MN ENGINEERING CONTEST 2022

CHATFIELD HIGH SCHOOL

Around The World In 20 Steps

Group Members:

Co-captain and Storyteller: Nick

Co-captain and Artist: Claudia

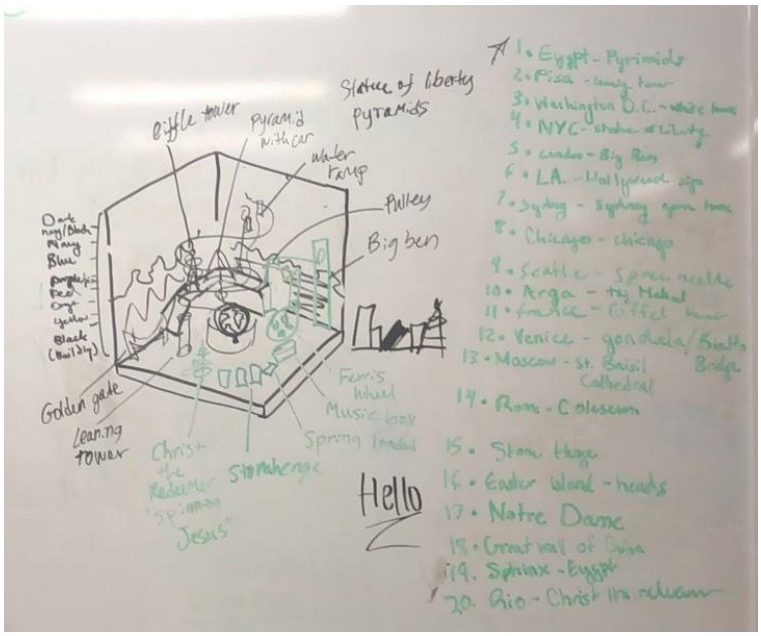
Journalist: Mackenzee

Material Specialist: Mary

Mechanic: Kieran

Technician: Marianna

1. Initial Sketch and Description of Machine Design Planned



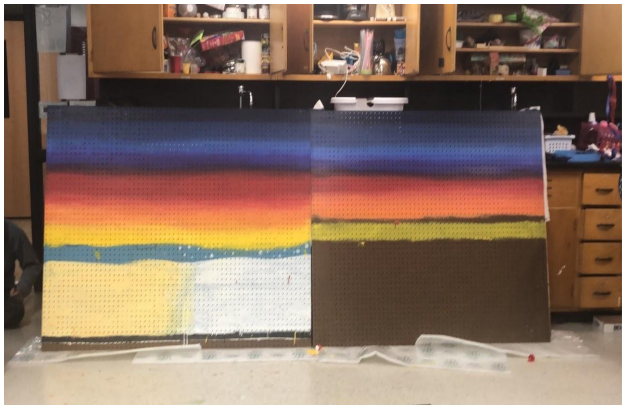
The first time we came together and saw the contest theme, we knew we wanted to do an around-the-world theme for our machine. We decided to have our title be themed around a book, this book being “Around the World in 80 Days” by Jules Verne and Peter Holeinone. We started listing all of the monuments and landmarks we could think of along with our artist coming up with a color scheme. In the end, we had a full plan to base our machine on.

We started at a Big Ben which would've been attached to a string on the Ferris wheel pulling it upward, opening the music box lid it was attached to. This music box let go of a slider that hit Stonehenge. Stonehenge would fall causing Christ the redeemer to spin, hitting the leaning tower of Pisa. The leaning tower of Pisa would fall and break the golden gate bridge. The collapsed bridge would pull a string releasing a pendulum which would hit a car on top of the pyramid. The car would fall in a bucket causing the pulley to come up upward and push up a cup of water. The water would flow down the tube falling into a bucket pulling down the curtain in front of the globe.

Many of the things we had planned had to be cut for lack of ability to make them or to make them work. Here are a couple of our favorites: The curtain around the globe that would fall, the golden gate bridge that broke in half, and the Nile river as our hydraulic step.

2. Progress Photos

November 30th, 2021



December 14, 2021

January 4th, 2022

January 7th, 2022

January 25th, 2022

February 25th, 2022

3. Written Description and Image of Final Machine Design

Our Machine takes you around the world in 20 steps everywhere from the Statue of Liberty in New York, Christ the Redeemer in Rio De Janeiro, to the Great Pyramids Of Giza, and even underwater to the Titanic Shipwreck just off Newfoundland. Our machine begins in the upper right-hand corner near the painting of Big Ben. The machine continues along the back wall with a statue of liberty torch salt contraption, There is a sudden drop down and forward to the London Ferris wheel and the journey continues around the right side edge of the machine to our domino Stonehenge at the front corner of our machine, the energy transfers wrap around with a spinning Christ the redeemer holding a spoon, in which we jokingly refer to as our buddy “hey-sues”. His spoon sends a ball down an inclined plane leading to the left-hand corner of our machine, this ball causes the leaning tower of Pisa to finally take a fall! On the left back wall of the machine, we see a weight connected to the Eiffel tower of France knock a toy car down the famed pyramids of Giza. This movement trips our hydraulics and then our chemical reaction. Lastly, this sends a tennis ball into our globe triggering the LED light at the bottom, therefore POWERING THE WORLD!

Final sketch of our machine

4. Written and Numbered List of Machine Steps

Please note: The red word in each step indicates which object has the energy
Blue is the hydraulics step
Green is the electric step
Orange is the chemical reaction
The underlined word refers to the simple machines used to create the mechanical energy transfers

1. The journey around the world begins when a person pushes the blue toy car with potential energy (PE) down an inclined plane. As the toy car's PE is converted to kinetic energy (KE) it falls off the inclined plane onto a mousetrap

2. The mousetrap, a first-class lever, pulls a string

3. that triggers the statue of liberty torch (a funnel filled with salt)

4. The moving kinetic energy of the salt falls into a bucket

5. The bucket weighs down on a first-class lever.

6. This first-class lever lifts another first-class lever, releasing the yellow golf ball.

7. The yellow golf ball travels down the inclined plane falling into a bag on the London Eye K-Nex Ferris wheel.

8. The London Eye K-Nex Ferris wheel and axle spins, releasing the Titanic

9. The Titanic spring-loaded slider hits the

10. StoneHenge formation dominos on first-class lever hinges causing the last one to fall on a mousetrap.

11. The mousetrap pulls a wound up Christ the Redeemer on a wheel and axle causing it to spin.

12. Christ the Redeemer twists and his wooden spoon hits a green golf ball down an inclined plane.

13. The green golf ball rolls down an inclined plane hitting a counterweight that is holding up the Leaning Tower of Pisa. When the weight is removed from its bracket

14. it releases the first-class lever holding up The Leaning Tower of Pisa which falls onto a platform, triggering a Ship Horn sound effect as well as causing

15. the Eiffel Tower weight to fall off the platform on a pendulum.

16. The pendulum weight hits a red toy car causing it to roll down the Pyramids of Giza inclined plane.

17. At the bottom of the Pyramid the red toy car hits a weight and pulls down the plunger on a hydraulic syringe, forcing water to lift the other end of the syringe using fluid pressure.

18. This causes the vinegar bottle to tip forward, enter the balloon and mix with the baking soda. The chemical reaction produces carbon dioxide which inflates the balloon.

19. The inflated balloon pushes a tennis ball down an inclined plane.

20. Finally, the tennis ball falls off the inclined plane onto a battery-operated button light turning it on to illuminate the globe and “POWER THE WORLD”

5. Cost of Machine and Percent of Recycled Materials Used

We used mostly recycled or donated materials from our school or homes except for Paint rollers, wood fill, and some extra triangle hinges. Those **cost us a total of $20.** In numbers, this makes 3/32 things used on our machine were not recycled or leftover materials. In other words, our machine is made of 90.62% recycled or donated materials

Paint rollers & Wood fill- around $10
Triangle hinges- around $10
Paint- Donated by The Chatfield Rube Goldberg Team
Hydraulics syringes- Recycled
Small PVC pipe halves- Recycled
Hot Wheels cars- Donated by Nick
Hot Wheels track- Donated by Nick
Golf ball- Recycled
K'nex- Borrowed from the science department
Weights- Borrowed from the science department
Eye hooks- Found in the room we used
Mousetrap- Recycled
String- Recycled
Scrap Wood- Recycled
Cardboard- Recycled
Bottle- Recycled
Batteries- Reused
Balloons- Recycled
Spring-loaded slider- Found in the school
Pulleys- Donated by the Science Department
Funnel- Donated by the science department
Hot glue sticks- Donated by the science department
Popsicle stick- Recycled
Plastic- recycled
Toy spiral track- Recycled
Fish Bowl- Donated by the science department
Button light- Donated by Mackenzee
Spice Rack- Recycled
Tennis Ball- Found in the school
Mac & Cheese cup- Recycled
Bolts- Leftover from the year before
Nails- Leftover from the year before

6. Written or Visual Documentation of Major Successes and Challenges

November: This month we had many problems figuring out our initial steps for our machine design and finding time to paint. Claudia being our designated artist had some trouble finding time to paint so some of us tried to help as much as possible. Other problems we had were with our initial design. We had lots of trouble coming up with mechanical steps that are possible to make with the materials we could find.

December: During this month we had our walls reattached to the machine after being fully painted. We had a strong design but weren't sure how to make many of these ideas work. We didn't build much but worked hard and formatted lots of ideas.

January: this was our most progressive month for building. By the end of the month, we had 15 of our current 20 steps built. Some of the steps we had were cut because of various reasons.

February: this was our month with the biggest roadblocks. We had problems with our advanced steps and incorporating them into what we had already built. We ended up having to cut a few old steps to make the new advanced steps work. We finally got all of our steps in and our machine was finished.

March: this month was spent getting our machine to work and run perfectly. This took many hours and we had trouble finding time to get together because of other activities we are in. Eventually, we got our machine to work and put our numbers on finalizing our machine and making it ready for competition.

7. Written or Visual Documentation of the Incorporation of Advanced Components (Chemical Reaction, Electrical Step, Fluid Power, and Mechanical Action)

**These were live links in our Team Google Doc, but may need to be entered manually from the .pdf into a search bar so you can see visual representation of our advanced components at work.

Chemical Step:
https://youtu.be/F6OMNNXLWV0

Materials = Baking soda & Vinegar, latex balloon, recycled water bottle, hair elastic

Electrical Step:
https://youtube.com/shorts/aCqVGZ_x558?feature=share
"Power the World"

Materials = button light to "Power the World," 2 AA Batteries, tennis ball

Hydraulic Step:
https://youtube.com/shorts/Qd5R66HoKjA?feature=share

Materials = 2 yellow syringes, plastic tube, water, zip ties to hold them to the pegboard, 200g weight to activate first plunger

Complete Run Video:
https://www.youtube.com/watch?v=C2c3HnHdVvg

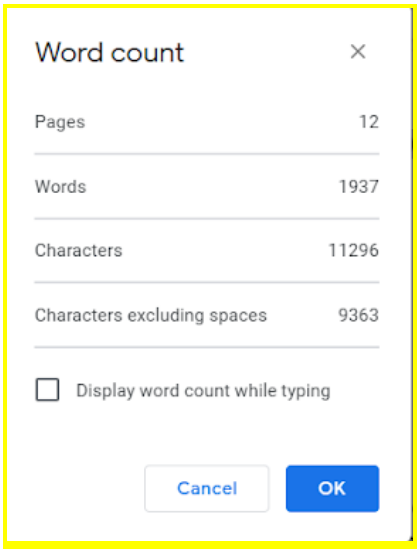
8. Team and/or Individual Reflections of Entire Process

Much of our team has learned so much since we started doing this contest in 2020. Looking at our friends currently on the Freshman team we can't help but look back and see how much knowledge we've gained in just one year. We gained knowledge of different scientific processes and how to use our time wisely. Not only in ways easily seen like learning how to use new tools, or how to problem solve using the engineering design process when our machine just won't cooperate. We also learned how to communicate with each other regardless of how frustrated we got at times. It seems the days we would lock ourselves in a room with our machine to work from 10 to 8 would be seen as prison time, but we all grew as friends and engineers over the years. Even though at times it makes us stressed and a little annoyed, it's still an activity we all look forward to.

Much of the things we learned were basic knowledge that we need in potential careers, to fixing something at home. For example, with our original electrical step, we had to learn how to connect small wires properly and safely. We also had to learn that sometimes an idea just won't work and that the solution could be much simpler than you originally thought.

Doing this project has taught us so much about the engineering design process and teamwork. We can't think of a better way to learn skills that we will remember for the rest of our lives.

9. Document Word Count: 1937 words of 2500 limit



10. Bibliography

"Baking Soda and Vinegar Experiment." *Primary Connections: Linking Science with Literacy*, The Australian Academy Of Science, *https://www.primaryconnections.org.au/themes/custom/connections/assets/SBR/data/Chem/sub/baking/baking.htm#:~:text=The%20reaction%20is%3A,dioxide%2C%20water%20and%20sodium%20acetate.&text=The%20 solid%20baking%20soda%20was,bubbles%20in%20the%20foaming%20mixture*