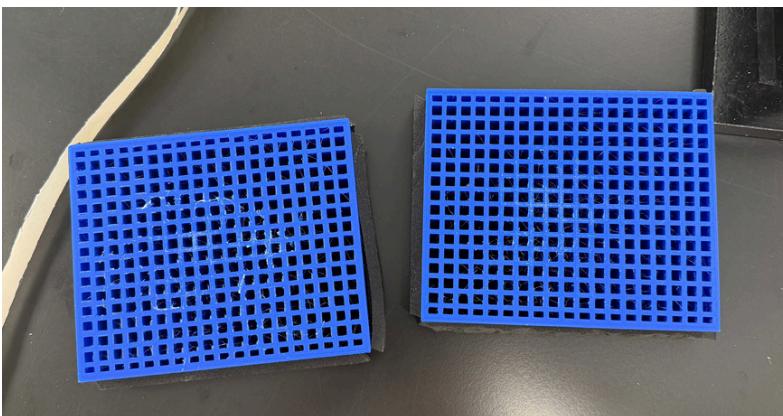
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NEXT DESIGN ITERATION

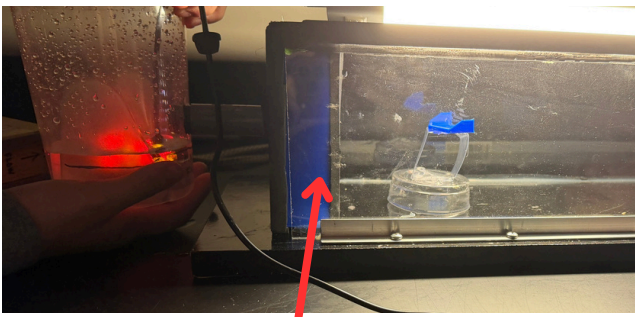
- I observed that some of the straws in the air straightener were not completely horizontal, and some ends were crushed during manufacturing, which created inconsistent flow.
- I redesigned the air straightener in Autodesk Fusion360 and FDM 3D printed it as one solid piece using PLA Filament.
- I believe that having a uniform grid eliminates variability in airflow and will give more accurate results.
- This also has Weatherstripping Tape to create a tight seal.
- Testing is currently in progress.



CAD Design



3D Printed Air Straighteners



Wind Tunnel with new Air Straightener

