

Engineering Machine Design Contest 2024 Journal

Space Ducks

Wildlands School

Coach: Andrew Johnson

Team Members :

Danica Strauss, Aryanna Bergerson, Daniel Madsen, Samantha Hanson,
Elijah Gundry

Materials

Cost Of Machine - 25.81\$

91.75% of our machine was recycled

Item	Cost	Item	Cost
Screws, bolts, nails, washers, nuts, eyelets	Free	Fish tank gravel vacuum	Free
Wood - 2x4, 1x4, 1x6, furring strips, plywood	Free	Drill, drill bits, drill drivers, "2" hole drill	Free
Pulleys	Free	Zip ties, duck tape	Free
PVC straight pipe, t-pipe	Free	Zip strip, extension cord	Free
Peg board	Free	Dominoes	Free
Small Fan	Free	Paint, paint brushes	Free
Baseballs	Free	String/twine	Free
Motion sensor	Free	Paper	Free
Marbles	Free	Hot glue	Free
Hot wheel tracks	Free	Grocery kart wheels	Free
Shop Vacuum motor	Free	Phone	Free
Clear syringe tubing, Syringes	8.00	Dry ice	Free
3d printed cup	Free	Dowels	Free
Golf balls	Free	Tacks	Free
Wire holders	Free	Baking soda	Free
Peg board hooks	Free	Vinegar	Free
Balloons	5.49	Jars	Free
Dumping mechanism	Free	Binder clips	Free
Water	Free	Thumb tacks	Free
3d printing syringe pusher	Free	Hinges	\$6.32

Threaded rod	Free	Electrical tape	Free
3D printed tracks	Free	Note cards	Free
Plastic welder	Free	Short how wheels tracks	6.00
Light switch	Free	Circuit interrupter harness	Free

Machine Steps

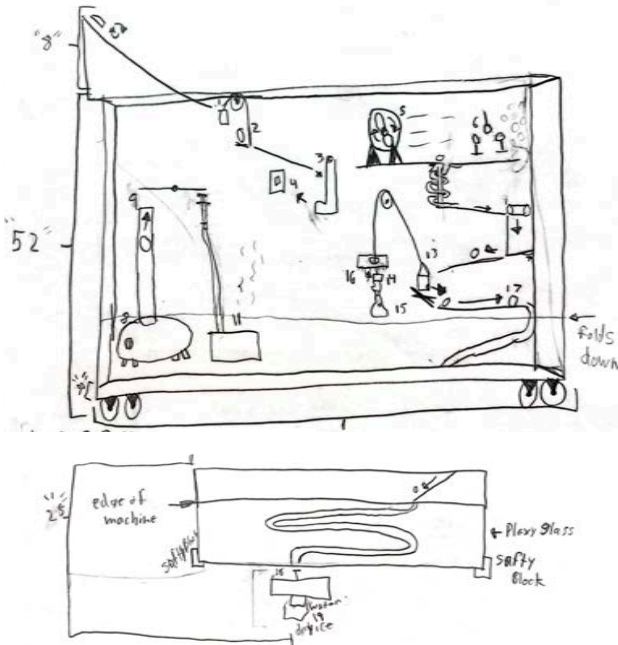
(Advanced components)

- Number 1: Is activated by someone **calling a phone** as it slides down the **inclined plane**
- Number 2: The phone makes contact with a line of dominoes pushing them over. At the end of the line a domino falls in a cup attached to a pulley
- Number 3: The weighed down **pulley** pulls up on a nail
- Number 4: Releasing a baseball to roll down the board which **Triggers the motion sensor**
- Number 5: **Turns on our shop vacuum motor**
- Number 6: Air from the vacuum pushes the plunger up through the tube
- Number 7: Hitting the **syringe pushing the vinegar through the tube into a jar**
- Number 8: In the there is a **Vinegar and baking soda reaction** that creates carbon dioxide and expands a balloon
- Number 9: **The motion sensor Also turns on a fan**
- Number 10: The air from the fan blows a piece of paper holding a ball bearing
- Number 11: the ball bearing rolls down a **inclined plane** falling into a cup on a **pulley**
- Number 12: The pulley pulls up on a light switch which kills all of our electrical components and keeps them from running.
- Number 13: The Balloon continues to expand and pushing up on the back of a car pushing it down the track
- Number 14: The Car rolls down and hits a golf ball
- Number 15: The golf ball rolls down and hits a **dumping mechanism**
- Number 16: Releasing dry ice into the water
- Number 17: creating a **Dry ice and water reaction**

Advanced Components

- Fluid Components: Our fluid component is a syringe with clip on clear tubing and filling the water cup for the dry ice.
- Chemical Components: Our chemical component is a reaction of baking soda being poured into vinegar and making carbon dioxide gas that fills up a balloon and then popping the balloon on a thumb tack.
- Mechanical Components: Our mechanical components are Inclined planes for the phone and baseball/marbles and our pulleys that catch dominoes and our marble.
- Electrical Components: Our electrical components are the motion sensor triggering and turning on the shop vacuum motor and turning on the fan.

First Draft/Description



This year for engineering we started by researching what our steps could be and making our first draft. Once we figured out what we wanted to do we got the things that we needed and started making the first step. We called it a silly bean. It will use rotational force to move itself down a ramp, when it went down the ramp it would fall into the cup attached to the pulley, triggering a ball to roll down an incline plane hitting a lever. The lever then goes up and trips the motion sensor starting the motor that folds down the other half of our machine. The motion sensor also starts a vacuum motor and shoots a plunger up and makes a board pivot, pushing down on a syringe full of water into potassium. The final thing the sensor starts is a fan which blows a marble

down the ramp along with blowing bubbles. The marble continues down the machine and falls into a cup on a pulley. The pulley triggers and untwists a balloon with baking soda in it and pours it into the vinegar cup. The balloon expands and pops when it reaches a line of tacks. The cup hits a board and tips over letting the marble out as it continues down the ramps to the end. Hitting its final step which is triggering a dumping mechanism that pours dry ice into water.



Final Picture/Description

Our machine starts by a vibrating phone running into dominos. They fall in a cup and the cup pulls up on a nail releasing a baseball. The baseball rolls down an inclined plane triggering a motion sensor. Starting a vacuum motor pushing a 3d printer plunger through a clear tube. Pushing on a syringe releasing vinegar into baking soda creates a reaction blowing up a balloon pushing up on the back of a car pushing it down the track and hitting a golf ball. The golf ball then rolls

down an inclined plane hitting a dumping mechanism releasing dry ice into water creating a reaction. The motion sensor also triggers a fan. The fan blows on a piece of paper pushing a ball bearing down a track into a cup on a pulley. The pulley gets triggered and pulls up on a light switch that shuts off all of our electrical components.

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Group Reflections

Samantha: This is my second year doing this project and the first year we did it, we made it to the championships. How I feel like I grew from this project was by overcoming some of the conflicts with the group. Some challenges were, overcoming those conflicts, and trying to have all 5 of us work on the machine. That was a challenge because we didn't have much space on our machine for everyone to be working on it at the same time. A few successes for me were, working on the journal, splitting up into groups of 2-3 and working together in those groups, and overcoming those challenges/conflicts. I'm excited about doing this project.

Danica: This is my third year participating in the engineering machine design competition. This year I was not going to do the project because I thought I didn't have enough time but a friend convinced me to. We put a team of three together but unfortunately, it didn't work out. I still wanted to continue the project so I put a new team together. Eli because he is good at building and 3D printing design, Ary who is an amazing writer and is always ready to learn, Samantha is a hard worker who is willing to listen, and Dan who always makes time to help out. We have learned a lot about the nervous system, stress, and the impact of phones on the brain and body for the story, so we can have a better understanding of what we will be talking about in our presentation. We have had quite a few challenges in the group so far one of the main ones has been on the machine with our motion sensor. It either will get triggered by a shadow or won't trigger at all. We have also had problems with losing things because people forget to put things back where they go so we spent a couple of hours over a week or so to get everything in order.

Eli: This is my first year competing in the engineering machine design competition. The main reason I joined this project was to improve my 3d design skills. Unfortunately, we didn't end up using 3d design as much as I was hoping. On the other hand, due to the lack of computer side work, I got to improve my hands-on skills. Our first major success was getting the plunger/syringe step to function properly. During this step, we have a vacuum trigger via a motion sensor. The vacuum pushes a plunger up a tube and pushes a syringe. Before using the plunger we were attempting to use golf balls to push the syringe. This idea failed because the balls would stop applying pressure to the syringe. By using the vacuum it would apply a constant pressure to the plunger and syringe.

Dan: This is my third year of competing in the engineering machine design competition. Out of all the machines I've built, this one I'm the most confident in. I wasn't originally going to do this project this year but the group that was forming was really good and I wanted to do the project again. But there wasn't a lot of time at school or space to work on engineering. So we ended up working most of the time at someone's house, usually Danica's. We end up working 4-6 hours on school days and 6+ on non-school days. I'm very invested in this project and I think and hope we'll do well.

Ary: This is my second year competing in the engineering machine design competition. I chose to do engineering this year because it's a good way to improve skills I'm not good at like my problem-solving skills, creating solutions, and technical skills. It's also a fun learning environment where I get to work with people that I don't work with. So far we haven't gotten into an argument and if we did it was over something really little that we fixed right away. I took on the task of writing the story to go along with our machine. It was difficult since I had no idea what the story was going to be about but I worked past that and wrote the story. I have written 4 drafts and have changed the story each time so we can learn more about what younger people deal with. I think this is going to be a better machine than last year's machine.

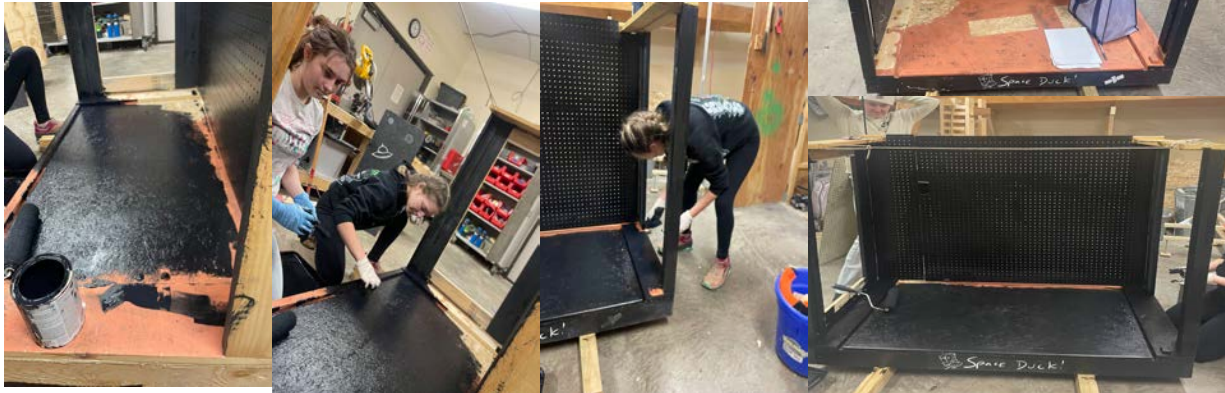
Team Engineering Journal

STEM Process

1/15/2024 - Today we figured out our team and started planning what our machine was going to look like and how we wanted to go about it. We also went through the rulebook.

1/18/2024 - We did some work on what our biology theme would be for the machine and researched what cool ideas we could use.

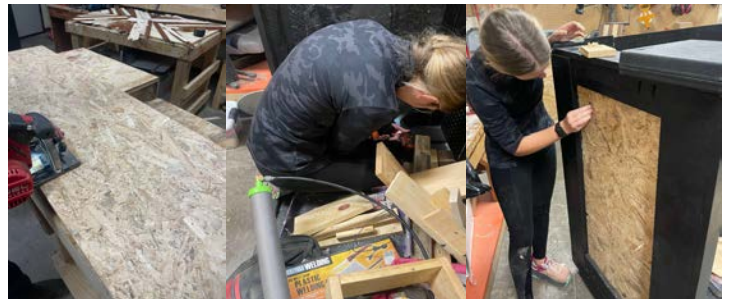
1/19/2024 - Today we started cleaning and taking the base apart, we also put a fresh coat of paint on it and continued researching our theme.



1/23/2024 - Started planning the steps of our machine and learning how to make them work.

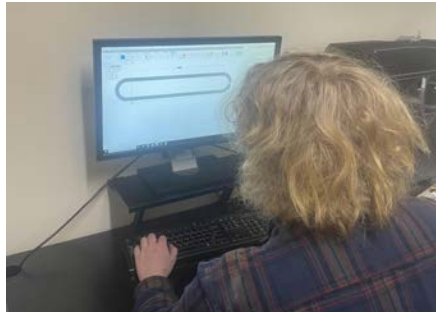
1/31/2024 - Today we just spent a little time cleaning, painting and planning so when the whole team is back we have a fresh base and fresh start. Danica also took some time to think of some more steps we could use.

2/7/2024 - Today we cut down a piece of plywood for our right side and put both sides up. And filled in old light holes with homemade putty.



2/8/24 - Today we painted both sides of the machine base and continued planning our steps with the whole team. We ended up thinking of some really good ideas and found some that danica and dan's team didn't use last year.

2/16/24- Today a few of us got together and we talked about the theme and what we could possibly do. We also talked about more ideas for the steps

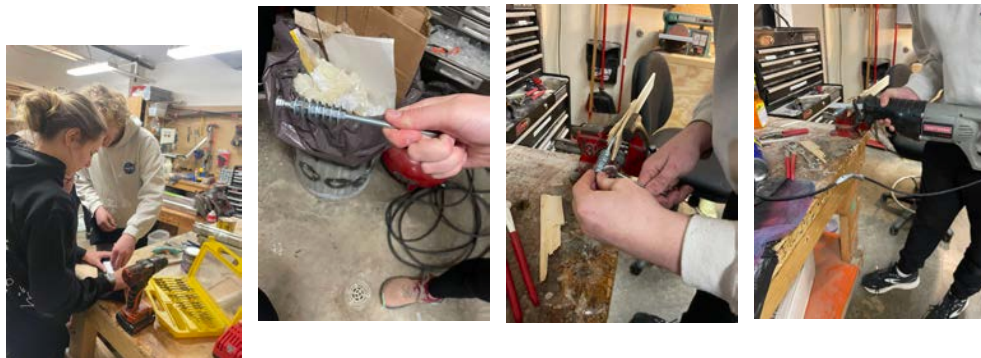
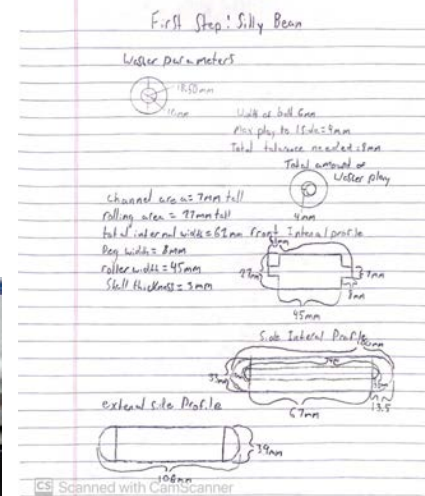
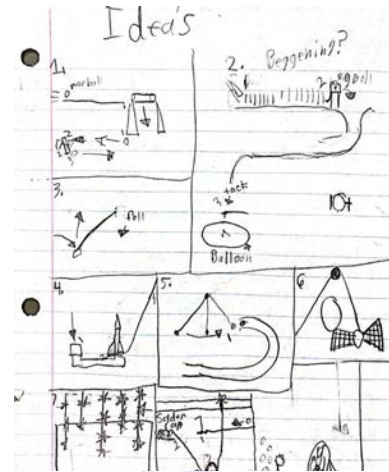


2/20/24 - We had a very productive meeting today. We decided on our first step and started designing it. We did base our step off of silly beans, a bean shaped toy with a weight on one side.

2/21/24 - Today danica spent time working and making our first draft of our machine. We have to finish talking it out with the team and get any feedback of what we can do to make it better.

2/22/24 - We started working on our story line and how it can go along with our machine and how everyone can be involved. We also fixed the journal and worked on making plans for future meetings.

2/26/24 - Today we broke the news to Eli that the silly bean didn't work. So we decided to try drilling a hole and putting small nuts in the silly Bean. To see if it made a difference and put duct tape on the board and on the ends of our bean to see if that would help. We also made steps of hot glue to help the bean flip. But none of that helped it work. So we designed a new silly bean. Out of a threaded rod with a every other pattern of washers and nuts that we will be encapsulated in a 3d printer casing Eil designed. So we spent time designing and printing the 3 and hopefully final silly bean today.



2/27/24 - Today we came into school and the print for our silly bean was finished. We put our threaded rod in before we left school on



monday and came back to a great print. But unfortunately we cut the rod too short and it would not stay sitting straight in the 3D printed case when we tried to roll it. So we decided to use a step we have used in the past that works amazingly and is something different that a lot of people wouldn't think to use.

3/3/24 - Today Danica added our first step and worked on cleaning the base up because it was full of salt and sawdust from it living in the school's woodshop and hauling it home in the salt and snow.



3/7/24 - Today we finally had our first meeting with the whole group after the base was moved to Danica's house. We started by touching up some paint on the side of the base where it was a little patchy and added on our next board for the dominos. Then danica and ary started trying to make the pulley work because it was in a small space and finally it was tied and worked. While we were struggling with that Eli, Dan and Samantha went to samanthas to get a fan for our next couple steps. While they were gone a couple of us started to get our next set with a nail holding a baseball. Once they got back from Samantha's. Samantha attached the fan and Eli, and tested and made a holder for our motion sensor. We also added a track for our baseball. After everyone was done with their tasks and losing steam we talked about things that we can do at school and made a couple plans for after spring break or when we can meet next.



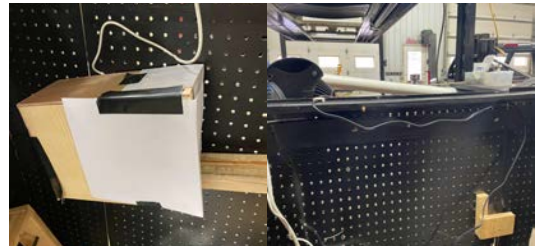
3/11/24 - No new steps, only improvements to the machine. Today we got a different fan and fixed the pulley because it wouldn't stay tight and would loosen over time. Also made a step with an old shop vacuum motor that would suck golf balls up a tube through a 90 and through another tube. That would then drop the golf balls on a syringe. We also made a couple ideas for the story and a 3D printed piece.

3/14/24 - Over the last couple days we all have spent some time working on stuff Ary spent time working the story, Danica spent time working on some steps for next week's meeting and



Eil spent time trying to get out 3D print to work because it keeps failing after only printing the bottom half.

3/15/24 - Today the group spent time making a to-do list of things that need to be done to the machine, presentation, journal and story. We also made plans of when we are going to meet next week and what needs to be accomplished between then and now. Danica also spent time revising a few of our steps to make them a work or just improving them. Like our motion sensor would activate any shadows so danica made a box around it. But we do have to fix the sensor because the baseball still wiggles and activates it all over again. We also started working on finding places for all of our wires because we don't want them hanging out everywhere.



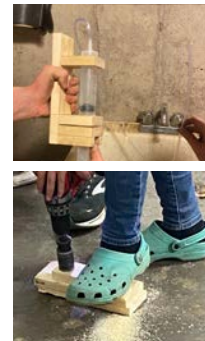
3/18/24 - Today we worked on changing things around the motion sensor, the ramp for the baseball. We had to change it because it would detect the baseball and the whole ramp would move when anything went off on the machine. The track for the marble we had to fix because we had to cut a hole in the wood and the track for the marble and

trim the edge.



3/19/24 - Today we worked on the journal, like writing the materials list and cost. We also worked on making the whole presentation we wrote about the design process and the challenges. We worked on finishing the story for the machine. We also worked on a 3d printed plunger for the vacuum motor and syringe.

Later that night a couple of us met up to work on our machine. We wanted to get the vacuum motor and syringe step done. We mounted the clear tube and then started building a holder for the syringe and testing it to make sure the pressure wasn't too much.

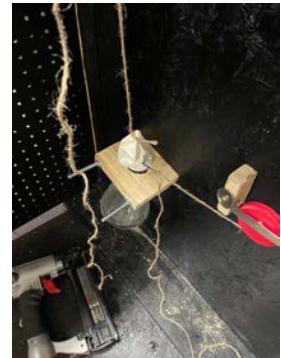


3/20/24 - Today we worked on writing the story. We also worked on the reflections and fixed some punctuations. We also had to 3d print the plunger from the night before because it broke.



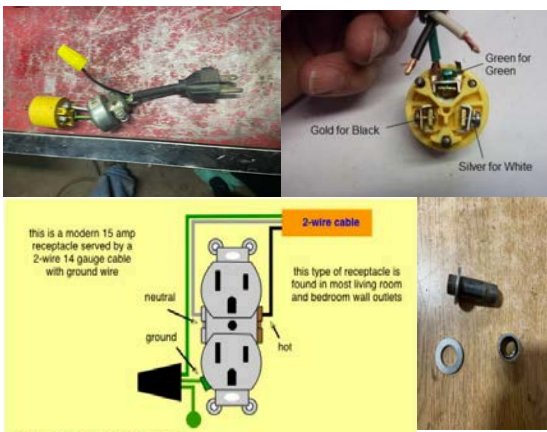
Last night we met to work on our machine and we split into groups so we could get more done. Ary and Eli worked together and Danica/me and Samantha worked together. Eli and Ary worked on building and attaching the pulley, string and cup for the marble. They also built a holder for the beaker. Samantha and I helped ary and eli cut a hole in the holder after that we worked on painting a fold out extension that we will put on our machine tomorrow night , we also re-painted the backs of our presentation boards from last year. While everything was drying we organized a bunch of our materials so they are easier to find.

3/21/24 - Today was the first time in a long time we had the whole group together. So we divided up tasks so there was stuff for everyone to do. Ary and Eli worked on putting our next little section of steps, they started by attaching the beaker holder and a pulley to help the string pull up on the balloon and release the baking soda into the vinegar. Danica, Dan and Samantha worked on fixing a couple steps, finishing painting our presentation boards, making a new updated draft of our machine and revising our story.



3/25/24 Today Danica, Ary and Eli worked on putting all the wiring on the back of the machine and making it look nice. We took a plastic mason jar and took the lid and drilled a hole and put a grommet in so the clear tube for the syringe wouldn't move.

3/26/24 Today Danica, Ary, and Eli Worked on making the balloon nozzle. We couldn't get our balloon to stay on the beaker so we built and designed a new pressure chamber for our chemical reaction. We took a plastic mason jar and took the lid and drilled a hole and put a grommet in so the clear tube for the syringe wouldn't move. Then we drilled a bigger hole to fit a small chunk of threaded pipe and sandwiched two washers between the bottom of the lid and the threaded pipe. We used the threaded pipe to put the balloon on. We also made a wooden box for the jar to mount it.



3/27/24: Today Danica had a little extra time before everyone showed up so she built our circuit interrupter that she wired into our kill switch. Once everyone got there we mounted the kill switch. Eli and Samantha then spent time building another nozzle for the clear tube because the grommet

wasn't holding air or pressure so we built the same things as the balloon nozzle just smaller.

3/28/24: Today Danica and Ary worked on a lot of the writing things like the presentation, writing the story on note cards, finding pictures relating to stress, looking over the reflection to make sure they looked good. Eli was working on the machine he worked on putting the car track and a stand to help support the car track. Eli had to melt plastic together so the other track would work.



3/29/24: Today we printed out the pictures for the back of the cardboards. Ary and Samantha put the pictures on the back of the cardboards. Eli was working on the machine he had to change some things around. so the syringe would have enough time to empty before the kill switch was

triggered. Eli and Danica then worked on the car tracks leading to the dumping mechanism. Ary and Samantha worked on the presentation and getting or presentation note cards and boards done. We then had the amazing idea to make models of the stress response sections (heart, lungs, kidneys, stomach, liver and brain). So they are easier to follow. So danica and ary started to work on those so we can paper mache tomorrow. then Danica and Eli finished up by attaching the fold out extension.

3/30/24: Ary, Danica, and Samantha met up and worked on the design part of the machine. Samantha worked on cutting and taping the lungs, livers, and kidneys and helped out a little bit with the presentation. Ary and I finished all of the writing stuff and presentation.



4/1/24: Today Danica Ary and Samantha worked on painting the organs for our machine while Dan and Eli painted the machine. After we painted we practiced our presentation. Danica and ary went over the presentation and fixed what needed to be fixed. Then we finished painting the liver and kidneys and finished putting things on the machine. We packed up everything we needed for tomorrow and Loaded our machine.

4/2/24: Today was competition day. Samatha and danica arrived at augusta around 8 and unload the machine and all of our materials. Eli then arrived and We started to set up the machine and presentation materials. Our first set of 2 runs was okay. We had to touch our machine 5 times (costing us 15 points) and had to do a full restart (costing us 5 points). Our second set of 2 runs went better. We only had to touch the machine 2 times (costing us 6 points) and taking longer than 4 minutes to set up our machine for the second run (which cost us 5 points). But fortunately we still placed second and only lost to first place by 6 points and also won best in theme, best journal and best presentation. We packed up and decided that we're gonna work hard and try to place well at championships.



4/08/24: Today danica spent time pulling the machine out and fixing the ball bearing section like adding a few walls so the ball can't jump off the platform along with finding a solution for the motion sensor and fan so the ball bearing actually stays. She also planned a day for everyone to meet and finish the machine. She also spent time working on our presentation and fixing it so there is no possible way we can go over our time limit .

