

ENGINEERING MACHINE DESIGN CONTEST 2023

CHATFIELD HIGH SCHOOL

The Smarshins

IDENTIFY THE PROBLEM

What is the challenge?
What are the limits?
How can you solve it?



GREEN TEAM ROLES

ROLE	TEAM MEMBER
Lead Engineer	Logan
Advanced Components Captain	Jack
Journal Master	Emma
Photographer / Videographer	Amelia
Storyteller	Jameson
Artist	Liam
Business Manager	Addy
Material Specialist	Brandt
Hardware Mechanic	Lincoln
Step Chief	Eli
Safety Officer	Lincoln

1. Bibliography

EXPLORE

Find out what others have done. Gather materials and play with them.

1- “Chatfield High School Rube Goldberg 2022 OPEN A BOOK Challenge.” YouTube, uploaded by Nora Gathje, 22 March 2022, <https://www.youtube.com/watch?v=sCdYOVbCgzg>

2- “Run #2.” YouTube, uploaded by Nora Gathje, 5 March 2019, <https://www.youtube.com/watch?v=plbGEX4hrs0>

3- “The Lunch Feeding Contraption | Joseph's Machines.” YouTube, uploaded by Joseph's Machines, 27 September 2018, <https://www.youtube.com/watch?v=4jruLdkHhi4>

4- “Kitchen Krew Apply a Band Aid Run #1.” YouTube, uploaded by Nora Gathje, 27 February 2017, <https://youtube.com/shorts/8T78z9uceQk?feature=share>

5- “Around the World In 20 Steps | Full Run Video.” YouTube, uploaded by Kenzee D, 20 April 2022, <https://www.youtube.com/watch?v=C2c3HnHdVvg>

6- “Perfect run video.” YouTube, uploaded by Kenzee D, 23 March 2021, <https://youtube.com/shorts/uje8XWjt5Iw?feature=share>

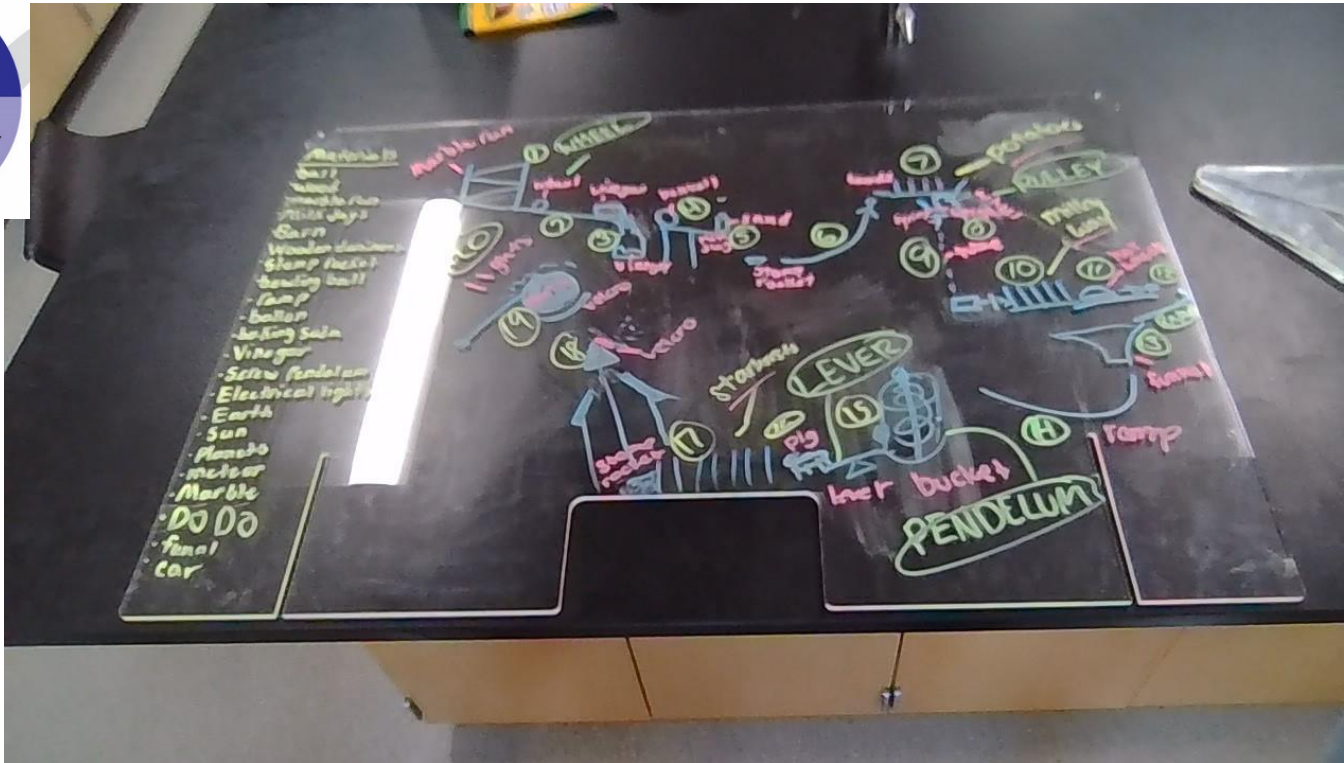
7- “IMG 2155.” YouTube, uploaded by Nora Gathje, 1 March 2016, <https://www.youtube.com/watch?v=zf8fipwdTWk>

8- “The Martian.” IMDb, directed by Ridley Scott, 2 October 2015, <https://www.imdb.com/title/tt3659388/>

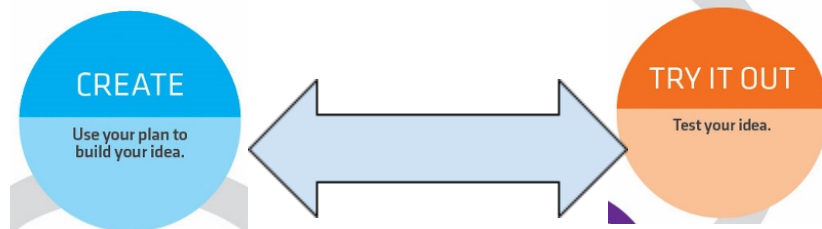
2. Initial Sketch and Description of Planned Machine Design

DESIGN

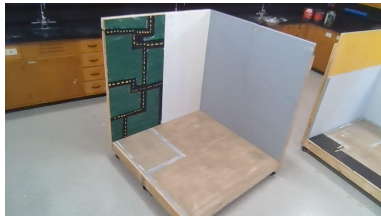
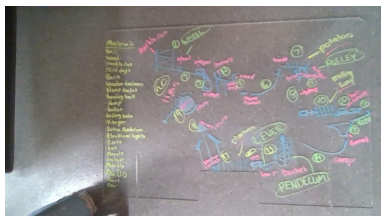
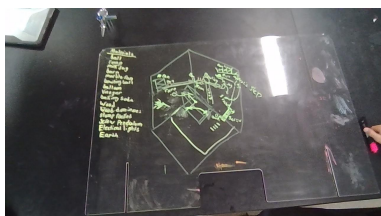


Think up lots of ideas.
Pick one and make a plan.
Make a drawing or a
model.













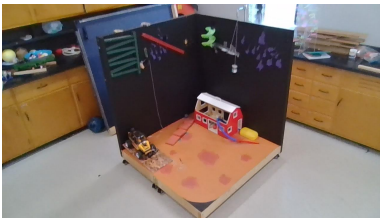


Our initial sketch was to go from a ramp to a ramp. The ball that rolled off the ramp would then hit a bottle of vinegar into baking soda. The baking soda and vinegar balloon would then hit a ball that would hit a bottle full of sand. The bottle would land on a stomp rocket and the rocket would hit dominos. The dominos would trigger the pulley which would then trigger the hydraulics. The hydraulics would trigger another set dominos. That set of dominos would trigger a car which would hit a ball into a funnel. The ball would then go off a ramp into a bucket. In the bucket there would be a pendulum which would hit a ball. The ball would fall on one side of the lever. On the other side of the lever there would be a pig. The pig would then trigger a third set of dominos which would fall on the second stomp rocket. That stomp rocket would stick to the earth and trigger the lights.

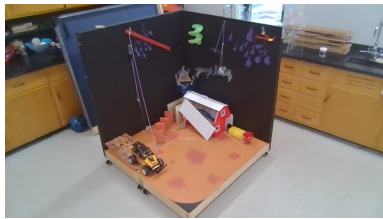







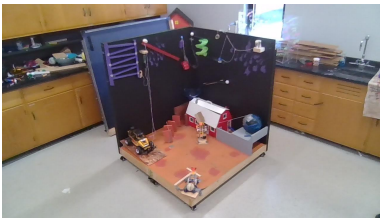





3. Progress Documentation

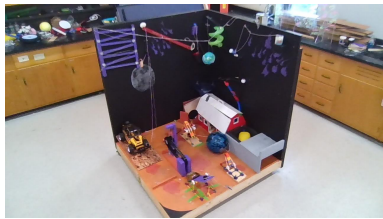





Date	Description of work	Progress Photo
9/26/22 monday	We got our platform. Then we talked about the design and drew the design.	
9/27/22 tuesday	We worked on our initial sketch.	
9/28/22 wednesday	We researched websites for the project and wrote the bibliography.	
9/29/22 thursday	We worked on the initial sketch again. We had our platform painted and got the platform back.	
9/30/22 friday	We decided about how our 3 working steps would be built and what we would use to make them.	

10/3/22 monday	We practiced and improved on our 3 working steps with a trial run.	
10/4/22 tuesday	We went to the RubeRoom and saw our platform after the artist (Liam) had been working on painting it for the past few days.	
10/5/22 wednesday	We worked on our platform and we added another 3 steps to the build.	
10/6/22 thursday	We worked on our platform again. We also added another 5 steps and added paper towels over the bottom so when we were stepping on the machine that paint wouldn't chip or wear out.	
10/7/22 friday	We were working on our platform	
10/10/22 Monday	We added 5 more working steps and tested them.	
10/11/22 Tuesday	We used the marble run to build our slow step.	

10/12/22 Wednesday	We added our slow step	
10/13/22 Thursday	We added a car to the machine.	
10/14/22 friday	We added a syringe to the hydraulic step.	
10/17/22 monday	We practiced the sound effect and made a way for the sound effect to work.	
10/18/22 tuesday	We added a ramp and funnel to the corner of the machine platform.	
10/19/22 Wednesday	We added four dominos beside the barn.	
10/20/22	MEA	
10/21/22	MEA	

10/24/22 Tuesday	We did not add anything new. Improving the steps we already had.	
10/25/22 Wednesday	We made our windmill out of K'Nex.	
10/26/22 Thursday	We added the bowling ball and did a couple test runs.	
10/27/22 Friday	We added a platform so the bowling ball would not roll all over	
10/31/22 Monday	We painted our platform so the bowling ball would not roll all over	
11/1/22 Tuesday	The windmill did not turn at first. We found a way for the windmill to work.	

11/2/22 Wednesday	We decided where we wanted to put the windmill.	
11/3/22 thursday	We painted stars onto the machine, soon after we realized that was a bad idea. We ran out of time so we couldn't paint over the stars that day.	
11/4/22 Friday	We covered all the stars. We painted the moon and added our electrical step.	
11/7/22	<p>We fixed and upgraded parts of the machine. <i>sketch of planned machine</i></p> <ul style="list-style-type: none"> • <i>include labeled components</i> • <i>label anticipated transfers of energy</i> • <i>directions of force</i> • <i>materials</i> 	
11/8/22	We added lights and adjusted them to fit around some steps on the machine.	
11/9/22	We painted more of the machine and added lights around the ramp.	

11/10/22	We added cushioning for the bowling ball so that it would not slam loudly or shake the machine.	
11/11/22	We added some things to help with the machine.	
11/14	We added our chemical step	
11/15	We worked on our machine and did many test runs.	
11/16	We worked on our machine so it would be good for the full send	
11/17		
11/21/22	We talked about our journal.	
11/22/22	We talked about our costumes	
3/8/2023	Final machine touches	
3/9/2023	Added numbers for steps	

4. Major Successes and Challenges



Challenge #1

Problem: The sound did not work at first.

Proposed Solution: We first had it falling down freely. We instead taped a string on the right side and made it tip instead.

Success: Yes- the noise maker tipped slowly and made a sound effect.

Challenge #2

Problem: The golf ball kept flying out of the funnel.

Proposed Solution: We added sides to the funnel.

Success: Yes- the golf ball stopped falling out of the funnel.

Challenge #3

Problem: The windmill would not turn.

Proposed Solution: The weight was too heavy. It was proposed to either change the weight or use a different ball.

Success: No success because the proposed solution was not adopted.

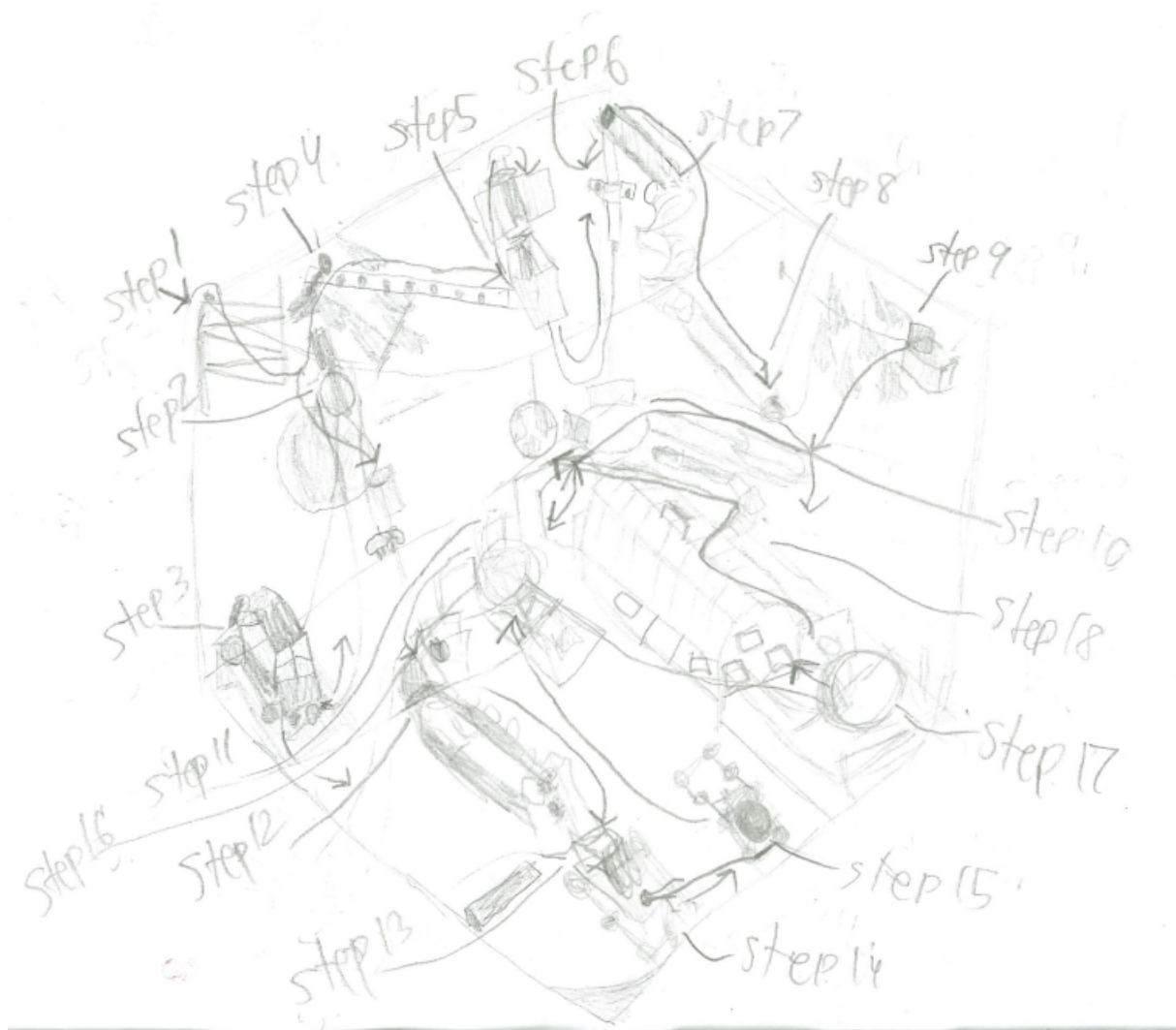
5. Final Machine Description

Our first step is a marble going down a marble ramp. The marble then transfers its energy to the pig. The pig falls, connected to a string on the pulley, and pulls out a pin, connected to the other end of the pulley. The pin gets pulled out from underneath the tire of a car. The car then rolls down the ramp. The car has a string connected to it and on the other end of the string there is a pin. The pin gets pulled which releases the egg. The egg then rolls down a ramp and falls into a bucket. The bucket is connected to one end of the hydraulics and pulls that end down. The other end of the hydraulics goes up. The side that goes up has a ramp connected to it. The ramp has a bottle filled with

vinegar on it. The bottle of vinegar pours into the balloon of baking soda. The chemical reaction, caused by the baking soda and vinegar, causes the balloon to fill with air. The balloon then hits a golf ball that swirls around a ramp. The golf ball goes down another ramp and hits another golf ball. That golf ball is connected to a string which is connected to a cow noise maker. The cow noise then swings down and hits another golf ball. That golf ball goes into a funnel then down a ramp. The ramp leads the ball to hit the dominos. The dominos release a pin with a string wrapped around it. The string unravels and releases a weight which is on the other side of the pulley as the pin. The weight lands on the switch of the motor which has wheels and a track on it. There are gems sitting on the track that fall into a chest. The chest is on one side of a lever, and the chest tips the lever. The lever pulls a string which is connected to the catapult. The catapult launches a ball which hits the k'nex holding the wheel from spinning. The k'nex releases the wheel which pulls a string connected to a bowling ball. The bowling ball falls on the end of the stomp rocket and launches the rocket. The rocket then sticks to the earth.



Final Machine Sketch



Major Redesigns form Original Idea

Our final machine is nothing like our original idea. Our original idea had lots of ramps leading to ramps which we thought would be boring. Some steps from our original design are still in our machine but not in the same order. Some things that are different are the placement of the hydraulics, chemical step, and dominos.

The SMARShins

Narrator- This first step takes a MOON-ite (minute)

Sarcastic- That egg will be SCRAMBLED

Jokester- Lets give this machine a SHOT at winning

Excited- I really hope we TWIST up these other teams

Questioneer- That reminded me of a joke, What do you win in a space talent competition?

Everyone- I don't know? What do you win?

Questionnaire- A CONSTELLATION prize

Doesn't Understand- Huh? I don't get it

Space Farmer- You know like a consolation prize

Doesn't Understand- Uhh What?

KTSG- Let's move on

Cow pun- That must have been an invisible cow because it was HERD and not seen

Singer- I CAME IN LIKE A WRECKING BALL

Questioneer- Why do all planets have to date black holes?

Sarcastic- Because they're so attractive.

Jokester- those planets really fell for the black hole

Excited- This machine is GEM packed with fun

Narrator- The black hole really pulls this machine together don't you think

Sarcastic- Good thing that rocket didn't get stuck in a SPACE JAM

CAST

Narrator- Logan

Cow (cow puns)- Amelia

Space farmer - Lincoln

Jokester- liam

DOESN'T understand- Emma

Keeps the story going- Addy *if we get off track will lead back*

Sarcastic- Jameson

Excited- brandt

singer - Jack

Questioneer- Eli

6. Machine StepList

The **red** word in each step indicates which **object has the energy**.

The underlined word is the simple machine used to create a mechanical energy transfer.

Blue is the hydraulic step.

Orange is the chemical reaction.

Green is the electric step.

1. The glass marble rolls down the purple marble ramp system and dislodges a magnetic **marble**.
2. Both of those marbles roll down the final part of the ramp then they hit a **pig**.
3. The pig falls which pulls the pulley which pulls out a pin from under the tire of the **Mars rover** which rolls down the ramp.
4. At the bottom of the ramp the rover's tripwire releases the **egg** to roll down the red ramp into a bucket
5. The **bucket** pushes down the hydraulic syringe which forces fluid to the other side of the hydraulic to raise the black ramp with the chemical bottle.
6. When the ramp is raised the **vinegar in the bottle mixes with baking soda** in the balloon, producing carbon dioxide which blows up the balloon.
7. The balloon pushes the **golf ball** down the green swirling ramp.
8. The **golf ball** hits another golf ball that swings on a pendulum
9. and knocks the **cow noise** off its ledge on a pendulum.
10. The cow noise hits another **golf ball** that rolls into a black hole (funnel shaped ramp) which eventually
11. causes the first **domino** to fall over on a hinge lever.
12. The final domino releases the pin connected to the pulley which releases a **weight** to fall on the switch that starts the electrical step.
13. The **running electrical motor** drops the
14. **gems** into the chest sitting on a lever.
15. The lever tips and pulls the pin to the catapult which launches a **red ball**
16. that hits the target on the **spinning wheel**.
17. The spinning wheel pulls the string on the **bowling ball**.
18. The bowling ball falls on the rocket air pump and the **rocket** shoots and hits the earth.

Reset checklist

The Smarshins

- ☐ Large marble wedge in marble run
- ☐ Pig hanging by leg
- ☐ String over pulley
- ☐ Red pin in front of rover wheel
- ☐ Aline rover wheels strait
- ☐ Pin in red track
- ☐ Egg at top of track behind pin
- ☐ Bucket facing red track
- ☐ Hydraulic set at "E"
- ☐ Chemical step set- 23 ml vinegar and 2.5g baking soda
- ☐ Balloon over foam block
- ☐ golf ball at top of green spiral ramp
- ☐ blue ball set on clay
- ☐ MOO noise maker upside down on black block
- ☐ Golf ball at top of black ramp
- ☐ Dominoes set up on hinges
- ☐ String twisted on wooden school under last domino
- ☐ String on pulley on rock mine weight at top
- ☐ 6 crystals on conveyor belt
- ☐ treasure chest levers set flat
- ☐ 5 gems in front of treasure chest
- ☐ 2 gems in back w/ 2 weights 20g and 10g
- ☐ blue pin set in k'nex catapult
- ☐ 500g weight ferris wheel set on lip of connects
- ☐ Bowling ball set in front corner string tight facing towards the Ferris wheel
- ☐ rocket on launcher
- ☐ aimed at the Earth
- ☐ lights on

7. Cost of Machine and Percent of Recycled Materials Used

ITEM	SOURCE	WHAT IT COST US
Marble	In the classroom	nothing
Marble ramp	Brought in	nothing
Plastic pig	Brought in	nothing
String	In the classroom	nothing
Pulley	In the classroom	nothing
Wood	In the classroom	nothing
Car	In the classroom	nothing
Knex	Brought In	nothing
Screws, nails, and hooks	In the classroom	nothing
Egg	In the classroom	nothing
Ramp	In the classroom	nothing
Bucket	In the classroom	nothing
Hydraulics	In the classroom	nothing
Spiral	In the classroom	nothing
Golf Ball	Brought In	nothing
Cow Noise	In the classroom	nothing
Funnel	In the classroom	nothing
Dominos	In the classroom	nothing
Weights	In the classroom	nothing
Rubber Band	In the classroom	nothing
Motor	Brought In	nothing
Wheels	In the classroom	nothing
Chain Link	In the classroom	nothing
Gems	In the classroom	nothing
Treasure Chest	In the classroom	nothing

Squishy Ball	In the classroom	nothing
Target	In the classroom	nothing
Bowling Ball	Brought In	nothing
Foam	In the classroom	nothing
Stomp Rocket	Brought In	nothing
Styrofoam ball	Brought In	nothing
String Lights	Brought In	nothing
Paint	Bought	nothing
Velcro	Brought In	nothing
Barn	Brought In	nothing
Tape	In the classroom	nothing
Paper	Printed	nothing

Grand Total = \$0.00

100% Recycled materials

8. Team and Individual Reflections of Entire Process

What was the most challenging part of this project?

“I think the electrical step because it took a week or two” -**Jameson Mcmanimon**

Name all the specific parts in the machine that you personally built.

“I built the egg and pin step, the hydraulic step, the blue spiral tube and the green spiral ramp step” -**Logan Pearson**

If you had time to change something about your machine, what would it be?

“I personally would change the cow sound step and redo all the strings.” -**Jack Logue**

Did you make any mistakes you can learn from?

“Yes, when I painted over the stars.” -**Amelia Biers**

What did you notice about how the group worked?

“Some days we would work really slow and get little to no steps in, other days we would work diligently and get multiple steps finished.” -**Eli Manahan**

What are you most proud of?

“I’m most proud of my step I made in the machine, to have the machine finished and look great with my art.” -**Liam Brawdy**

What was the most fun?

“The excitement of when our machine does a full run without it messing up.” -**Emma Fink**

Name 2 specific skills you learned in Explore Science 7 while working on this machine.

1. Teamwork
2. How to put a Rube Goldberg machine together. -**Lincoln Goldsmith**

How does this activity relate to real life?

“This relates to real life because it teaches you how to work as a team and how to do your job.” -**Addison Johnsrud**

Did you give your best personal effort to make the machine work successfully?

“I gave my best effort in building the machine and making it work.” -**Brandt McBroom**

10. Connection to future application

There are many ways we can use this class in future situations. One way would be the teamwork we used. This teamwork will help us in future jobs because we will be able to listen to other coworkers ideas and work together. Another way we can use the skills from this class would be problem solving. This class taught us how to problem solve because when a step wouldn't work we would have to adjust how we are doing things until it works. This class also taught us how to use our time wisely. We had one hour to work on our machine every day and had to work the whole time. Another way this class will help us is by sticking to your job and doing everything you need to do in order to succeed. This class taught us to be competitive but also help the other teams. This class will help us succeed in our future lives in many ways.