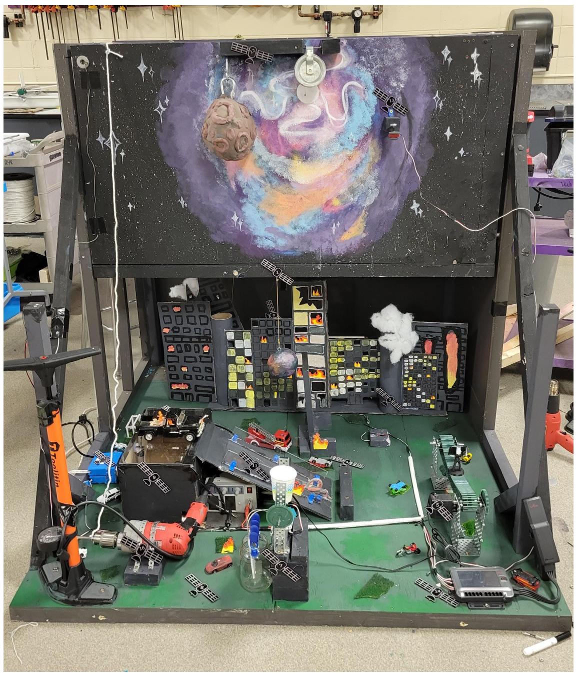
New Berlin Eisenhower High School Purple Team

Members:
Amanda Maly (12), Rebecca Przybysz (12), Becca Hall (11), Gabby Kazinski (11), Owen Schaar (11), Jayden Tay (11), Lucas Anderson (10), Jalesh Sesham (10), Quinn Shields (9), Alex Teller (9), Kyle Wisniewski (9)

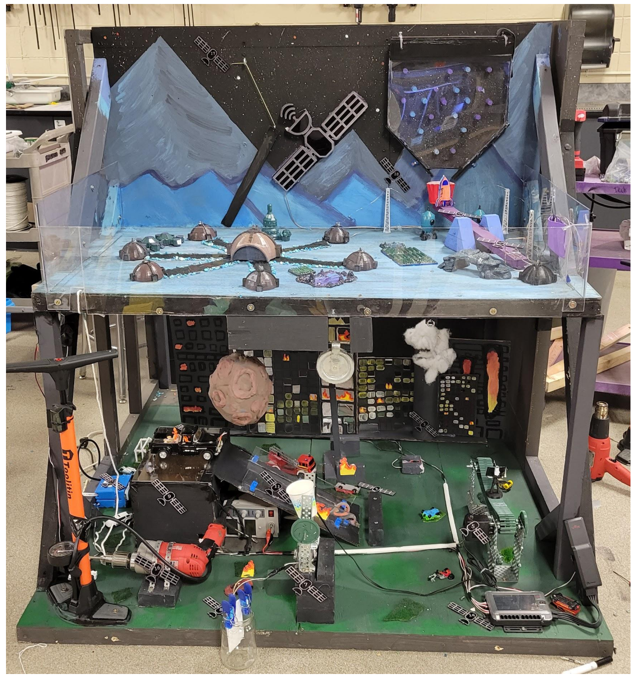
Table of Contents

Finished Machine

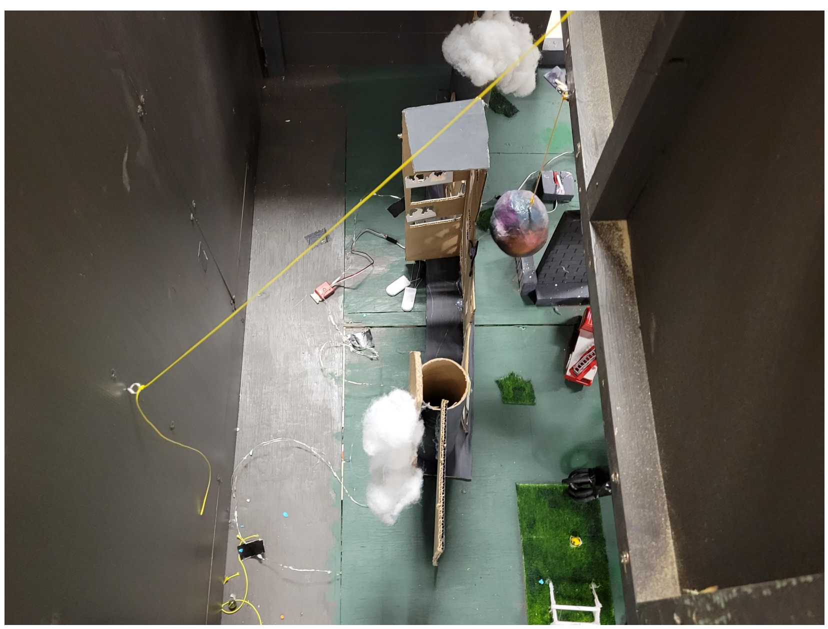
Base with wall up:



Base with wall down:



Through plexiglass wall: (Behind the city)



Progress Pictures/Check In

October:

Teams were chosen in early October. The rest of the month was spent designing the base of the machine. All of the calculations were gone over by the upperclassmen and coaches to make sure that the wall would smoothly turn. The team also shared ideas for the theme and what steps they wanted to include with the machine.

November:

Construction of the machine started in November. Two by fours were cut lengthwise to make two by twos. The wood was screwed together to create a wall. The walls were put together to form a base. While half the team worked on construction of the base, the other half worked on theorizing how the steps would fit together.

December:

Construction of the base is finished and the spinning wall was added on to the base. The base was painted and some steps were put onto the machine. It was decided that a corded drill would be needed to turn the wall.

January:

Saturday meetings started and the list of steps was theoretically finished. These steps were created. The spinning wall was painted to look like a planet and the base was taking on a city look. Most of January was spent debating how the wall would flip down.

February:

The machine was completed mid february and the kinks were started to be worked out. The script for a presentation was created and props were in the process of being thought of.

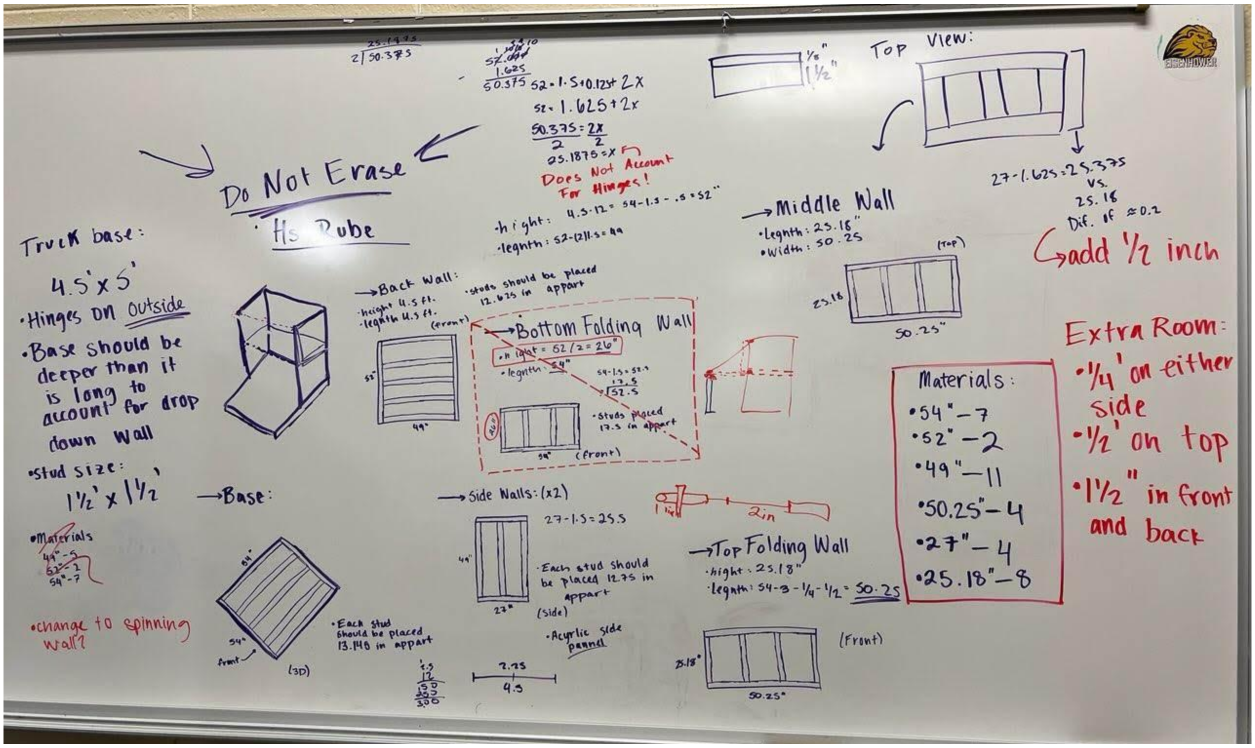
March:

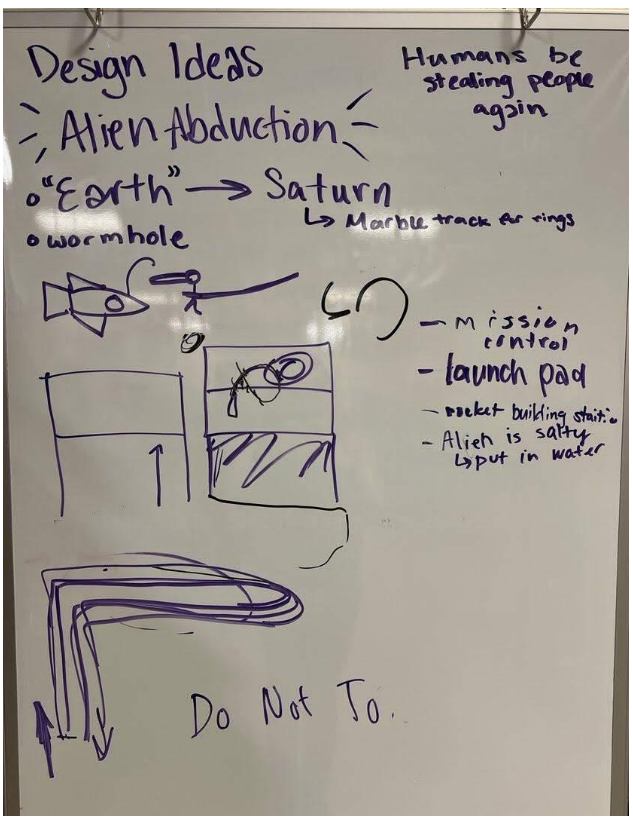
Props for the presentation were created. The machine was able to run two times through with minimal human intervention. We took the machine to Discovery World for state and won third place with a deduction of 10 points for not having our steps labeled correctly. Unfortunately, through transport, the spinning wall fell off the bolt and crushed some steps. The wall was fixed but the team did not have time to fix the steps before spring break.

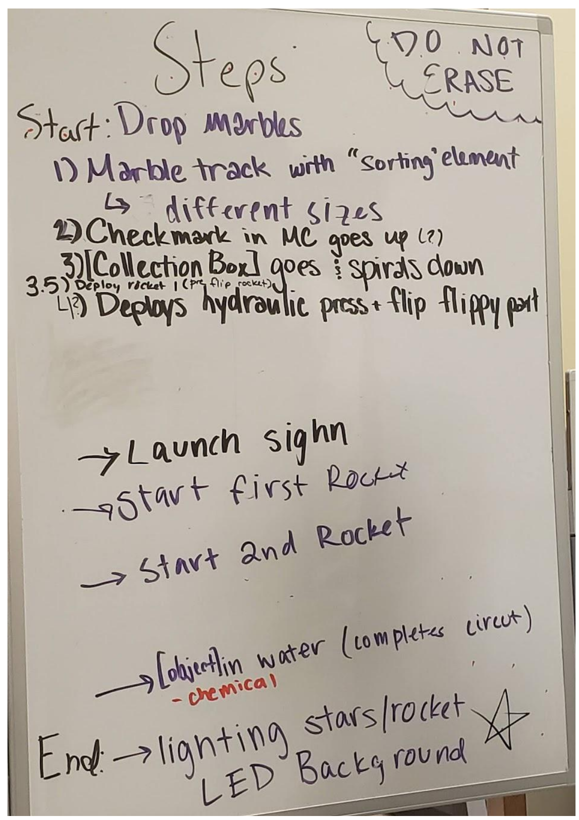
April:

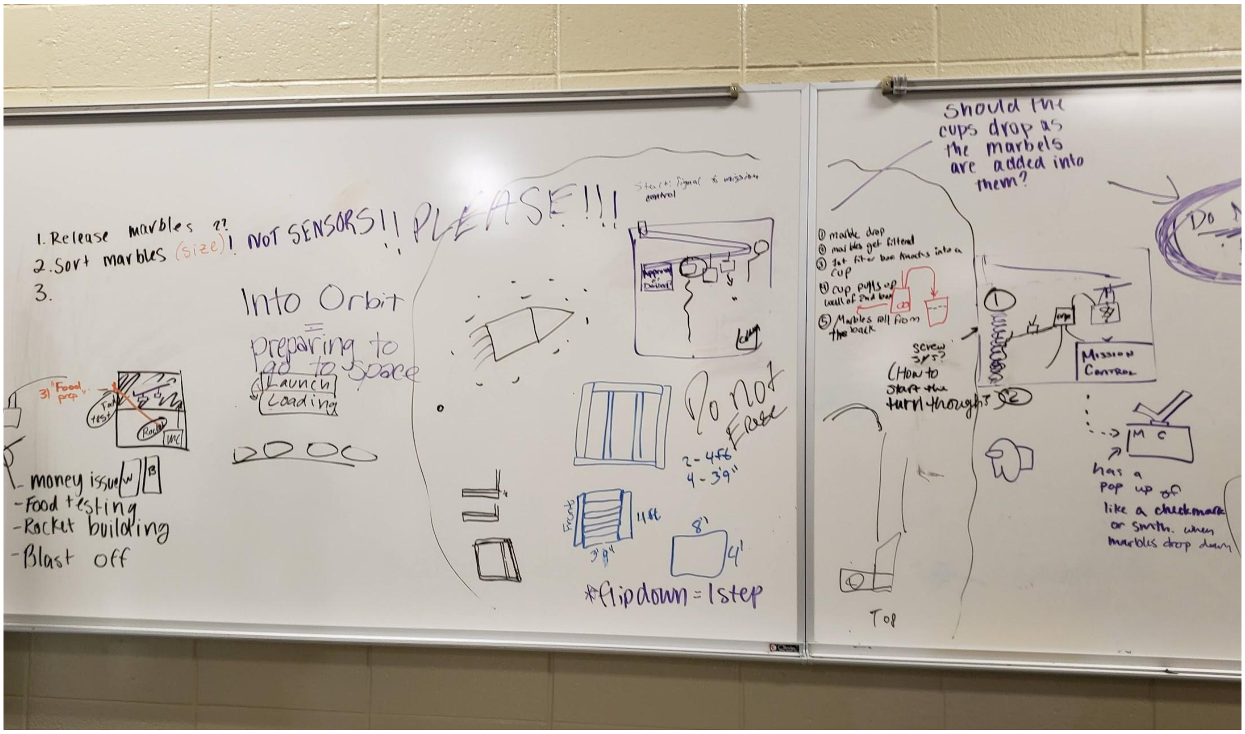
The crushed steps were fixed and the machine was given a better paint job for the base. The team looked over the grades we received from competition and added to the presentation and portfolio.

October:

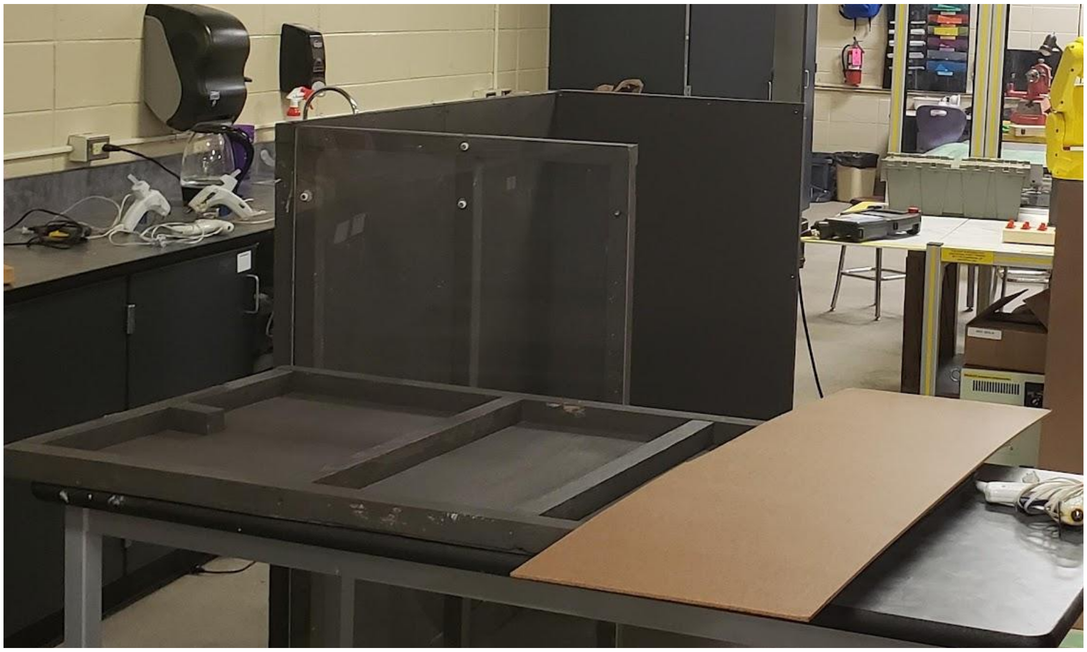

Do Not Erase
Hs Rube
Top View:
Truck base:
4.5' x 5'
•Hinges on outside
•Base should be deeper than it is long to account for drop down wall
•Stud size:
1½' x 1½'
→Base:
•change to spinning wall?
→Back Wall:
→Bottom Folding Wall
→Middle Wall
Does Not Account For Hinges!
27-1.625=25.375
vs.
25.18
add ½ inch
Extra Room:
•¼' on either side
•½' on top
•1½" in front and back
Materials:
•54"–7
•52"–2
•49"–11
•50.25"–4
•27"–4
•25.18"–8
→Side Walls: (x2)
27-1.5=25.5
→Top Folding Wall
•Acrylic side pannel
(Front)


Design Ideas
Humans be stealing people again
Alien Abduction
o"Earth" → Saturn
↳ Marble track for rings
o wormhole
– mission control
– launch pad
– rocket building station
– Alien is salty
↳ put in water
Do Not To.


Steps
DO NOT ERASE
Start: Drop marbles
1) Marble track with "sorting" element
↳ different sizes
2) Checkmark in MC goes up (?)
3) [Collection Box] goes : spirals down
3.5) Deploy rocket
4) Deploys hydraulic press + flip flippy part
→ Launch sighn
→ start first Rocket
→ start 2nd Rocket
→ [object] in water (completes circut)
– chemical
End: → lighting stars/rocket
LED Background


1. Release marbles ??
2. Sort marbles (size)! NOT SENSORS!! PLEASE!!!
3.
Into Orbit
=
preparing to go to space
Launch
Loading
- money issue
- Food testing
- Rocket building
- Blast off
Do not Erase
2 - 4ft
4 - 3'9"
Front
4ft
8'
4'
*flipdown = 1step
Should the cups drop as the marbels are added into them?
① marble drop
② marbles get filtered
⑤ Marbles roll from the back
screw sys?
(How to start the turn though?
Mission Control
M C
has a pop up of like a checkmark or smth. when marbles drop down
Top

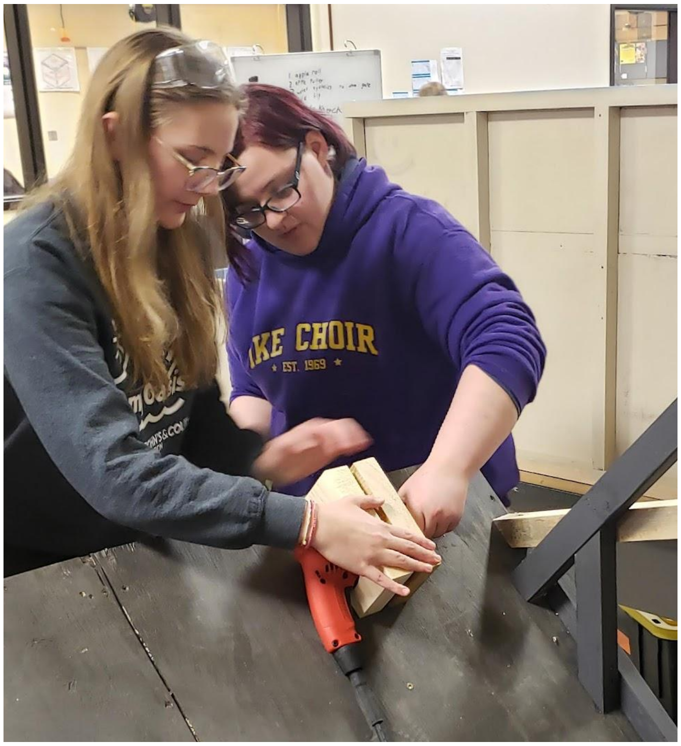
November:

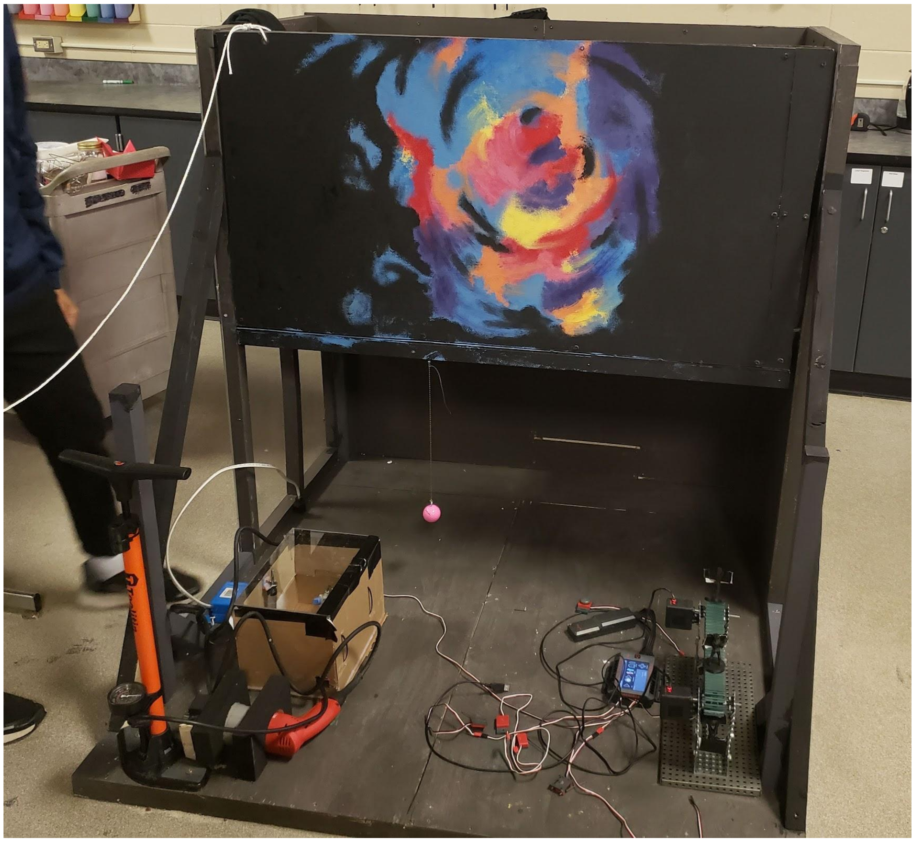



HOW
MACHINES
WORK
ZERO

December:

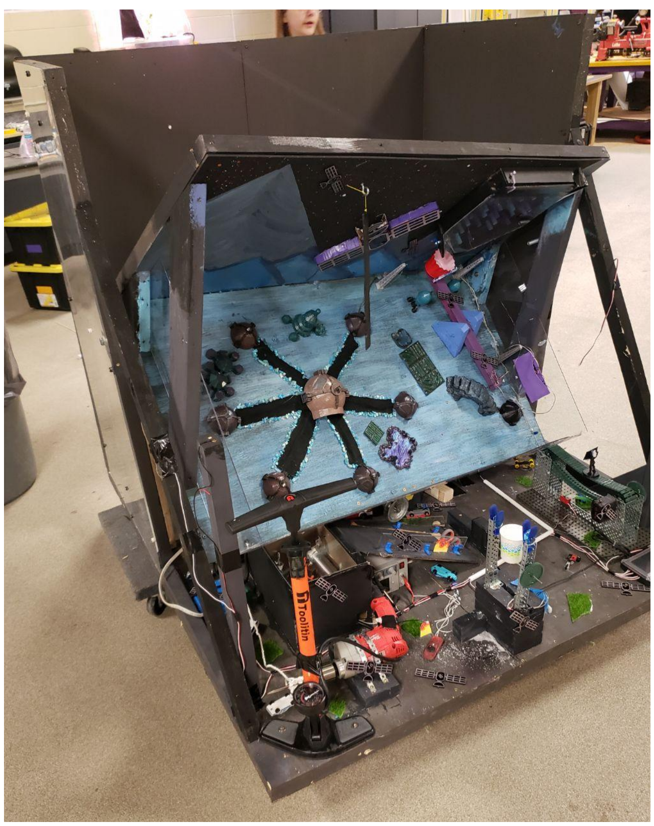
January:



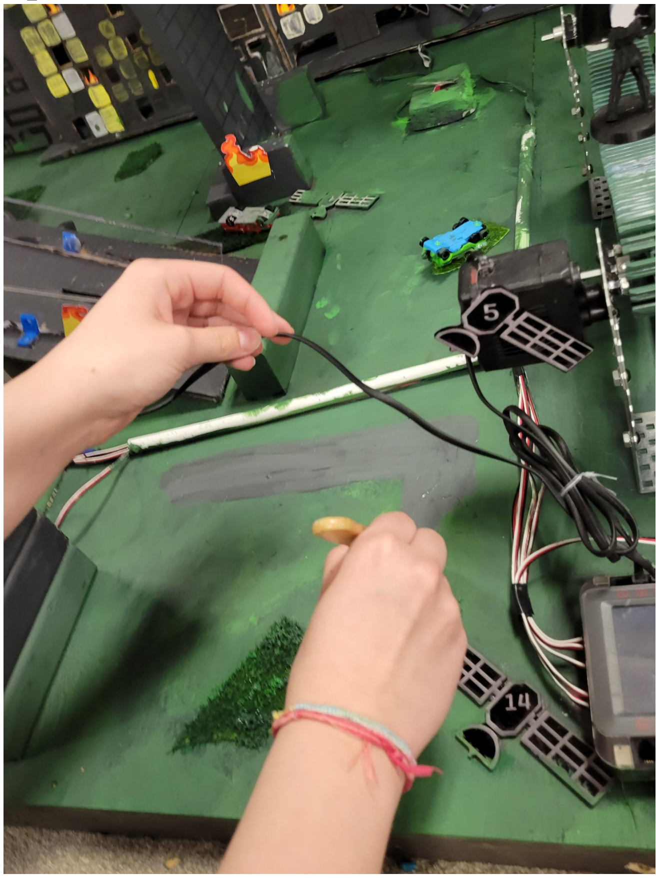


February:

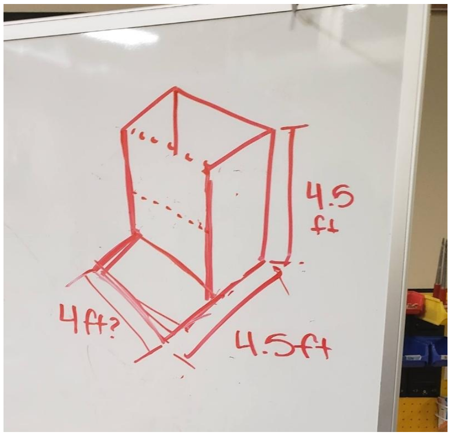
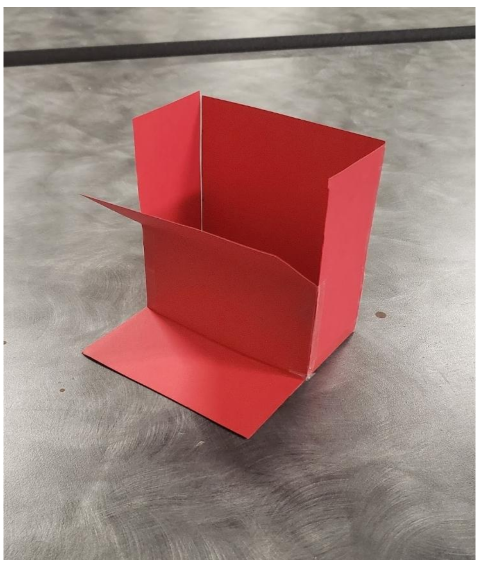
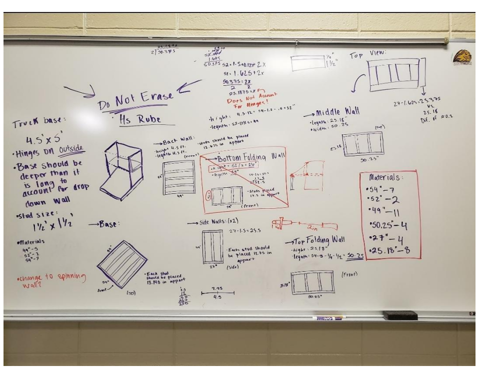
March:

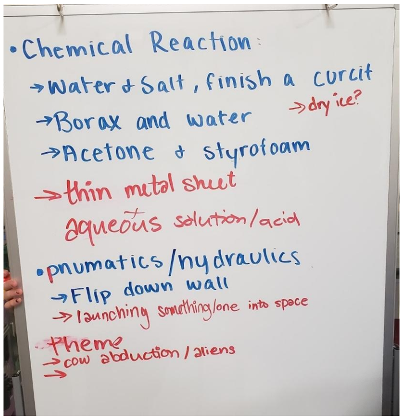


April:

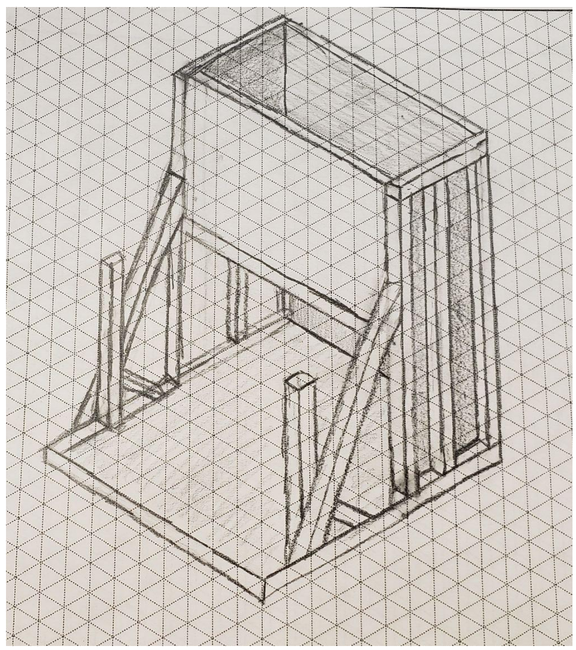


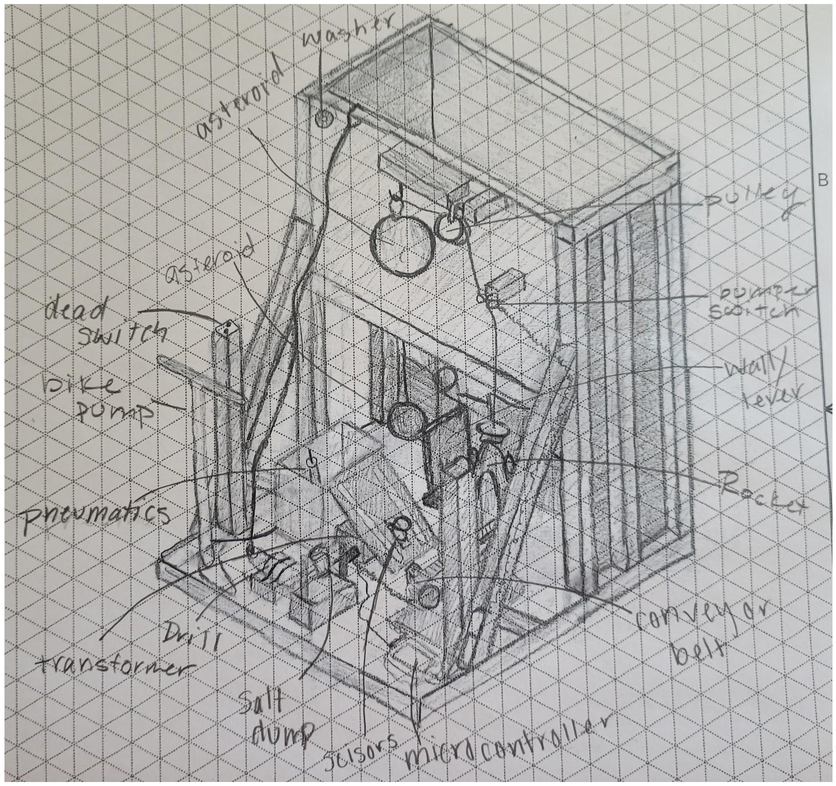
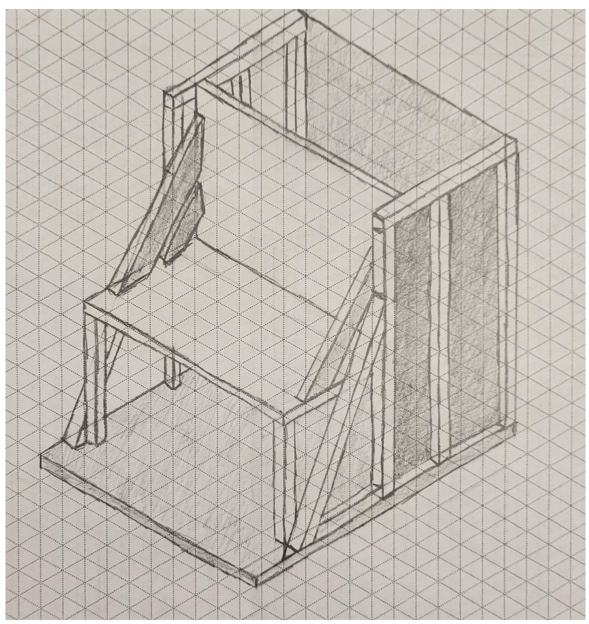
Planned Machine Design Sketch and Description

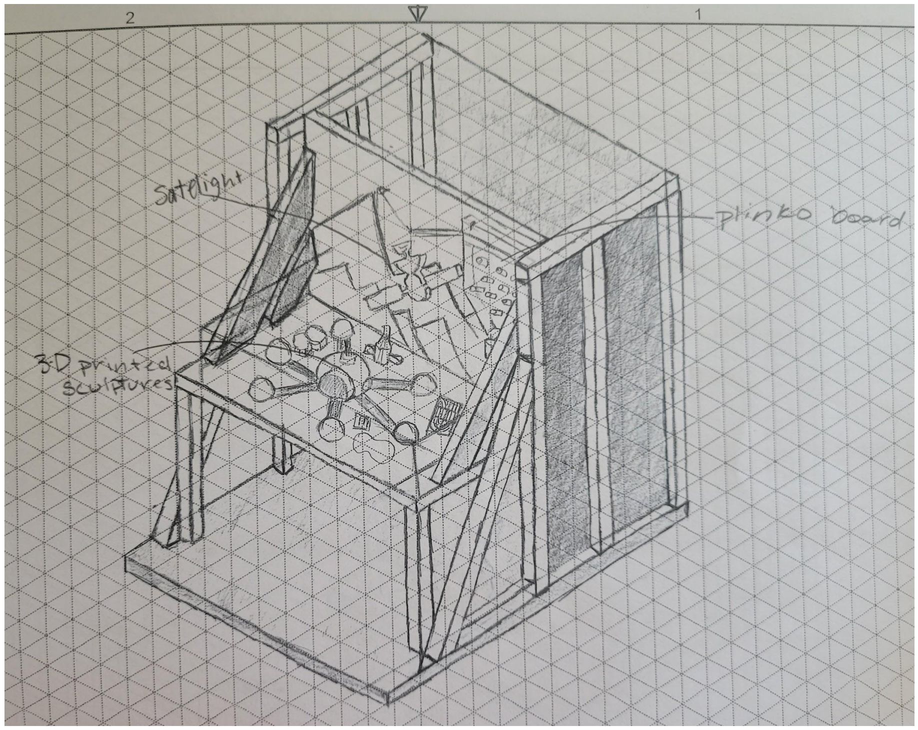
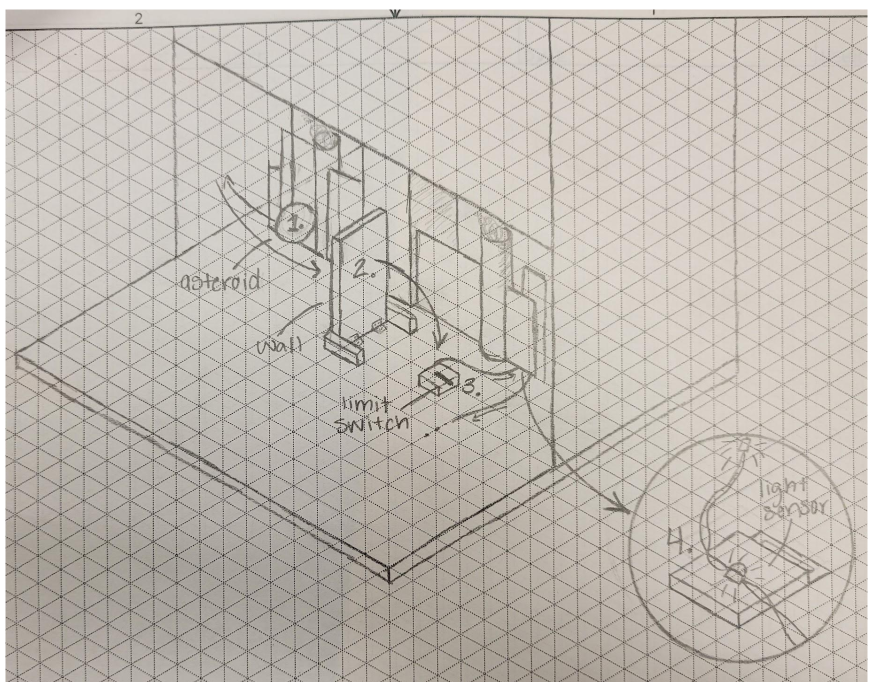
	The first part of our machine that we designed was the base. We brainstormed ideas to make our machine stand out and look different than other teams. We decided that we wanted to have a wall that flips revealing a whole other section of our machine.
	After we decided what we wanted our machine to look like and the effects of it we created a model of what we wanted the base to look like and function. This allowed our whole team to be on the same page with how our machine functions and looks.
	We then started to create official measurements for the base so we could start cutting wood and building the base. We took the design requirements into mind when deciding the size of our machine. We decided to make the dimensions slightly smaller than the maximum size so that we had some room to expand outside our machine.

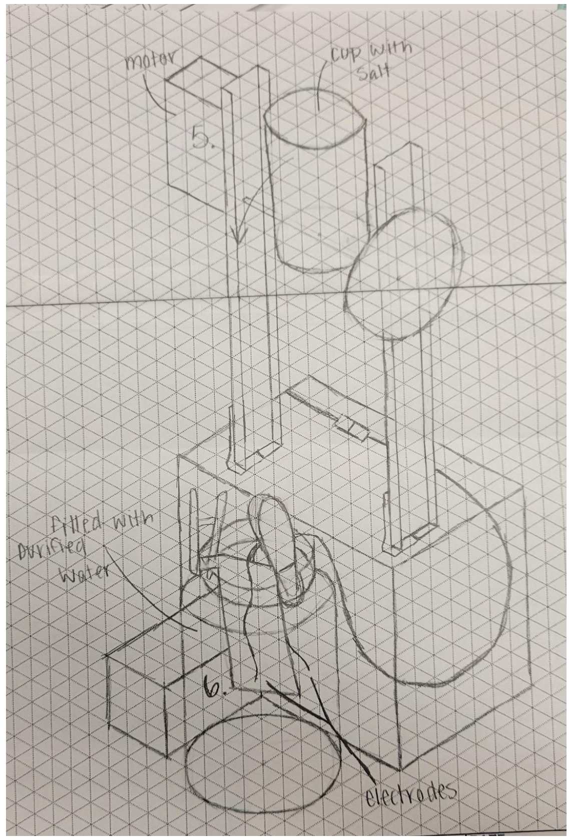
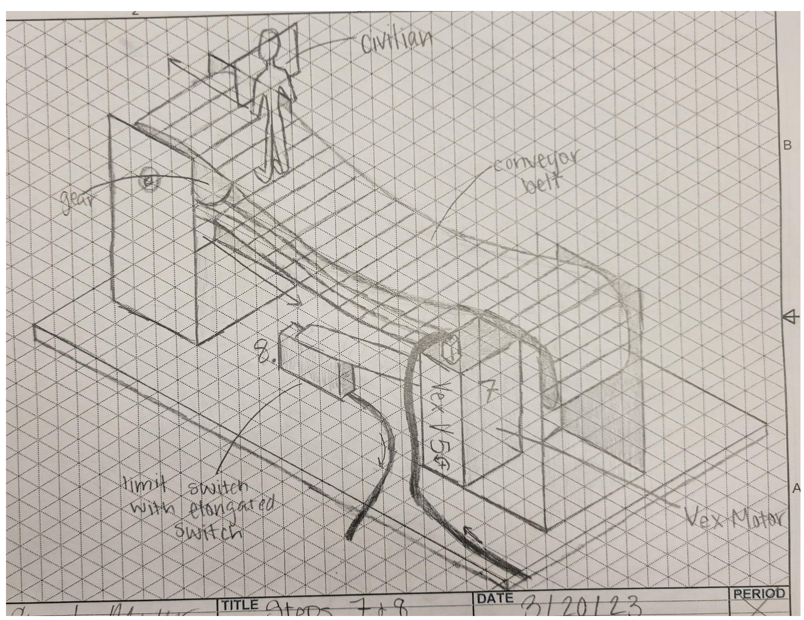
	After we designed the base we started to brainstorm ideas for our chemical reaction. We came up with the idea of combining purified water and uniodized salt to finish a circuit, mixing together borax and water to create a gelatine-like sludge, decomposition of styrofoam by acetone, and acid corrosion of metal. Of these reactions, we decided on the combination of salt and water, because it was the hardest chemical reaction to lead to another step. We also didn't want our machine to end with the chemical reaction step, because chemical reactions are meant to have a lasting effect on the machine, and not be a one-and-done thing.
Rotation Design Challenges	A large section rotating causes many design challenges since we had to find a way to rotate the wall without it causing our whole machine to shake and set off the rest of our steps. We initially attached a wooden dowel to a drill and then wrapped a sting which was attached to the top of the wall around the dowel. We found that the weight of the wall was too heavy for the wooden dowel which caused the dowel to snap in half when the drill was turned on. We then brainstormed some more ideas and decided that instead of using the wooden dowel we would just use a drill bit since it is much stronger than the wood. When the drill is turned on the string wraps around the drillbit which then pulls the wall down.

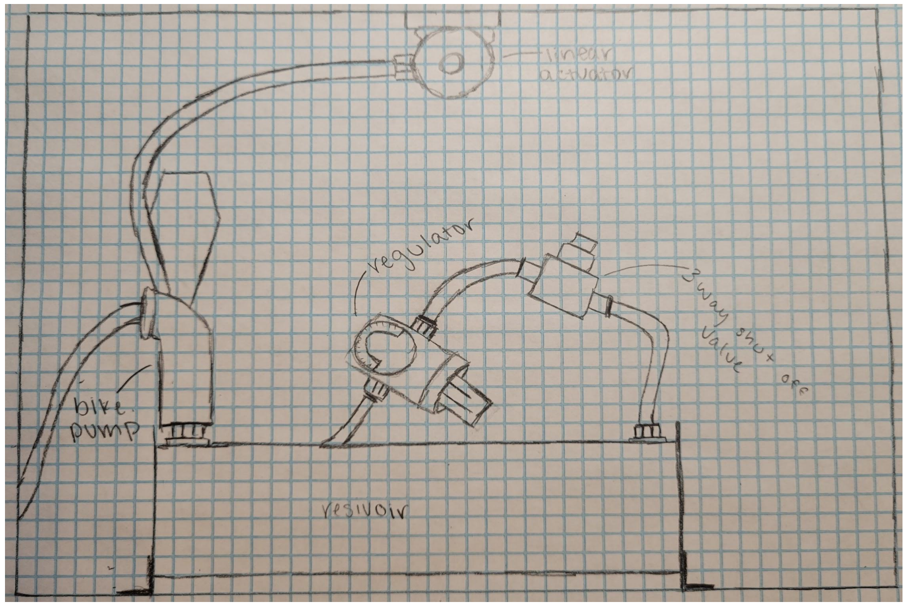
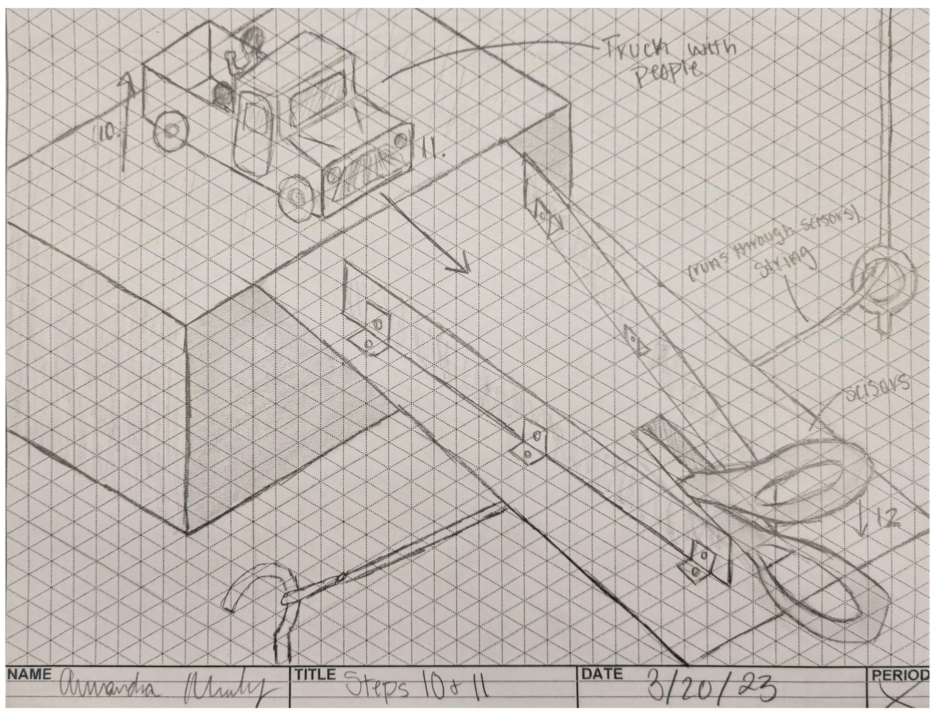
Final Machine Design

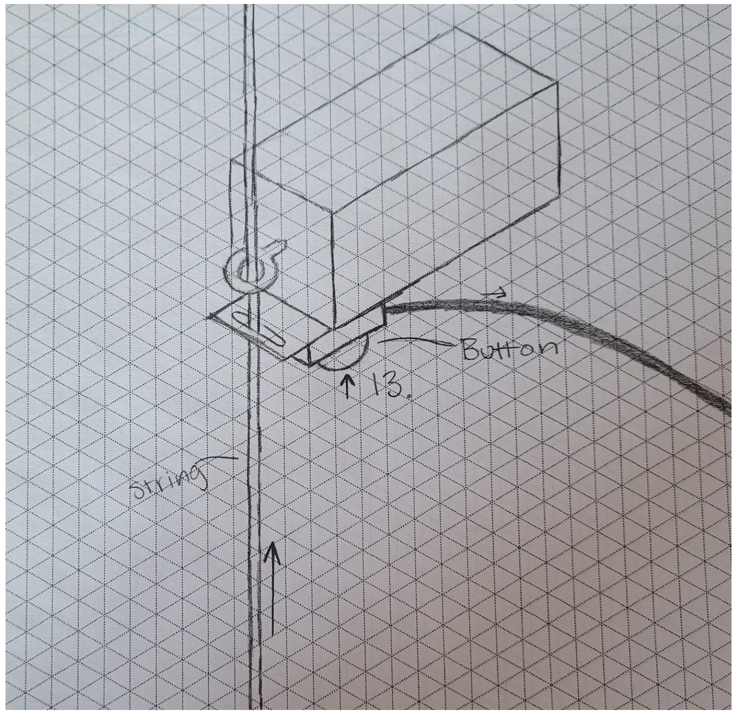
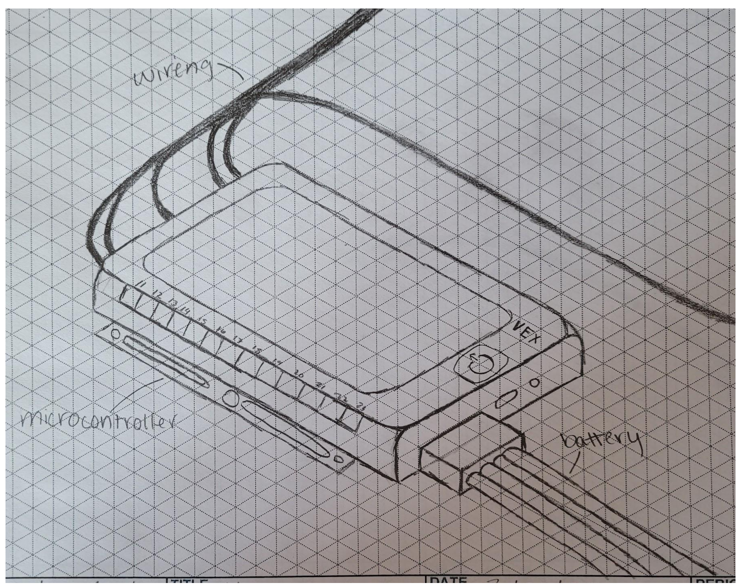
Theme and design goals	The theme of this build was built around the concept of 'Into Orbit'. Before creating a storyline, the team knew that we wanted a turning wall implemented into the base. As a team, we came together and brainstormed the following storyline. Earth is dying and will not be stable for human survival after an asteroid hits. After mixing enough 'hydrazine' (which is a chemical reaction between salt and water), people fill the rocket ship with supplies. Then a truck transports people to the rocketship for space travel. The rocket ship launches and travels to a foreign planet.
Base with (wall up)	

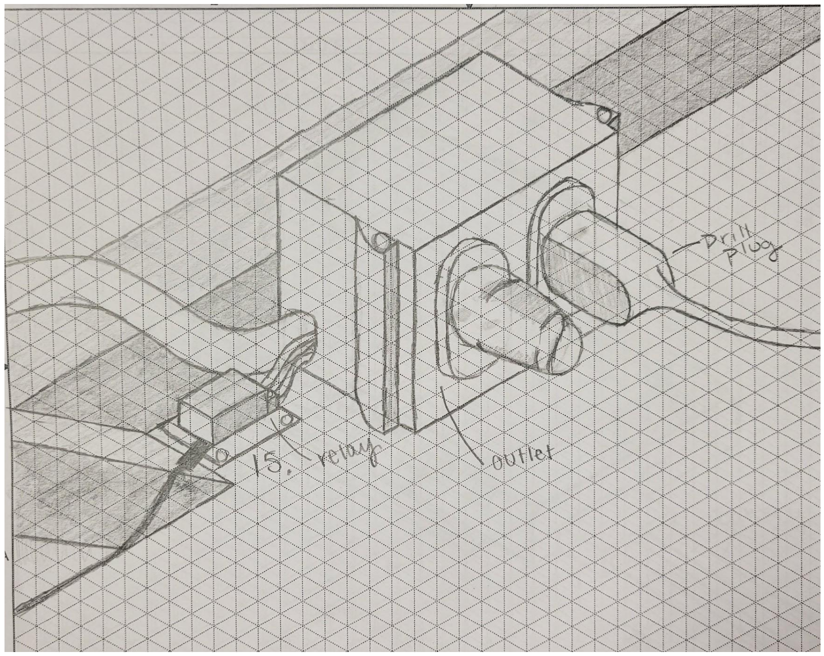
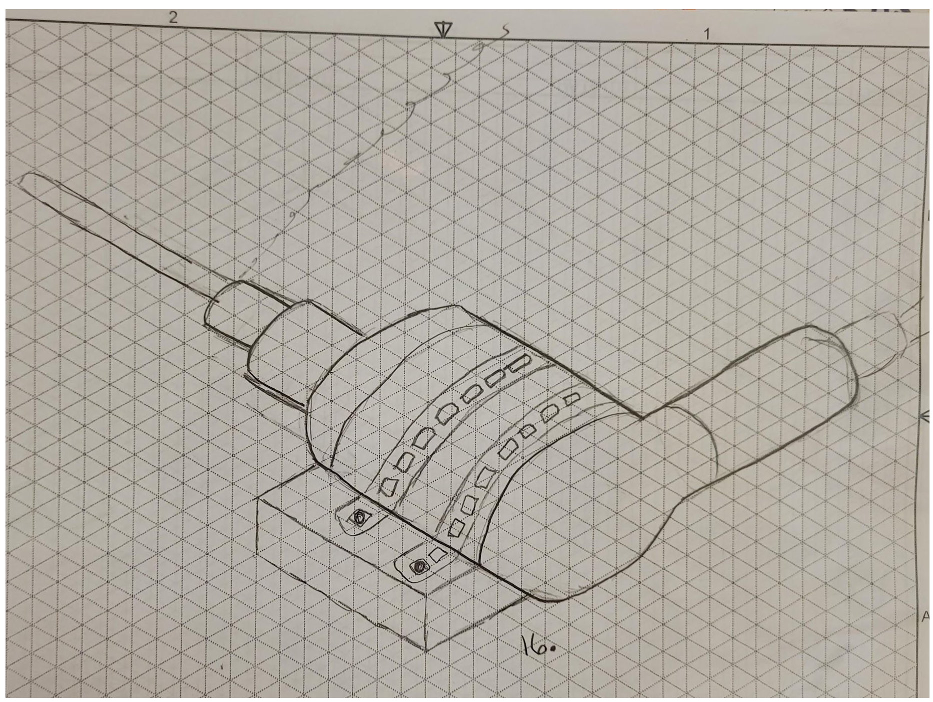
<table>
<tr><td>Base with steps
(Wall up)</td><td>
</td></tr>
<tr><td>Base (Wall down)</td><td></td></tr>
</table>

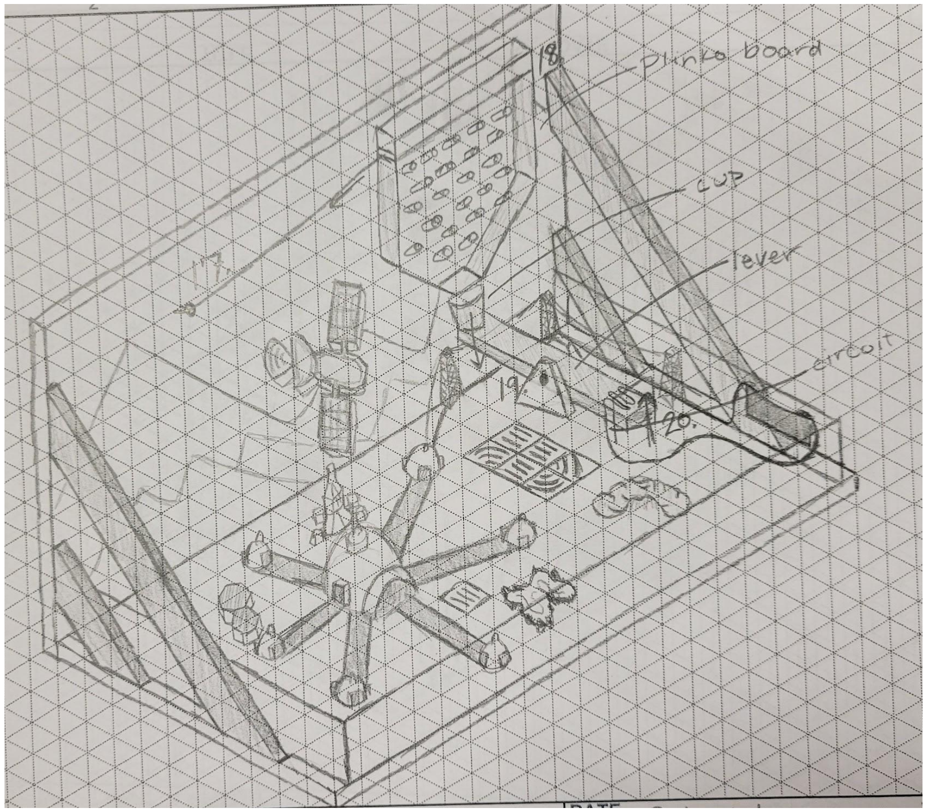
<table>
<tr>
<td>Base with steps
(Wall down)</td>
<td>
</td>
</tr>
<tr>
<td>Steps 1-4</td>
<td>
</td>
</tr>
</table>

Steps 5-6	
Steps 7-8	

<table>
<tr>
<td>Step 9 (top view)</td>
<td>
</td>
</tr>
<tr>
<td>Steps 10-12</td>
<td>
</td>
</tr>
</table>

Step 13	
Step 14	

Step 15	
Steps 16 (drill)	

<table>
<tr>
<td>Steps 17-20</td>
<td>
</td>
</tr>
</table>

Written Description:

As a team, we defined into orbit as repeating circular motion that an object takes another object of considerable mass. Anything you encounter in the universe is in orbit around something. It is generally not found near the surface of the earth because of the gravitational field, but as an object gradually gets further away from the surface of an object, it floats because it is further away from the gravitational field. For an object to be in orbit, it must be following a circular motion around a heavy object. Earth, for example, is in orbit around the sun and is moving at a velocity of 460 meters per second. The speed, or velocity, at which a planet moves around a mass is determined by the big G gravitational constant, the planet's mass, and the distance away from the point at which it orbits. Any celestial object in the entire universe is in orbit around a heavy object, whether it be a star or a black hole. Solar systems and even galaxies are in orbit around a large sum of mass.

Seen as any planet in the universe is in orbit, the team decided that moving to the planet would fit the theme. In the design of our machine, the chain reaction starts with an elastic collision between an asteroid and a wall on a hinge. The wall will fall over onto a limit switch, turning on a strip light. Once the lights turn on, a light sensor will sense the change and send a signal to the microcontroller to dump about eight grams of salt into a glass jar filled with purified water. There are two electrodes hanging in the purified water, so when the salt mixes with the water in a chemical reaction, an electrical bridge forms. The salt water reaction will complete a circuit sending a signal back to the microcontroller. Once the microcontroller senses the signal, the microcontroller starts a conveyor belt with a figurine attached. The figurine travels along the conveyor belt and hits a limit switch. The limit switch activates a pneumatic system, which creates an inclined plane with plexiglass. The truck positioned on the plexiglass rolls down a ramp rolling into a pair of scissors that cut a string. The string is wrapped around an eye hook and the other end is attached to an asteroid, so when the string is cut, the asteroid. When the asteroid falls, it brings a rocket up because the asteroid is attached via a string to the rocket. The string is wrapped around a pulley. The rocket hits a bumper switch and starts to run a drill. The drill is connected to a string that will pull down the wall. When the wall is pulled down, the machine will pull out a board that releases marbles into the plinko board. The marbles are funneled into a cup on a lever. Once the lever is activated, the lever will complete a circuit, lighting up a space city and satellite.

List of Machine Steps

1. Asteroid swings in knocking brick wall
2. Brick wall falls onto limit switch
3. Limit switch turns on city lights (electrical component)
4. Lights activate the light sensor
5. Light sensor activates motor dumping salt into the purified water (chemical component)
6. Water mixes with the salt creating a chemical reaction and finishing an electrical circuit
7. Electrical circuit activates the conveyor belt with a civilian on it
8. The civilian rides conveyor belt activating a limit switch
9. Limit switch triggers a pneumatic system (Pneumatic/hydraulic component)
10. A pneumatic piston lifts one side of a panel creating an inclined plane (mechanical component - inclined plane)
11. Car rolls down the inclined plane closing scissors (mechanical component - wheel and axle)
12. Scissors cut a string causing asteroid to fall and a rocket to launch(mechanical component - pulley and wedge)
13. Rocket activates a push button
14. Push button activates microcontroller (electrical component)
15. Microcontroller activates relay code
16. Relay and microcontroller code activates drill pulling the wall down
17. Wall turn pulls out a board from the plinko board
18. Board releases marbles into a cup
19. Cup presses down a lever
20. Lever completes a circuit that lights up the new planet (electrical component)

Cost of Machine and Percent of Recycled Materials Used

Orange = Bought	Green = Recycled	Purple = Category	Grey = Totals
3D Prints:	**Vex:**	**General:**	**Other:**
Circular House (7)	Axle	Wood	LEDs $8
Big Circular House	Wheel	Cardboard	Power Tool
Spaceship	Wiring	Paint	Blue Rocks $5
Thrusters (2)	Screw	Tape	Scissor
Alien House Tall	Servo	String	Toy car
Alien House Short	Green Belt Pieces	Rope	Weights Plates
Garden 1	Motor	Fiberglass $3	Sand
Garden 2 (3)	Limit switch	Hot glue	Clouds
Garden 3 (3)	Button	Screws	Smart Outlet
Rock Formation	Brain	Glitter	Glossy Varnish $12
Human Figure	Battery	Marbles	Acrylic Paint: $30
Rocket Ship (2)	**Pneumatics:**	Model Clay	Pulley Wheel
Pillar (3)	Reservoir	plastic Cup	Ball bearings
Water 1	Regulator	Glass bottle	Copper Wire
Water 2	three way shut off valve	Washer	Rubber Bands
Mini asteroid	Solenoid	Turf (4)	Chip clip
	linear actuator		5V Relay $5

<u>Totals and Costs</u>

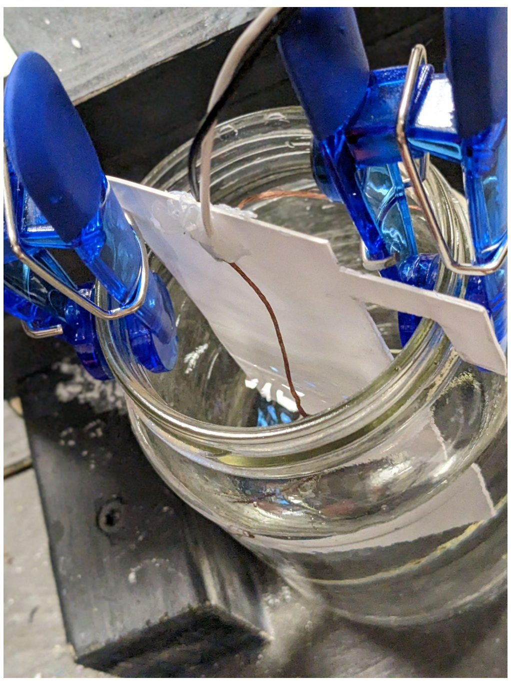
Total Grams of Filament: 500	Filament cost: $0.06 per gram	Bought %: 45%	Recycled %: 55%
Total bought: 36	Total recycled: 44	3d print cost: $30	Total cost: $85

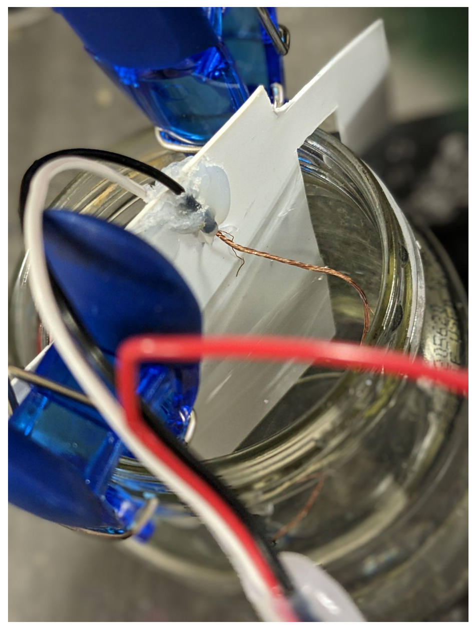
Applied STEM Processes

Chemical Reaction Component

Our chemical reaction step is an ionization process used to activate a relay. Salt dumps into a jar of water that has two wires in the jar. When the salt is mixed with water an electrical circuit is completed sending a signal to a microcontroller to activate a relay. The relay activates a drill.

When salt is mixed with water, the salt dissolves and dissociates into its constituent ions: positively charged sodium ions **(Na+)** and negatively charged chloride ions **(Cl-)**. This process is called ionization or dissociation. The complete chemical reaction is as follows:





$$\mathbf{NaCl + H_2O = NaHO + H_2O + Cl_2}$$

The water molecules surrounding the salt crystals interact with the ions, and the positively charged ends of the water molecules **(hydrogen atoms)** are attracted to the negatively charged chloride ions, while the negatively charged ends of the water molecules **(oxygen atoms)** are attracted to the positively charged sodium ions. These interactions result in the separation of the ions from each other and the formation of a homogeneous solution.

The dissolved ions in the saltwater solution are able to conduct electricity because they can move freely through the solution. When a voltage is applied across the solution, the sodium and chloride ions migrate to the electrodes with opposite charges, and the resulting movement of charged particles creates an electric current.

The chemical reaction of salt mixing with water involves the dissociation of salt crystals into positively charged sodium ions and negatively charged chloride ions, which interact with water molecules to form a conductive solution. The movement of these ions in the solution creates an electric current when a voltage is applied. This process can be thought of as the ions are creating a bridge between the positive and negative terminals.

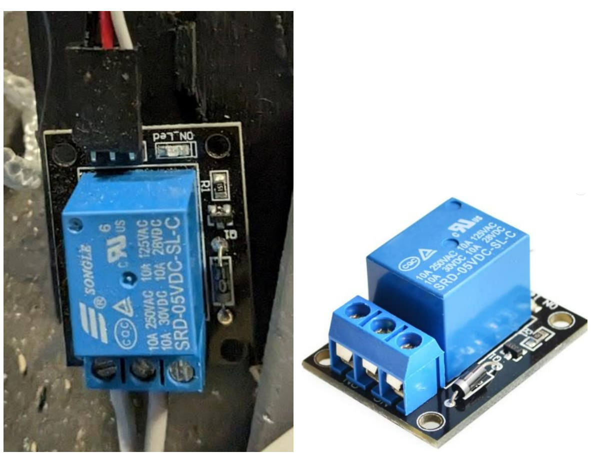
Electrical Components

Throughout the machine we integrated electrical components. Some of the components are electrical circuits and some of them are programmed using a microcontroller. One of the steps uses a relay to start an electric drill. A relay works by using a smaller electrical signal to control a larger one, allowing it to switch on and off a circuit remotely. A relay is an electrical switch that is controlled by an electromagnet. It is used to turn on and off a circuit remotely by using a smaller electrical signal to control a larger one.

A relay consists of three parts: a coil, a switch, and a contact. The coil is made of copper wire wrapped around an iron core. When an electrical current flows through the coil, it creates a magnetic field that pulls the switch toward it.

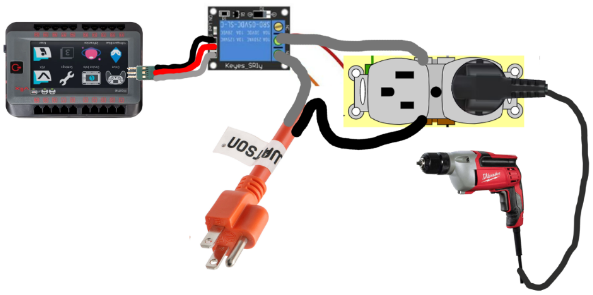
The switch is normally open, which means that it is not making a connection. When the magnetic field from the coil pulls the switch toward it, it closes the contact and completes the circuit. This allows the current to flow through the circuit and power a device or perform a specific function.

Relays are commonly used in many electronic devices such as cars, refrigerators, and air conditioners. They are also used in industrial settings for controlling motors and other heavy equipment.



Picture of relay

```
wall = 0
citylights = 0
pneuma = 0

def CityLights():
    global wall, citylights, pneuma
    while not Citylights.brightness() > 55:
        wait(5, MSEC)

def Saltmotor():
    global wall, citylights, pneuma
    SaltCup.set_velocity(10, PERCENT)
    SaltCup.spin_for(FORWARD, 600, DEGREES, wait=True)
    SaltCup.stop()

def Saltreaction():
    global wall, citylights, pneuma
    while not not saltwater.value() != 0:
        wait(5, MSEC)

def Convey():
    global wall, citylights, pneuma
    Conva.spin(FORWARD, 3.0, VOLT)
    wait(8, SECONDS)
    Conva.stop()
```

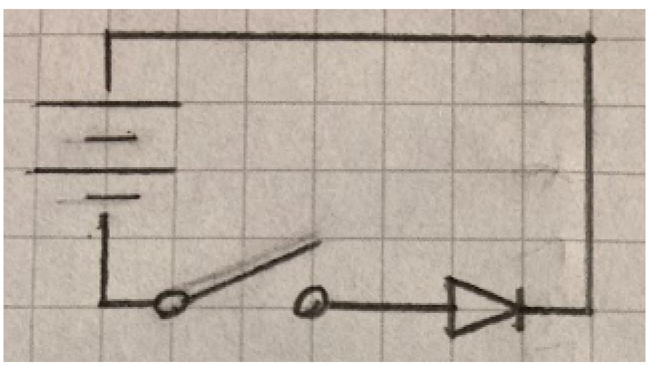


Picture of wiring the relay

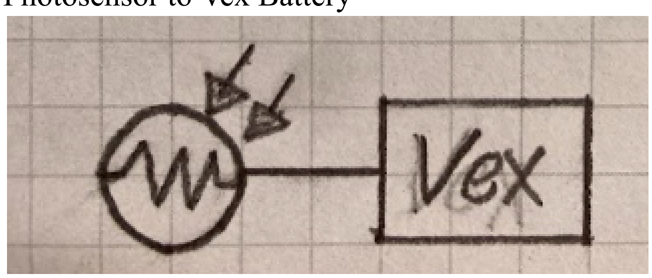
```
def wall2():
    global wall, citylights, pneuma
    while not Drilllimit.pressing():
        wait(5, MSEC)
    while wallstop.value() != 0:
        Drill.set(True)
        wait(0.2, SECONDS)
        Drill.set(False)
        wait(2, SECONDS)
        wait(5, MSEC)

def when_started1():
    global wall, citylights, pneuma
    wait(2, SECONDS)
    CityLights()
    Saltmotor()
    Saltreaction()
    Convey()
    wall2()

when_started1()
```

Python Code for the microcontroller (full machine)

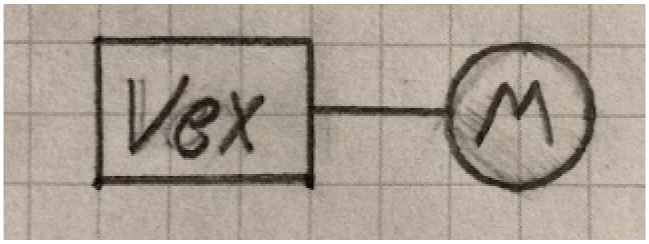
Lever causes LEDs to turn on, battery part of system



Photosensor to Vex Battery



Vex Battery to Cup Motor



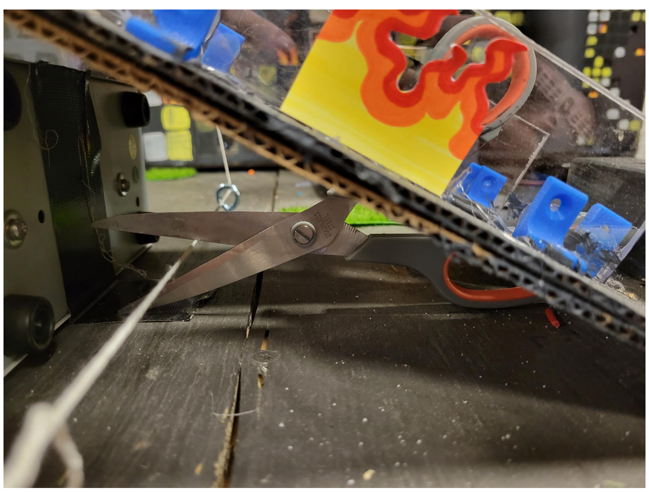
Mechanical Components

Throughout our machine we were able to take advantage of all six simple machines lever, wheel and axle, wedge, screw, pulley, and inclined plane. Throughout the next couple of pages, there is an explanation of each machine. Understanding how these simple machines work can help us design and build more complex machines, and make our work easier and more efficient.

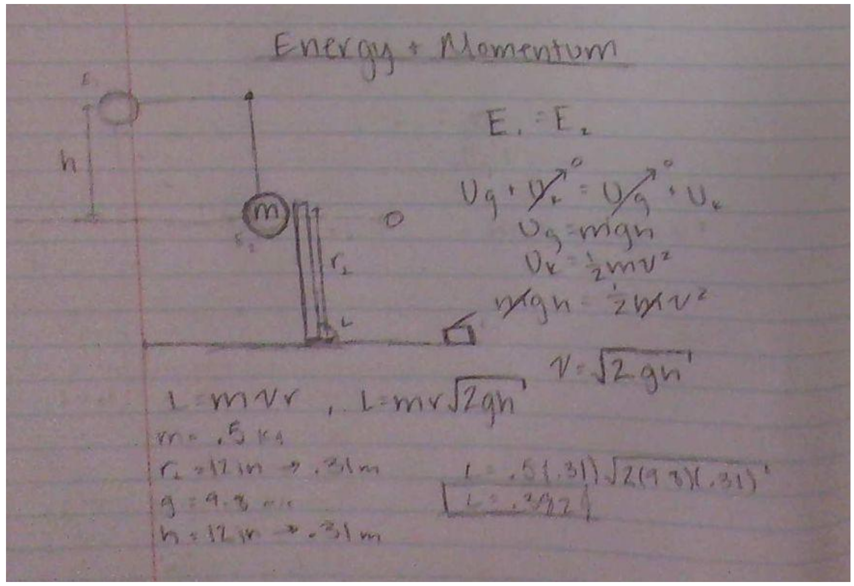
Lever

During step 12 we use a pair of scissors to cut a string. A pair of scissors is an everyday tool that is commonly used to cut various materials. Interestingly, a pair of scissors is an example of a lever. Specifically, the blades of the scissors act as levers, with the pivot point at the area where the two blades are joined, otherwise known as the fulcrum. When the handles of the scissors are squeezed together, the force applied to one blade is transmitted to the other, causing the blades to cut through the material. The longer blade of the scissors acts as the lever arm, while the shorter blade acts as the load arm. By applying force to the lever arm, the load on the load arm is increased, making it easier to cut through the material. This simple yet effective design makes a pair of scissors a highly efficient cutting tool.

We also use a lever in step 20 to activate the light. The lever in step 20 is a class one lever. The marbles fall into a cup on the one effort side causing a downward force. Then with the fulcrum placed in the middle, it changes the load to an upward force. The load side of the level is used to activate the ending circuit.




Step 2 of the machine is a third class lever. It is a third class lever because the pivot point, or fulcrum, is on the (bottom) edge of the board. Load is applied to the (top) other end of the board to get the lever to turn. The momentum from step one is conserved so the lever will fall over. Below is an extended free body diagram as well as energy and momentum calculations.

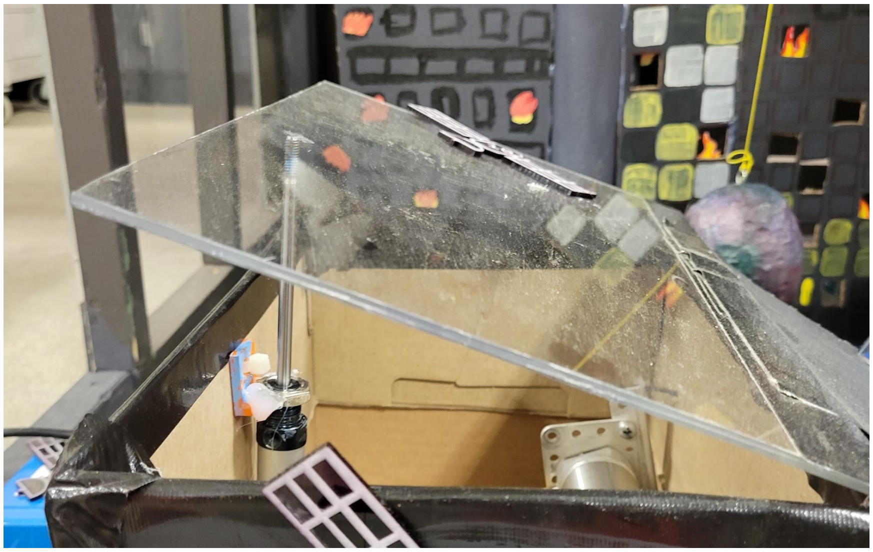


Wheel and Axle

During step 11 we have a car roll down a ramp. A car rolling down a ramp is an example of a wheel and axle because it involves two simple machines that work together. The wheels on the car are attached to an axle, which is a rod that runs through the center of the wheels. This allows the car to roll down the slope of the ramp while the axle remains stationary. The wheel and axle combination reduces friction and makes it easier for the car to move, as the rotation of the wheels around the stationary axle requires less force to move the car forward.

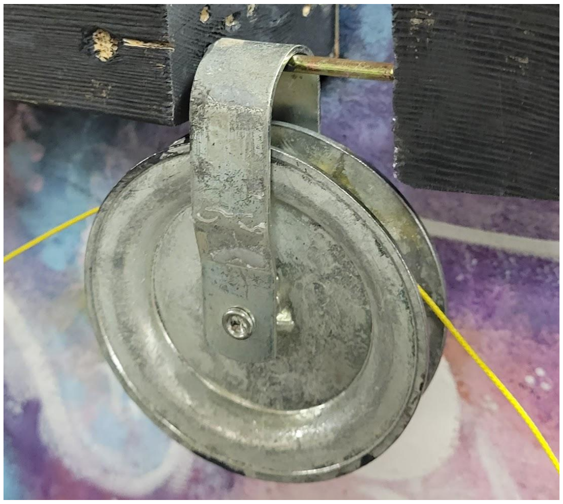
Inclined Plane

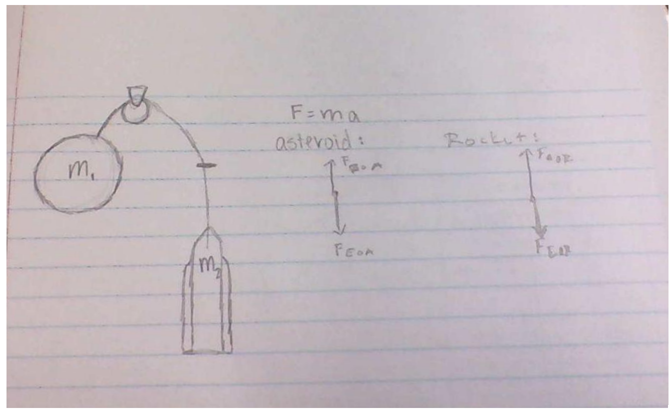
During step 11 the pneumatic system creates an inclined plane. Lifting a panel involves changing its position from a horizontal plane to an angled one. The angled surface formed as a result is an inclined plane that can be used to move objects with less effort. The steeper the angle of the inclined plane, the greater the mechanical advantage gained when moving objects. The use of an inclined plane is based on the principle that a longer distance over which a force is applied requires less force.



Pulley

During step 12 we use a stationary pulley to launch a rocket into a push button. A stationary pulley consists of a grooved wheel mounted on a fixed axle, with a rope or belt looped around it. When a force is applied to one end of the rope, the pulley rotates on its axle and changes the direction of the force. Newton's third law is shown in the free body diagrams.





Wedge

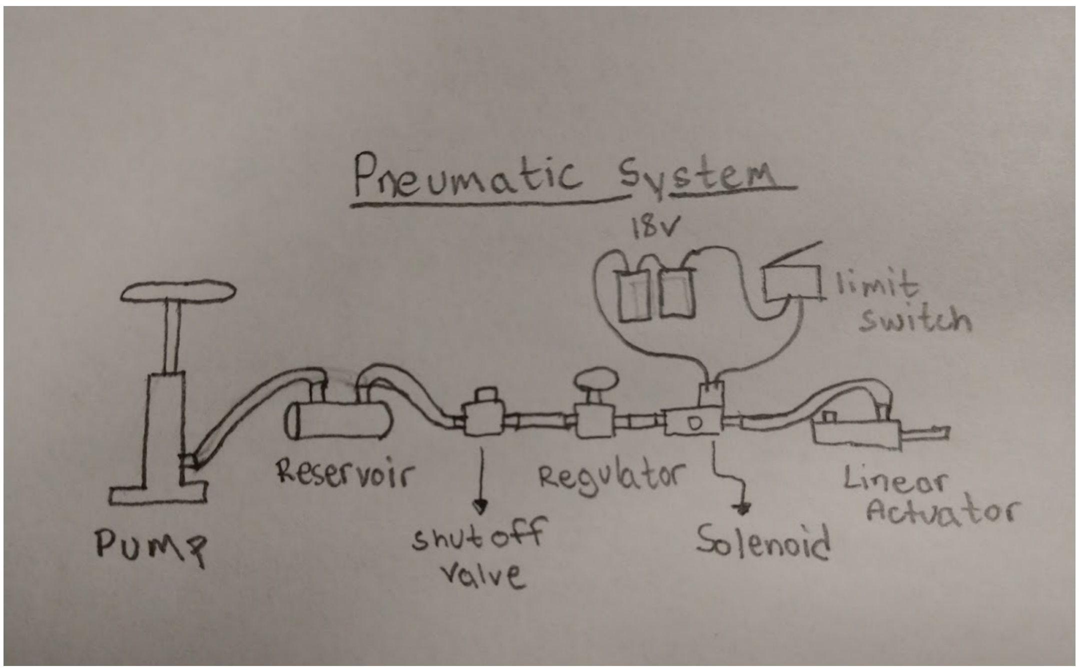
The same scissors in step 12 also act as a wedge. The blades of the scissors are designed to come together at a sharp point, which creates a wedge shape. This wedge shape is what allows the blades of the scissors to cut through the material. When the blades are forced together, the sharp point of the wedge-shaped blades concentrates the force onto a small area of the material being cut, making it easier to sever the material. This design also helps to prevent the material from slipping or moving as it is being cut, allowing for greater precision and control. Overall, the combination of lever and wedge principles in the design of a pair of scissors makes it a highly effective and versatile cutting tool.

Screw

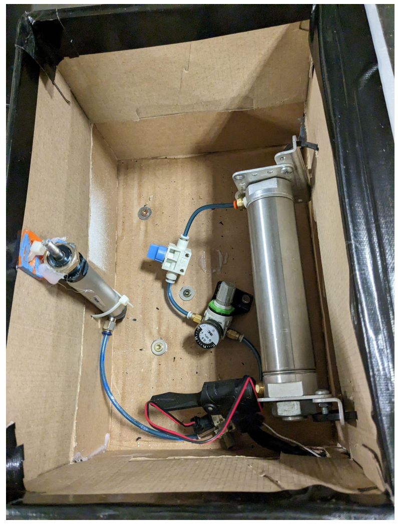
Throughout our machine we used screws and bolts to hold components together. We needed to select the correct size thread pitch and diameter screw for the application we needed to hold together. Screws are simple machines used to hold parts together in a machine. They work by using threads to wind around the shaft of the screw. When turned, screws move through the threads and pull two objects together, holding them in place. They provide a mechanical advantage by making it easier to apply force and pressure on the objects being held together. This advantage is determined by the pitch and diameter of the screw.

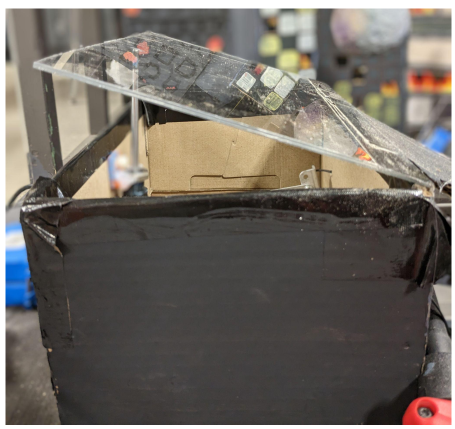
Fluid Power Components

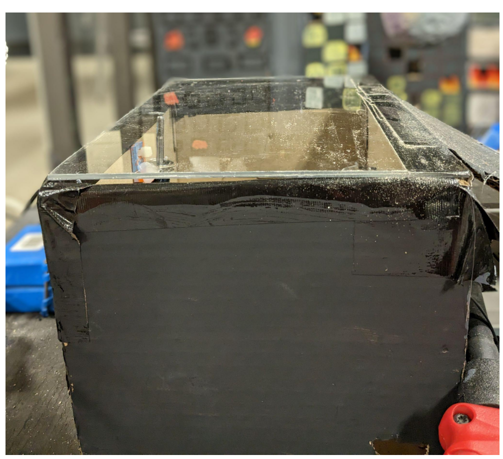
Our fluid power part uses **pneumatics**. Our pneumatics design uses a reservoir, regulator, three way shut off valve, solenoid, and a linear actuator. The reservoir stores the potential energy as compressed air, the shut-off valve isolates the stored compressed air, the regulator maintains the pressure, the solenoid electronically controls the airflow and the actuator converts the compressed air to mechanical energy. This is different from the syringe fluid power because it uses a gas (air) instead of water or fluid. We used fluid power to transition from an electrical step to a mechanical power step. The linear actuator lifts a ramp to let the car collide with the scissors.



Pictures of Pneumatics System







Reflection

This project was a challenge that our team had to overcome. We learned several valuable skills from this, including teamwork, time management, and distribution of resources. These lessons, along with the complications we had along the way are what led us through this project. Every day was a new problem and our goal was to find a solution. This process really made us think about what we wanted success to look like and helped us understand what we needed to do to get the job done.

When this project began, we struggled to work together as a team. We were unable to create a plan that everyone liked, and we kept shooting down other team members' ideas. In addition, some team members just sat around during work times. But as we began to make progress and put effort into the project, we collaborated on ideas and became a functioning, well-oiled machine of a team. Eventually, work got done much quicker and the machine was done before we knew it. I feel the team developed best from working during times outside of the normal school day because we have more time to interact and take breaks while working on the project. We felt more of a connection and more like a team.

One major challenge we had while working was creating an effective and fun way of turning the wall. We decided on a drill. To make this work, we created a program from scratch. This step was important to make our project work. It involves hitting a limit switch which activates the code, making the drill spin a specified amount so that it can bring down the wall using the rope that attaches the two. Making this work required a lot of trial and error, and we had to designate team members to make the code so that it could work properly. This was a very time-consuming process that could have amounted to nothing if we did not have members who were skilled in the field of coding. We also struggled to figure out how to stabilize the drill on the base of our project. At first, we tried cutting blocks of wood into a shape that would secure the drill, and prevent it from moving. Unfortunately, the wood was unable to handle the power of the drill and cracked many times, rendering the wood useless. These wood blocks took very careful measurements and meticulous cutting, so we opted for another material to hold down the drill. We found that steel VEX brackets effectively constrained the drill without any damage occurring. Finally, we were able to make this step work, while having minimal issues with the rope getting caught on the drill when it turned.

Another challenge we had in the building process was getting the rocket ship to work. Before even adding it to the machine to work it into one of the steps it fell apart. The bulk of it was made using multiple 3D prints which were put together into four main parts. These parts, however, did not stay together and broke multiple times. The adhesive that we used was epoxy.

Because we used 2 part epoxy, which must be mixed and applied quickly before it hardens, we had very little time for each attempt to put them together, at very specific parts of the prints. After a few tries, we were able to finally get the rocket to fit together correctly, and it remained as one. Once this was done, we added it to the project and ran into our next problem, making it function in a way that would proceed to the next step. The rocket was supposed to be lifted from the base until it hit a bumper switch, activating another step and continuing the process. We had planned to do this with a motor from our Vex supplies and a pulley system, but upon creating the contraption in this way, we discovered that the motor was not strong enough to lift the rocket ship. In retrospect, we should have tested this from the start, before implementing it into the machine. Because it did not work we had to rework the step and decided to instead have a weight disguised as a planet falling to the base. This counterweight was used with the pulley system to pull the rocket up toward the bumper switch. The mass of the weight was more than sufficient and the issue was fixed.

One instance of success during the creation of our machine was when we found an easy solution to a small problem that had occurred in our steps. When the wall falls, the next step is supposed to be for marbles to fall down the plinko board since it will now be vertical. The problem was that the marbles were moving around before the wall fell, breaking the contraption. Our solution was to slide a thin piece of wood near the top of the plinko board, which would keep the marbles from moving too early. Once the wall moved, a string attached to the piece of wood would cause it to slide out of the plinko board, allowing the marbles to fall. This solution was achieved easily and took very little time to fix a part of the system that kept the entire process from working. This was just one moment of many during the project when we were able to fix a problem quickly and efficiently.

While working on this project we learned a great many things. Since our machine included a pneumatic system we had to make use of various outside resources in order to figure out how to make it work and understand exactly what we were doing. We also had a chemical reaction that we had to study so that we knew the amounts of materials needed to correctly complete the chemical reaction. Coding was a challenge at first because only a few of our team members understood how to do it, but eventually, they were able to work it out and the steps requiring code functioned properly. An important part of this project was managing the money we had to spend on materials, as going over would be a problem. We had to find uses for recycled materials and carefully decide where to designate our money. As we grew as a team, we began to manage time better and make more progress during work sessions. The things we learned from this project will surely help us all in the future.

This project has made me realize just how much I enjoy engineering. Before joining this team I was not sure what I wanted to do after high school. I became a part of this team when my friend recommended I try it out. At the start, I struggled to help out and be an effective teammate, but eventually, I found that I enjoyed building and using engineering processes to create an idea that is shared by a whole team. There were a lot of challenges we had to overcome, and I had to work hard, but I was able to create connections and have fun in a way that I never would have in any other way. Now that we have finished the project I have realized that I want to pursue engineering as a career. I love that there are barely any restrictions in engineering, I can hit each problem differently. Because of this project, I am looking forward to taking engineering-based classes next year that can further my understanding of the field. After I graduate, I hope to be able to go to a technical college so that I can get a degree in mechanical engineering so that I am able to pursue this dream of mine for the rest of my life.

Overall, our participation together on this team has been an important experience that I am sure we all enjoyed. The excitement of months of effort culminating into a single day where we can present what we have poured our hearts and souls into. I am confident that if we were to do it again, our project would be even greater. Each of us contributed a different portion of our skill to part of the project and that was the reason we were able to make our project as great as it is. Teamwork is an amazing thing–it allows people to come together and complete things they could never dream of doing alone. Every issue we had was solved by multiple people, and far more creative solutions were used than if a single person had worked through it alone. Our team has completed this project, an accomplishment I am sure we are all proud of. Though we may go our separate ways from here, I believe that we will all find happiness wherever we might end up in life, and we will share the connection forever, of once being a single, great, team.

Resources & Citations

Britannica, The Editors of Encyclopaedia. "hydrolysis." Encyclopedia Britannica, 25 Mar. 2023, https://www.britannica.com/science/hydrolysis. Accessed 4 April 2023.

David, Isaiah. "Why Salt in Water Can Conduct Electricity" sciencing.com, https://sciencing.com/salt-water-can-conduct-electricity-5245694.html. 21 March 2023.

Firkin. "Space pattern 3." 5 Jan. 2016. *OpenClipArt*. Accessed 21 Mar. 2023.

National Geographic. "Orbit." *National Geographic Education*, National Geographic, education.nationalgeographic.org/resource/orbit/. Accessed 21 Mar. 2023.

Parker Pneumatic. "Gas Laws." *Parker*, Parker Hannifin, Nov. 1998, www.parker.com/static_content/parkerimages/pneumatic/serv/TEC-14.pdf. Accessed 21 Mar. 2023.

USGS. U.S. Department of the Interior, www.usgs.gov/media/images/water-molecules-and-their-interaction-salt. Accessed 21 Mar. 2023.

"What is Pneumatics?" *Norgren*, 9 Oct. 2019, www.norgren.com/en/support/blog/what-is-pneumatics#:~:text=Pneumatics%20makes%20use%20of%20an,the%20end%20of%20the%20process. Accessed 21 Mar. 2023.