Team Advisors

Mission Folder: View Mission for 'Power Play'

State	Maine
Grade	8th
Mission Challenge	Alternative Sources of Energy
Method	Engineering Design Process
Students	couldnt_find_a_good_username couldnt_find_a_username_either tennis2016 Bigvin123

Team Collaboration

(1) Describe the plan your team used to complete your Mission Folder. Be sure to explain the role of each team member and how you shared and assigned responsibilities. Describe your team's process to ensure that assignments were completed on time and deadlines were met.

Our team began working on Ecybermission by the end of October, 2015. We first needed to come up with which field we would work on this year. By the beginning of November we decided to work on alternative sources of energy and began brainstorming, We wanted to create and design a device that would generate electricity for communities in need while providing a healthy and fun lifestyle for families and their children. During the 2nd week of November we had tons of ideas to choose from and we chose the idea of making fun equipment for children that they could use everyday. What better source of fun for kids than a playground. All of our team members worked on research for 1 hour every Wednesday. We started to develop the idea of playground equipment and started to distribute jobs to each of our team members. We did our best to distribute jobs equally based on our strengths and talents. Vincent had experience in the construction so he was in charge of the construction process. Grace scheduled most of our meetings and when we would meet with teachers.Vincent and Grace mostly worked on the construction of our model and prototype. They would go down to the tech ed room to build and then improve upon this design. Mr. Groening, the Tech Ed teacher at Troy Howard Middle School, would be there to help mentor our construction and engineering part of our mission. Once they completed the merry-go round, we all started to test and experiment with our merry-go round. We would take all of our data and info and put it into a google doc. This is where most of our information, data, and notes were kept. This was so that we could all easily access them from home. Josh answered mission questions and kept in touch with our . Before he wrote in the answers the whole team would discuss what needed to go into that answer. Sydni would take notes, do bibliographies and was in charge of research. She would tell the rest of our team what we needed to research on a specific day. We were all able to distribute workload equally and we agreed on most occasions. Our teamwork was strong and we were able to meet our deadlines.

Uploaded Files:

- [View] **Team Collaboration 1** (By: tennis2016, 02/25/2016, .JPG)
  Vincent assembling merry-go-round base
- [View] **Team Collaboration 2** (By: tennis2016, 02/25/2016, .JPG)
  Grace assembling pulley system
- [View] **Team Collaboration 3** (By: tennis2016, 02/25/2016, .JPG)
  Josh, Sydni, and Vincent testing first prototype
- [View] **Team Collaboration 4** (By: tennis2016, 02/25/2016, .JPG)
  Vincent and Josh testing second prototype
- [View] **Team Collaboration 5** (By: tennis2016, 02/25/2016, .JPG)
  Grace and Josh drilling holes for third prototype

Engineering Design

Problem Statement

(1) What problem in your community did your team try to solve? Why is this problem important to your community?

75% of the human emissions released from the past 20 years are from fossil fuels. This is why the topic of alternative sources of energy is big in the science field, but not big enough. When fossil fuels are burned they emit toxic gases such as hydrocarbons, carbon monoxide, sulfur and nitrogen oxides, and many more. Our town of Belfast has been making efforts to keep the area green. Pollution will cause problems anywhere but especially with all the farms in Maine, keeping the air clean is very important. This is why our team is trying to come up with a design that the whole community can use to generate electricity. Taking kinetic energy and converting it into electricity was the approach we wanted to take. Our team was thinking of common areas where a lot of kinetic energy was present. The playground. From the swings to the see-saws to the slide kinetic energy was everywhere. This is why we wanted to use playground equipment to generate electricity. We feel as though helping out our community by finding an alternative source of energy will definitely be important to the communities goal of becoming greener.

(2) List at least 10 resources you used to complete your research (e.g., websites, professional journals, periodicals, subject matter experts).

Websites Used:

"Energy Poverty." Energy Poverty. N.p., n.d. 23 Feb. 2016. Website, electronically published.
(http://www.iea.org/topics/energypoverty/)

"Solar & Alternative Energy." A Scalable Solution to Harvest Kinetic Energy. N.p., n.d. Web. 23 Feb.
2016
(http://spie.org/newsroom/technical-articles-archive/3749-a-scalable-solution-to-harvest-kinetic-energy)

"U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." How Much Electricity Does an American Home Use? N.p., n.d. Web. 23 Feb. 2016
(.https://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3)

Roller, Emma. "Hike, Kick, and Dance to Charge Your Gadgets." The Body Electric. Slate, n.d. Web. 23 Feb. 2016.
(http://www.slate.com/articles/health_and_science/alternative_energy/2013/03/kinetic_energy_harvesting_technology_to_power_lights_cell_phones_medical.html)

"Thermodynamics:Kinetic and Potential Energy." Kinetic and Potential Energy. N.p., n.d. Web. 23 Feb. 2016.
(https://www.chem.wisc.edu/deptfiles/genchem/netorial/modules/thermodynamics/energy/energy2.htm)

"U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." Maine State Profile and Energy Analysis. US Department of Energy, n.d. Web. 23 Feb. 2016.
(https://www.eia.gov/state/analysis.cfm?sid=ME)

"News." How Does a Wind Turbine Generate Electricity. N.p., 2016. Web. 25 Feb. 2016. (http://goldpower.net/news/how-does-a-wind-turbine-generate-electricity/)

"DC Motor." N.p., n.d. Web. 25 Feb. 2016. (http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/motdc.html#c1)

Brinson, Linda C. "How Much Air Pollution Comes from Cars?" HowStuffWorks. N.p., 29 Aug. 2012. Web. 25 Feb. 2016. (http://auto.howstuffworks.com/air-pollution-from-cars.htm)

"Why Are Fossil Fuels Bad for the Environment?" Why Are Fossil Fuels Bad for the Environment? N.p., 2016. Web. 25 Feb. 2016. (http://www.bionomicfuel.com/why-are-fossil-fuels-bad-for-the-environment/)

"Fossil." Fossil. N.p., n.d. Web. 25 Feb. 2016. (http://www.energy.gov/science-innovation/energy-sources/fossil)

"Historical Timeline - Alternative Energy - ProCon.org." ProConorg Headlines. N.p., 2016. Web. 25 Feb. 2016. (http://alternativeenergy.procon.org/view.timeline.php?timelineID=000015)

Nate. "How to Use a Multimeter." How to Use a Multimeter. N.p., n.d. Web. 25 Feb. 2016. (https://learn.sparkfun.com/tutorials/how-to-use-a-multimeter/measuring-voltage)

Teachers/Experts Consulted:

Mr. Steve Groening, Technical Education (Shop) Teacher, Troy Howard Middle School. person.
(sgroening@rsu71.org)

Mrs. Beth Haynes, Science Teacher, University of Maine. person.
(bhaynes@rsu71.org)

Miss Sarah Joy, Librarian, Troy Howard Middle School
(sjoy@rsu71.org)

Mr. Rafe Blood, Science Teacher, Troy Howard Middle School. person.
(rablood@rsu71.org)

(3) Describe what you learned in your research.

Oil will not only run out one day it also is not very safe to our planet. When fossil fuels are burned gases are released and many of them are toxic. Some gases are: sulfur oxides, carbon dioxide and monoxide, and hydrocarbons. Also about 75% of human emission come from the burning of fossil fuels. These are reasons why moving away from these fossil fuels is the best choice for now and the future.
When anything moves it becomes some form of kinetic energy. We also can harness kinetic energy and turn it into electricity. Then why not do it? When we use mechanical energy to turn the coil in a magnetic field in produces motional emfs (voltage). When the coil spins it generates a voltage proportional to the rate of change in the magnetic field. This is a form of Faraday's law which says, "Any change in the magnetic environment of a coil of wire will cause a voltage (emf) to be "induced" in the coil." (http://hyperphysics.phy-astr.gsu.edu/hbase/electric/farlaw.html#c1) Wind turbines generate electricity using the same principal. When wind blows it catches in on the blades of the turbine which spins a shaft connected to a generator. Other forms of human activity based kinetic energy turned electricity are stationary bikes, shoes that convert walking into electricity, and so many more. Harvesting kinetic energy is definitely big as an alternative source of energy.
Our merry-go round will also provide a healthy lifestyle for countries where it provides a place for kids and adults to get healthier. Physically and mentally. While they are getting stronger they are also providing for their community by generating electricity.

Experimental Design

(4) Develop a design statement. Be sure to describe what exactly your device should be able to do. Do not describe HOW it's going to do what it needs to do.

The device that our team will design will be a merry go round that will be able to generate electricity from kinetic energy.

(5) Determine the criteria for a successful solution and identify constraints for your design. Discuss what the device must have in order to accomplish its job and the restrictions of the device (i.e. the size, the cost, the weight, etc.).

Refer to file Criteria/Constraints

(6) Identify the relevant variables you will use to test your prototype or model and explain how you will measure your variables.

One relevant variable that we will measure is voltage that is being generated by the motor. When the merry-go-round spins, a pulley on the merry-go-round spins the pulley on the motor. Then we will measure the voltage produced using a multimeter. We will set the multimeter to 20V DC and record the readings on the multimeter. Another relevant variable to our merry-go-round were the motors. We used different sized motors and different amounts of motors. For our first prototype we used one 6V motor. For our second prototype we used one 12V motor. For the third prototype we used four 12V motors.

Build Prototype or Model

(7) Develop a design and list the materials you used in your design. Include technologies you used (e.g., scientific equipment, internet resources, computer programs, multimedia, etc.).

First Prototype Materials:
5 1/2 in. by 3/4 in. pine board (1)
3 in. plastic wheel (1)
4 in. cardboard circle (1)
PROJECT MOTOR, 3V-6V (1)
small 5 1/2 in. by 3/9 in. (2)
1 1/2 in. pulley (1)
1/8 in. aluminum rod (1)
rubber band (1)

Second Prototype Materials:
5 1/2 in. by 3/4 in. pine board (1)
3 in. plastic wheel (1)
4 in. cardboard circle (1)
PROJECT MOTOR, 6V-12V, 0.14A (1)
small 5 1/2 in. by 3/9 in. (2)
1 1/2 in. pulley (1)
1/8 in. aluminum rod (1)
rubber band (1)

Third Prototype Materials:
5 1/2 in. by 3/4 in. pine board (1)
3 in. plastic wheel (1)
4 in. cardboard circle (1)
PROJECT MOTOR, 6V-12V, 0.14A (4)
small 5 1/2 in. by 3/9 in. (2)
1 1/2 in. pulley (4)
1/8 in. aluminum rod (1)
rubber band (4)

Materials Used for Testing:
Electric Drill (1)
Multimeter (1)

(8) Explain how you built your prototype(s) or model(s). Include each of the steps in your process.

1. Analyze the Problem - We brainstormed on easy ways to create electricity
2. Decide on Model - Our team chose the merry-go round as our playground equipment to create electricity. We chose the merry-go round because it had a constant rotating motion. We then made a model of the merry-go round. (See file: prototype 1,2,3) The whole model was on a wooden board with two legs so that the shaft of the merry-go round and the motor wouldn't touch the ground. The merry-go round was on a shaft with a wheel and pulley. One pulley was on the shaft and the other on the motor. A rubber band connected the two pulleys together. The pulley connected to the merry-go round was bigger than the one on the motor so that just one spin on the big pulley would create multiple spins on the small pulley. We first used a 6 volt motor and we generated some electricity. (See file: Prototype 1)The way we got the merry go round spinning was to attach the shaft to a drill and spin the merry-go round clockwise. Then we decided to use a larger 12 volt motor to generate more voltage. (See file: prototype 2)Our data showed us that the amount of voltage generated almost quadrupled. Then we figured we would try to generate the most electricity possible so we tried connecting four pulleys to four separate 12 volt motors. (see file: prototype 3) We tested it but with four motors equals four times the force so that prototype was unsuccessful. We all agreed to not use the third prototype. So we went back to our second prototype with just one 12 volt motor.

Test Prototype or Model

(9) Describe the data you collected and observed in your testing (use of data tables, charts, and/or graphs is encouraged).

See 6V, 12V Motor Voltage Output file
We collected the data for the voltage each motor could produce. The data table and graph we have provided is showing how the size of the motor affects how much voltage is being generated. This is by spinning the metal shaft with a drill to near maximum speeds. This information was collected with a multimeter.

(10) Analyze the data you collected and observed in your testing. Does your data support or refute your design statement? Do not answer with yes or no. Explain your answer using 'Our data supports/refutes the design statement because...'

Our data supports the design statement because we have achieved designing and engineering a merry-go-round that generates electricity. Our first prototype somewhat achieved the goal of generating electricity. Data showed us that even when the drill was going at high rpm the capacity of the motor was not allowing it to generate as much electricity as we would have wanted. Our second prototype was able to meet the standard of our design statement. It showed us almost four times the electricity that our first prototype produced. So, we concluded that our final prototype has achieved the design statement however, for the purpose of using this merry-go-round as a main source of energy, our design is not quite there yet.

(11) Explain any sources of error and how these could have affected your results

Our main source of error which would result in the inconsistency of our data would be the RPM of the drill. We would try to spin the merry-go round as consistently as possible for each experiment but we had no way of having the exact RPM every time. Other sources of error would come from the pulley sliding just a little bit or the height of the motor changing slightly between each test.

Drawing Conclusions

(12) Interpret and evaluate your results and write a conclusion statement that includes the following: Describe what you would do if you wanted to retest or further test your design. Evaluate the usefulness of your prototype or model. What changes would you make to your prototype or model for the future, if any?

In conclusion we have been able to design a merry-go-round that can generate electricity which was our original design statement. If we had more time to make a new procedure we would make sure that the rpm of the merry-go-round is consistent every time we test it. With more funding we would experiment with different types of motors and generators. The types of motors we would like to use would be a larger brushed DC motor or a permanent magnet generator mostly used by wind turbines. Also we would like to be able to store the electricity that we generate. The next step in our design would be to connect the motor/generator to a battery or capacitor so that the electricity that is created could be distributed anywhere. We would want to use more realistic materials and make the prototype more to scale. This prototype will be useful to our community by providing another source of energy. We could place the merry-go-around in parks and schools which would benefit the school and community. To conclude, our design has been able to produce electricity which is a start but, we are hoping with further research and design we will be able to make our merry-go-round power homes and communities.

Uploaded Files:

- [**View**] **Criteria/Constraints** (By: tennis2016, 02/25/2016, .pdf)
  Answers Question 5
- [**View**] **6V, 12V Motor Voltage Output** (By: tennis2016, 02/25/2016, .pdf)
  Part of question 9
- [**View**] **Prototype 1** (By: tennis2016, 02/25/2016, .JPG)
  This is a picture of our first prototype. One 6 volt motor was used.
- [**View**] **Prototype 2** (By: tennis2016, 02/25/2016, .JPG)
  This is a picture of our second prototype. One 12 V motor was used.
- [**View**] **Prototype 3** (By: tennis2016, 02/25/2016, .JPG)
  This is a picture of our third prototype. Four 12 volt motors were used. This prototype failed because it took too much force to turn all four motors.

Community Benefit

(1) How could your design help solve your problem and benefit your community? Describe next steps for further research/design and how you have or how you could implement your solution in the future.

Studies show oil and other fossil fuels will not be very effective in the future because of all their emissions and the fact that they will eventually run out. Belfast and every town out there needs a more sustainable energy source. Our merry-go-round will benefit our community most definitely. Belfast, ME is making many efforts to become an eco friendly city. Our town has an ecovillage with co-housing which is when members of the village share resources. (See Ecovillage File) Many buildings around town have solar panels including our own school. (See THMS Solar Panels file) This playground equipment will be another to add on to the list of alternative sources of energy. In further research and design our merry-go round will be able to store the electricity that we are able to generate. If we had more funding our main focus would be to build a full scale design. We could then place this merry-go round at a park we could record more accurate data of how much more energy a larger scale product could produce. We could also in further research learn the exact cost of this design and how we could make it more cost efficient. The reason we would try to make it more cost efficient would be so that we could build them in multiple places including developing countries around the world. Electricity will benefit them by being able to power water wells, filter water, run refrigerators to store food longer, and so much more. We believe our design will help out not only now but in the long run.

Uploaded Files:

- [**View**] **THMS Solar Panels** (By: tennis2016, 02/25/2016, .jpg)
  The solar panels on our school roof
- [**View**] **Ecovillage** (By: tennis2016, 02/25/2016, .jpg)
  The ecovillage in Belfast, ME

Mission Verification

(1) Does your Mission Folder project involve vertebrate testing, defined as animals with backbones and spinal columns (which include humans)? If yes, team must complete and attach an IRB approval form.

No

(2) Did your team use a survey for any part of your project? If yes, team must complete and attach a survey approval form.

No

(3) You will need to include an abstract of 250 words or less. As part of the abstract you will need to describe your project and explain how you used STEM (Science, Technology, Engineering and Mathematics) to improve your community

Our whole nation has been making efforts to going green especially starting from the 60's and 70's. The whole "green" movement slowed down towards the turn of the century. America resumed the efforts of becoming eco-friendly about a decade or so ago. Harvesting kinetic energy has become an alternative source of energy. Our team tried to look at common places where lots of kinetic energy is present. We were looking for places around our community when we found exactly what we were looking for: the playground. We researched on how we could generate electricity using common playground equipment. Our team learned about the science behind how generators work and came up with a design for our merry-go-round. We also learned about how technology has affected alternative sources of energy throughout history. After going through the steps of research we began the engineering process. In order to get a general idea of how much electricity a merry-go-round could produce we designed, and engineered and re-engineered a small scale merry-go-round. Each prototype consisted of the merry-go-round, a pulley system, and a motor. The data we collected showed that our final prototype was capable of generating up to 8.44 volts. On this track our merry-go-round could be a very efficient provider for the community.

Team Collaboration 1 (By: tennis2016, 02/25/2016, .JPG)

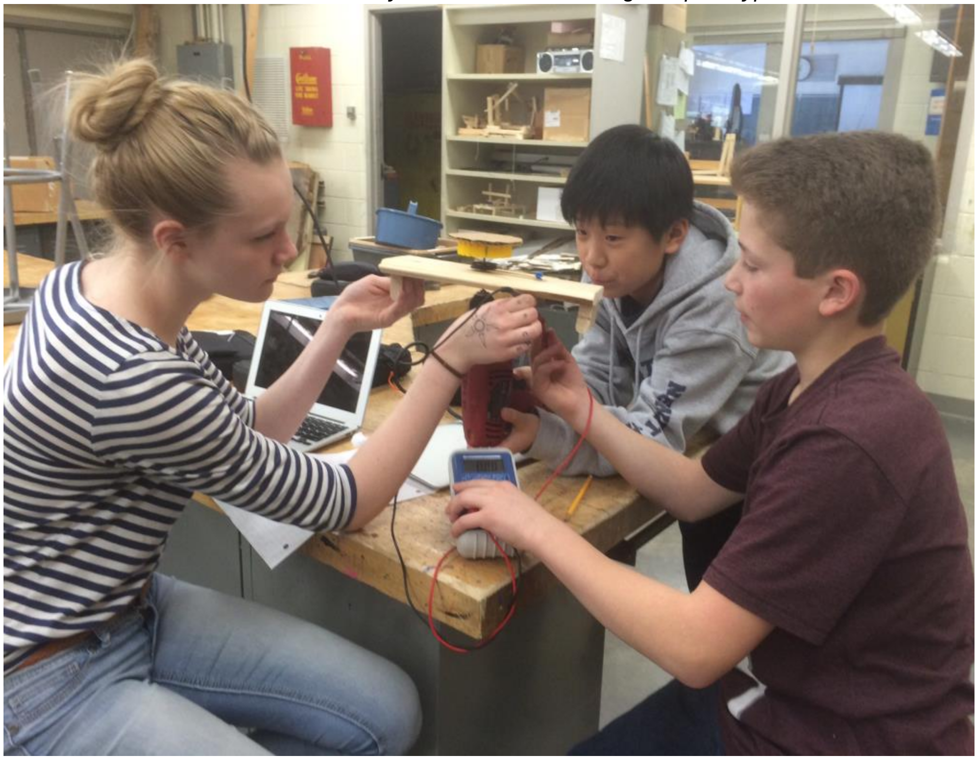
Vincent assembling merry-go-round base

Team Collaboration 2 (By: tennis2016, 02/25/2016, .JPG)

Grace assembling pulley system

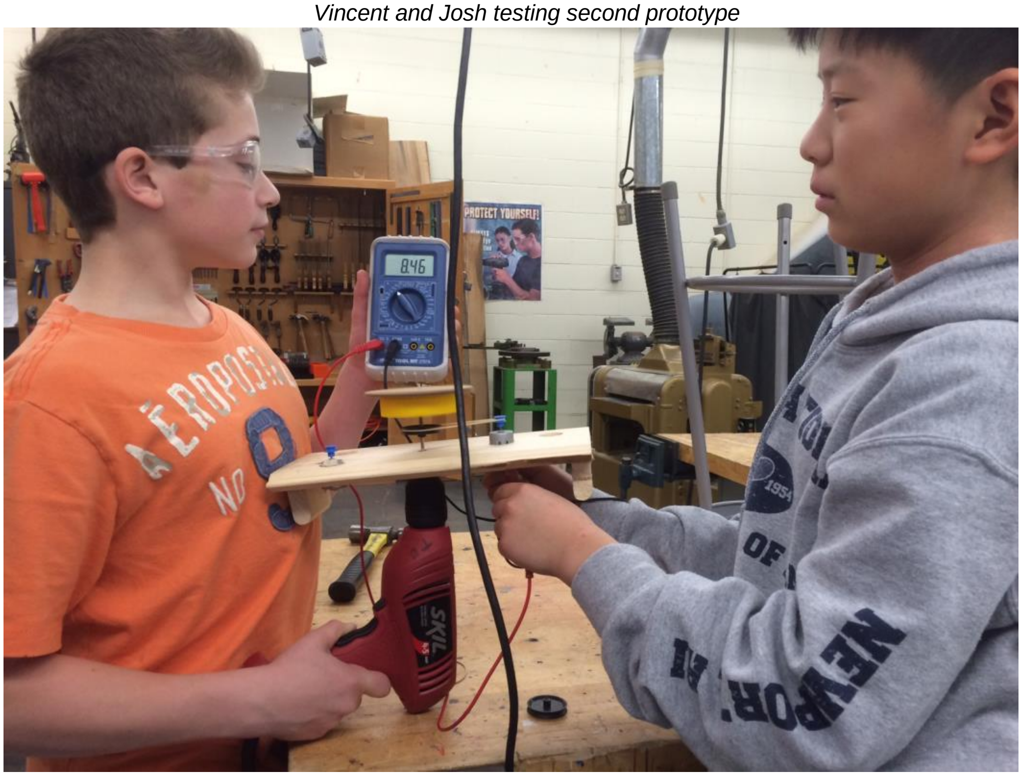
Team Collaboration 3 (By: tennis2016, 02/25/2016, .JPG)

Josh, Sydni, and Vincent testing first prototype



Team Collaboration 4 (By: tennis2016, 02/25/2016, .JPG)

Vincent and Josh testing second prototype

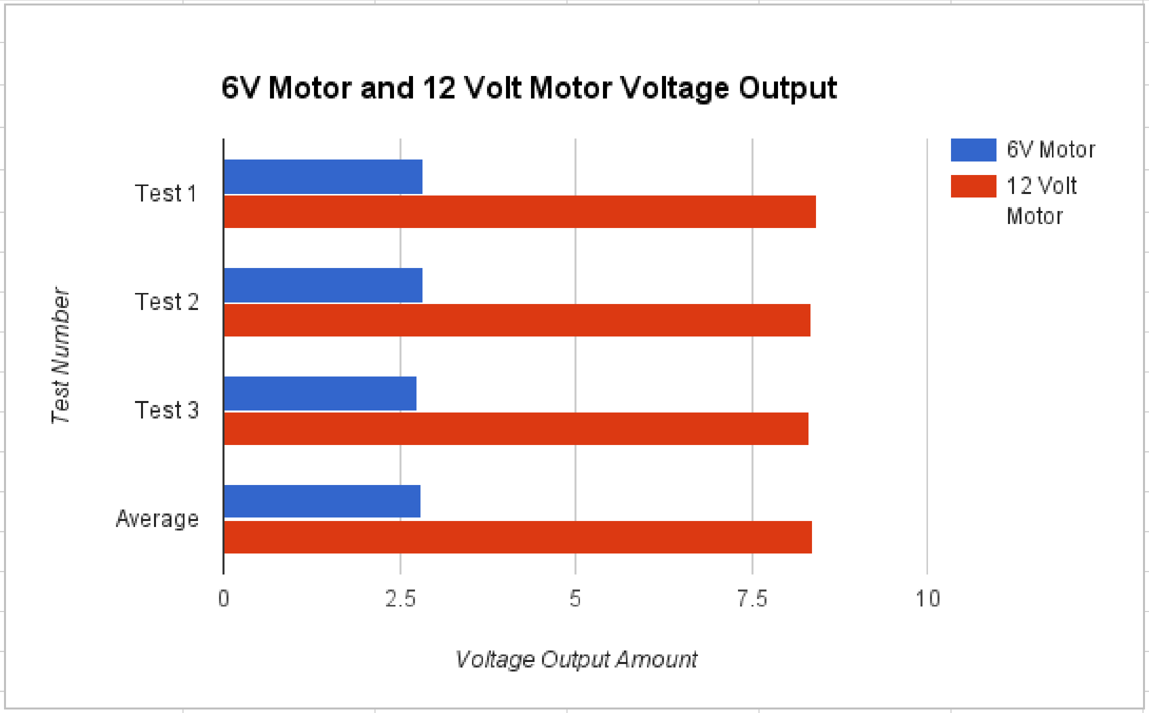


Team Collaboration 5 (By: tennis2016, 02/25/2016, .JPG)

Grace and Josh drilling holes for third prototype

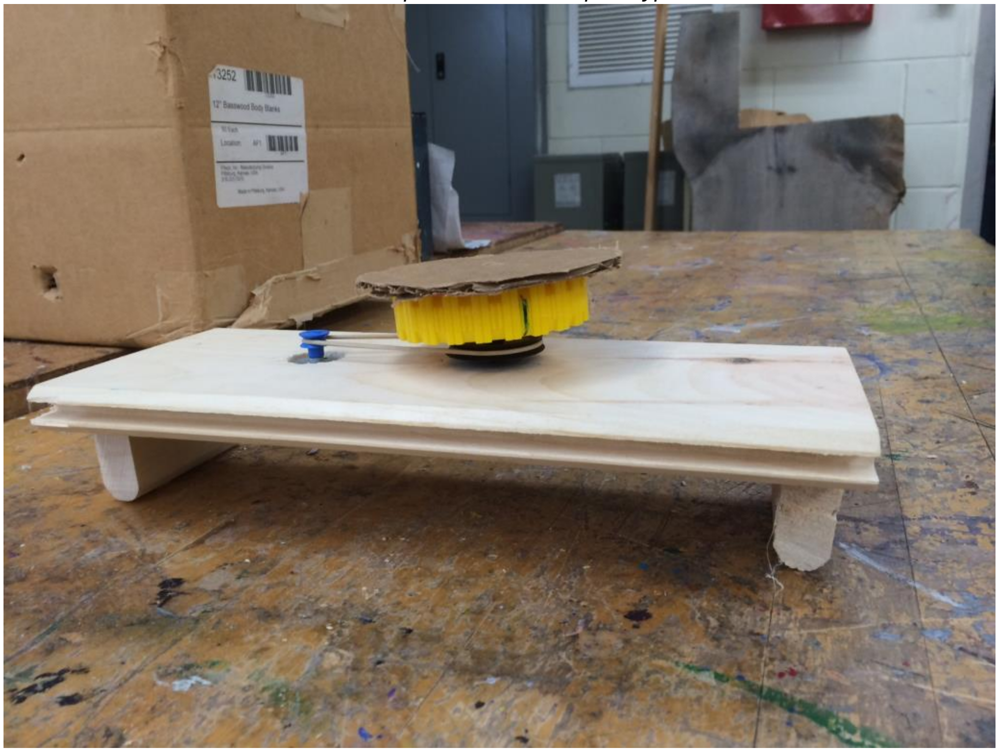
Criteria	Constraints
- Needs to able to spin like a merry-go-round. - It will have to spin as if it was a normal merry-go-round	- Money - We did not have enough money to make a larger scale with more realistic materials.
- Must generate electricity - The goal of our whole mission was to create a merry-go-round that can generate elctricity	- Time - If we had more time we would be able to do further research and develop a more.
- Needs to be safe - This design is geared towards children and their families so it needs to be safe to use	- Human Error - If there was not any human error then the design would have been more precise and consistent

Test Number	6V Motor	12 Volt Motor
Test 1	2.85	8.44
Test 2	2.84	8.36
Test 3	2.77	8.32
Average	2.82	8.37



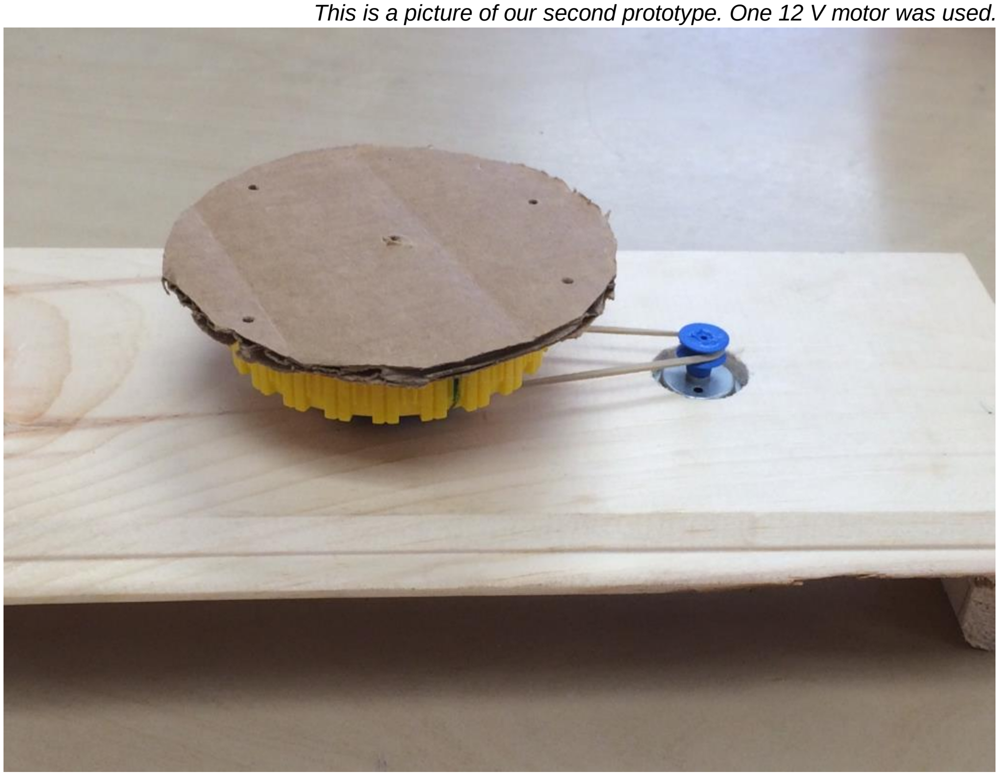
Prototype 1 (By: tennis2016, 02/25/2016, .JPG)

This is a picture of our first prototype. One 6 volt motor was used.



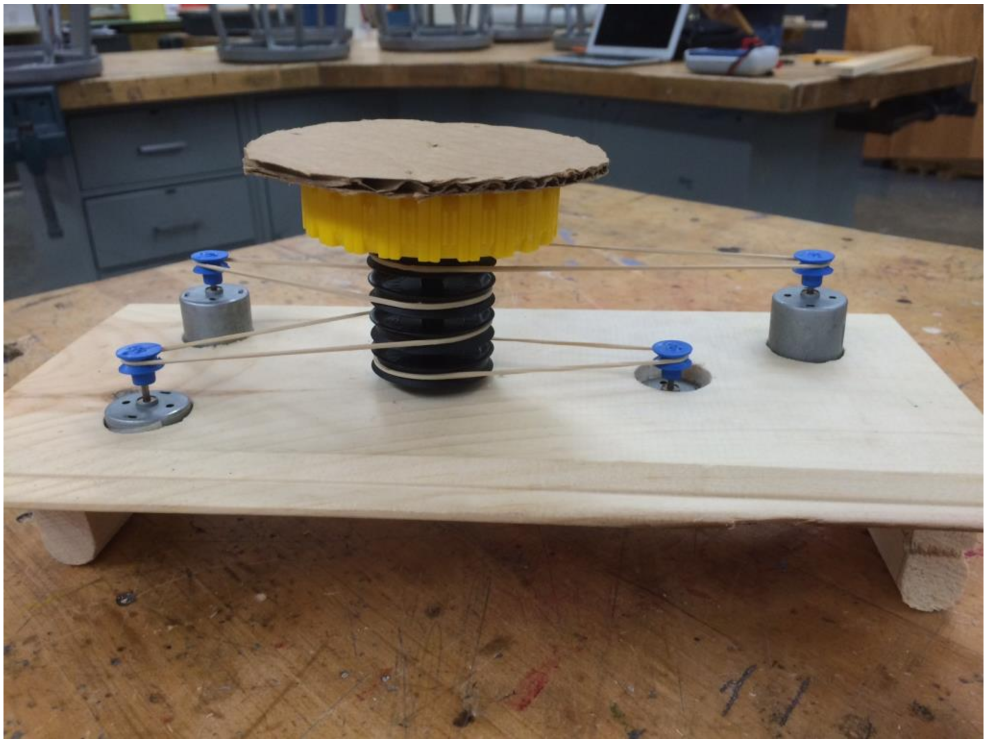
Prototype 2 (By: tennis2016, 02/25/2016, .JPG)

This is a picture of our second prototype. One 12 V motor was used.



Prototype 3 (By: tennis2016, 02/25/2016, .JPG)

This is a picture of our third prototype. Four 12 volt motors were used. This prototype failed because it took too m all four motors.



THMS Solar Panels (By: tennis2016, 02/25/2016, .jpg)

The solar panels on our school roof

Ecovillage (By: tennis2016, 02/25/2016, .jpg)

The ecovillage in Belfast, ME