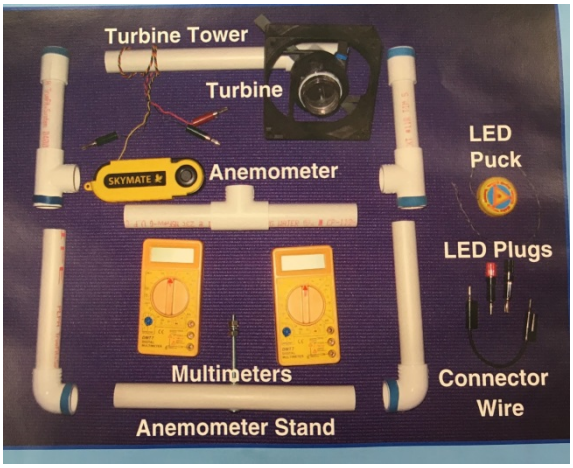
Tobolloco's Wind Turbines and Design Details

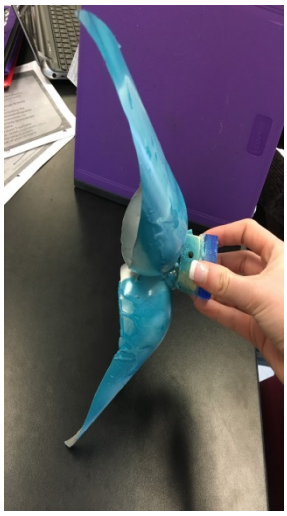
Team: Tobolloco

Goal: The goal of this project was to design and build three wind turbines that produced a large amount of power.



This contraption will be used once your pinwheel has been made. A fan will be placed in front of it to create wind, Your pinwheel will be attached to the hub, and the anemometer will show the wind speed while the multimeters will show the current and voltage which will be used to calculate the power the pinwheel is creating.

Design #1:



Materials:

- 3 SmartWater™ Bottles
- Glue Gun with Glue Sticks
- X-ACTO knife
- One nail
- Star washer
- Wooden circle w/ a hole drilled down the center
- Plastic juice bottle cap
- Sharpie or Permanent Marker

Angle of Blades:

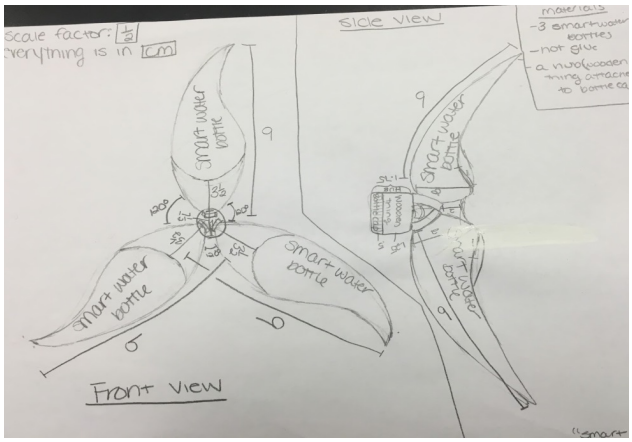
The blades were glued on the "hub" at a 0 degree angle.

Amount of Blades:

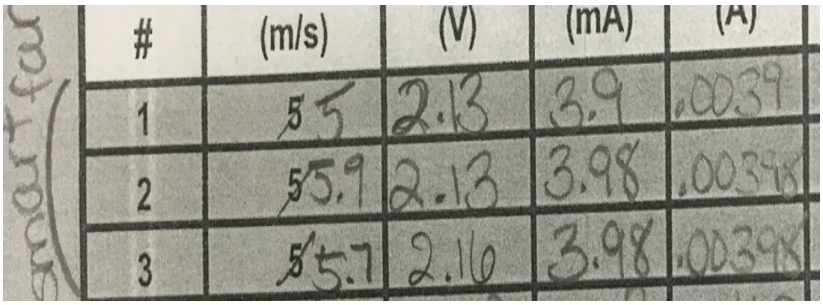
This design had three blades. This is because the group thought that three blades weren't too heavy while four blades may be, and that three blades would "catch" just enough wind/air from the fan, which would be used to spin the blades and create power, while two blades would not "catch" enough of the air. This is also why the blades were curved inwards-to catch some of the air blowing towards it which can be used to push it along.

Direction of Wind:

The direction of the wind to the blades is towards it. The fan faced right in front of the turbine.

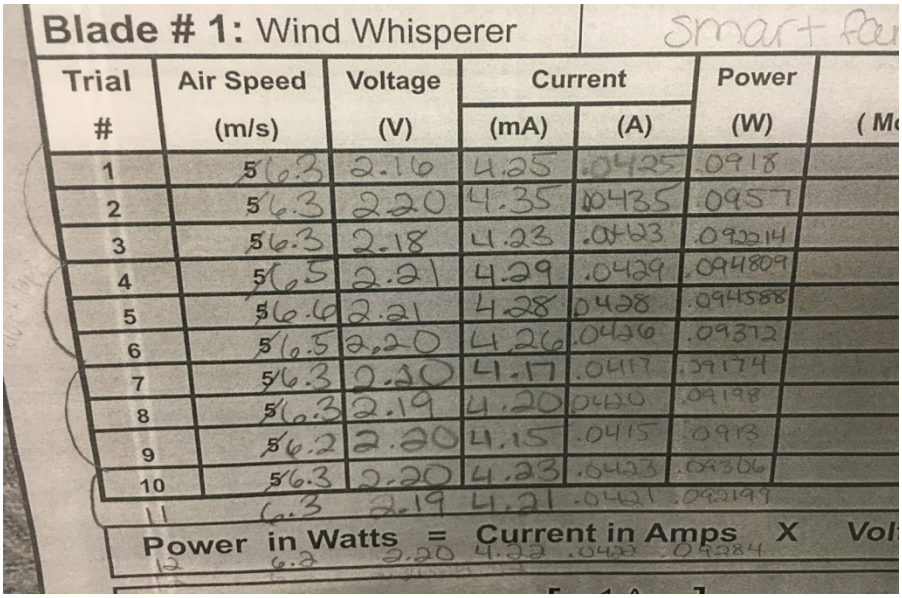


The scale drawing of the front and side view of the first design.



#	(m/s)	(V)	(mA)	(A)
1	5 5	2.13	3.9	.0039
2	5 5.9	2.13	3.98	.00398
3	5 5.7	2.16	3.98	.00398

The first three trials of the first design.
There is a fairly large amount of "Current".



Blade # 1: Wind Whisperer

Trial #	Air Speed (m/s)	Voltage (V)	Current (mA)	Current (A)	Power (W)
1	5 6.3	2.16	4.25	.0425	.0918
2	5 6.3	2.20	4.35	.0435	.0957
3	5 6.3	2.18	4.23	.0423	.092214
4	5 6.5	2.21	4.29	.0429	.094809
5	5 6.6	2.21	4.28	.0428	.094588
6	5 6.5	2.20	4.26	.0426	.09372
7	5 6.3	2.20	4.17	.0417	.09174
8	5 6.3	2.19	4.20	.0420	.09198
9	5 6.2	2.20	4.15	.0415	.0913
10	5 6.3	2.20	4.23	.0423	.09306
11	6.3	2.19	4.21	.0421	.092199
12	6.2	2.20	4.22	.0422	.092884

Power in Watts = Current in Amps X Vol

Four sets of three trials of our first design. These trials were taken because this was our best design.

Procedure for Design #1:

Materials:

- 3 SmartWater™ Bottles
- Glue Gun with Glue Sticks
- X-ACTO knife
- One nail
- Star washer
- Wooden circle w/ a hole drilled down the center
- Plastic juice bottle cap
- Sharpie or Permanent Marker

1. **Take 3 SmartWater™ Bottles. Use a Sharpie or permanent marker to draw the shape of the blade. This blade design could be compared to a curved teardrop. Make sure that at the base of the blade, the blade is curved in, like a little bowl, before it spreads out to the rest of the shape (this may help "catch" some of the wind that the fan is blowing towards it). The bottom of the blade (curved bowl) should be drawn near the mouth of the bottle (but not too close). Make sure the blades all look as much alike as possible on each bottle.**
2. **Then, use an X-ACTO knife to cut the mouthpiece and bottom off the bottle (it is okay for there to be a little lip there, because you will apply glue to that later to attach it to your hub). Try to make the edges of the bottle as smooth as possible (including the mouthpiece). You can then cut out your blade. Do this on each bottle.**
3. **Next, you are going to make the "hub". Take the small wooden circle (about the size of a juice cap) and drill one hole down the center (when it is lying flat). Place the bottle cap (flat side touching wood) on top and center it. Continue drilling the hole down the center of the juice cap. Then twist the star washer on to the screw. This will help keep everything in place.**
4. **Now, take your blades and glue the mouth of the blade on to the side of the "hub" using hot glue. Make sure the blade is being glued on at a 0 degree angle. Glue the next two blades on making sure they are spaced as evenly as can be.**

Design #2:

Materials:

- 3 SmartWater™ Bottles
- Glue Gun with Glue Sticks
- X-ACTO Knife
- One Nail
- Star Washer
- Wooden Circle (w/ a hole drilled down the center)
- Plastic Juice Bottle Cap
- Sharpie or Permanent Marker

Angle of Blades:

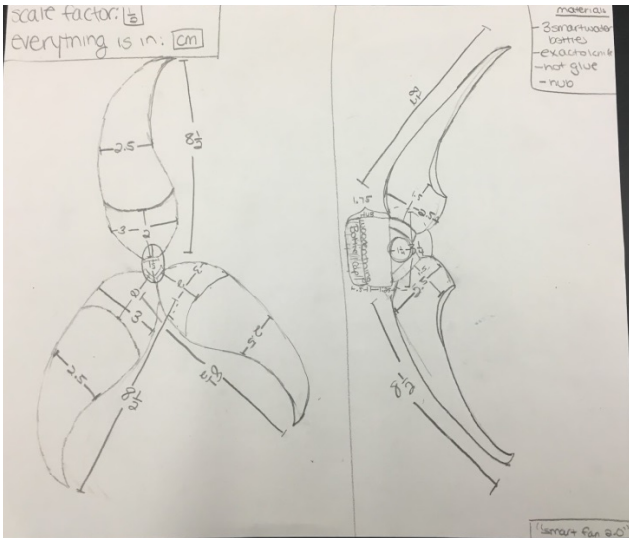
The blades were glued on the "hub" at a 0 degree angle.

Amount of Blades:

This design had three blades. This is because the group thought that three blades weren't too heavy while four blades may be, and that three blades would "catch" just enough wind/air from the fan, which would be used to spin the blades and create power, while two blades would not "catch" enough of the air. This is also why the blades were curved inwards-to "catch" some of the air blowing towards it which can be used to push it along (more down below).

Direction of Wind:

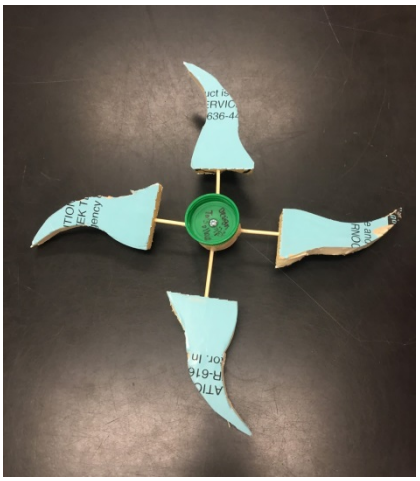
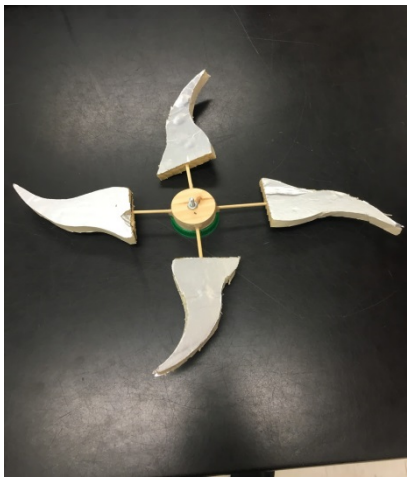
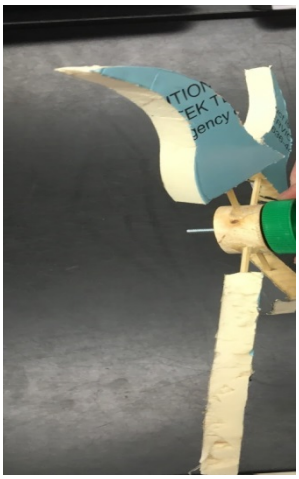
The direction of the wind to the blades is towards it. The fan faced right in front of the turbine.



The scale drawing of the front and side view of the second design.

The only thing that changed in this design is that the group made the blade-length shorter because they wanted to see if it would affect the outcome and change the amount of power considerably. As you can see in the data table below, the amount of power was far less* than the first trial which had the longer blades. A theory can be made that this large change in outcomes could be because of the blade length. Since this was the only variable changed between the two trials we can assume that the longer the blades, the more power because there is a larger surface area which the air will make contact with. With this design, the voltage was pretty close to the first design's amount, but the current was about half of Design #1's current. The current really affected the amount of power that was produced.

Design #3:

Materials:

- Foam Insulation
- Four Wooden Dowels
- One Nail and Star Washer
- Wooden Circle (w/ a hole drilled down the center and 4 holes along the sides evenly spread apart)
- Plastic Juice Bottle Cap
- Sharpie or Permanent Marker
- Hot Glue and Glue Gun

*Compared to first set of trials from Design #1

Angle of Blades:

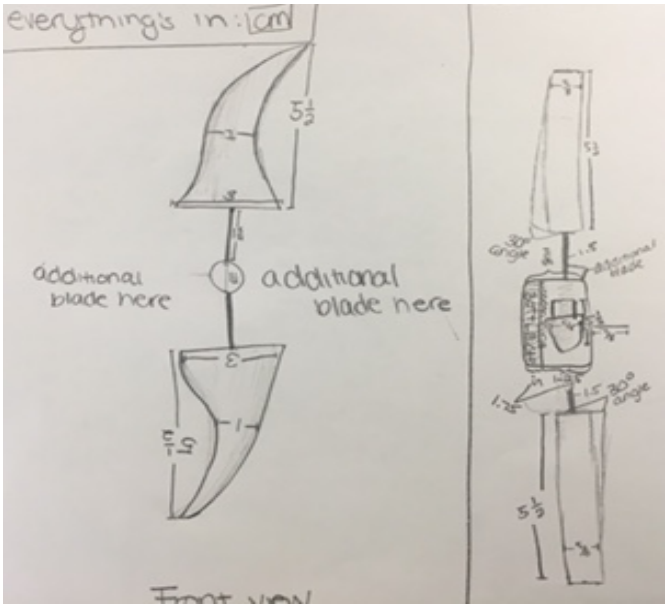
The group chose to angle the blades at a 30-degree angle. They wanted to see what angling the blades might do to the amount of power. They thought that if they angle the blades slightly, there would be more of a surface area, which the wind/air could push on.

Amount of Blades:

This design had four blades. The group noticed that the Insulation used was very light and so they thought they could try using four blades and it would not weigh the turbine down. They also wondered if four blades would be good because that meant there would be a larger surface area, so they gave it a try to see what would happen!

Direction of Wind:

The direction of the wind to the blades is towards it. The fan faced right in front of the turbine.



The scale drawing of the front and side view of the third design.

Trial #	Air Speed (m/s)	Voltage (V)	Current (mA)	Current (A)
3				
7	~~5~~ 5.9	.67	0.00	0
8	~~5~~ 5.9	.57	0.00	0
9	~~5~~ 5.9	.60	0.00	0
10	5			

Three trials of the third design.

This design did not do very well. The voltage was very low and there was no current. Since this design was very different than the first two designs, there is not one variable that can show or can prove what happened or what helps produce power. Some of these variables include number of blades, angle of blades, shape of blades/surface area, and more. The only variable that changed between Design #1 and #2 was the blade-length (surface area-a variable) (Design #2 was shorter) and so the weight (another variable) wasn't affected too much. Design #3 was very different and so many things could have affected how much power it produced.

Sources:

Mogielnicki, J., D. Harmon, J. Kramer, D. Lyons, D. Lentine, D. Taylor, and MC Baker. *Power in the Wind. Create It Lab*. N.p., n.d. Web. Mar.-Apr. 2016. <http://createitlab.org/static/pdf/PinWind_V29Sb_L.pdf>.