Day One 2/14/09

Today we began our construction on the mini desktop trebuchet. First, we cut out all of the pieces of wood that were given to us. Next, we sand each piece to get rid of any rough sides. Afterwards, we measured the dowel and marked it at 4", and marked two 1.5" dowels. We then cut the dowel at the markings and sanded the rough ends. Next, we sanded the end of the pin so that it was rounded, and we glued the paddle end into the arm slot, leaving a small hole going through the arm behind the pin paddle. After that, we glued the axle spacer blocks to the gussets. We glued the trough-side of the spacer onto the gusset. Next, we glued two of the counterweight pieces together, inserted the four stacks of pennies, 11 in each stack, and glued the remaining counterweight piece on top of the pennies. We then clamped the counterweight together as the glue dried.

Day two 2/17/09

On day two we began building the frame for the mini desktop trebuchet. We decided to make the solid face of the tie-beams and base to face outwards. We had some problems getting the frame to stay together because not all of the pieces were even. When glueing it together, we made sure that the base cross-beam with the holes went on one end of the frame. We then glued the trough onto the base cross-beams, right down the middle. After that we glued the gusseted axle blocks equal to the top of the frame, using the dowels to get it all in a straight line.

day three 2/18/09

We began day two by creating the sling. We cut a 4 inch long x 1½ inch wide piece of light weight fabric we then put 1½ inch long slits in each end of the fabric. After that, we overlapped the ends and tied string through the holes. Our string ended up being about 8 inches

long. We then used the 1.5 inch dowel to attatch the counterweight. Afterwards, we tied one end of the sling line to the hole behind the paddle in the arm tip, and tied a loop in the other sling line so that it hung from the pin. We made a trigger, but decided it was easier without it.

day four 2/19/09

We started the day by testing out the trebuchet. After testing a few times, we decided to sand down the paddle so the string releases sooner, so that it creates more of an arch rather than shoot in a straight line. We then decided to try out another sling. On the second sling we made one side 10 inches long, and the other 12 inches long. We soon found that this didn't work, so we stuck to the first string.

day five 2/20/09

Today we worked on shooting our treauchets at targets. We decided it is best if we use something to lift it up in the front to once again give the ball

more arch. We focused on changing up the angles to see which worked the best.

day six 2/25/09

After watching others teams shoot their trebuchets, we realized ours would work better if we shortened the string. Doing this added more arch and distance, so we didn't need anything to lift the front up.

day seven 3/9/09

Rules:

Design

- the height of the top of the pivot point must be less than or equal to 2 feet 2 inches from the ground
- the throwing arm must be no larger than 3 feet. (Includes sling hook)
- Top pivoting level may not be less than $\frac{1}{4}$" thick.
- Counterweight must be detachable, and can't come in contact with the throwing arm.
- trebuchets or platforms must have soft feet. No rubber or wooden feet.

- If wheels are used, trebuchet must be on a platform to stop rolling motion
- No loose parts allowed.
- No springs, rubber bands, flexible arms, etc. allowed.
- No pulleys or ball bearings can be used.
- Counterweight must be attatched, not looped over the end of the arm.
- counterweight must be the same as that provided in the trebuchet material kit.
- counterweight must be either: a) dangling throughout the entire throwing motion (makes no contact with other parts of the trebuchet lever arm), OR b) must be rigidly attached to the arm (ie. doesn't slide, wiggle, etc.)
- counterweight must be attached so that it does not come free on its own.
- top pivoting lever must not be able to lift off the ground in the cocked position until the counterweight is attached. Any fastening devices to be used in the competition will be included as part of the arm during testing for balance.
- top pivoting lever must not be collapsible

- top pivoting lever must be balanced toward the projectile end throughout the entire range of motion
- fastening devices will be included as part of the arm during balancing test
- firing release mechanism is NOT required.

Building the trebuchet

day one 3/18/09

28in Today, we decided how we were going to build our trebuchet. We decided were going to make a big trebuchet, and one 3/5 the size. We also decided we are going to try to use a scoop instead of a sling. We also chose to have our weight fixed

Day two 3/19/09

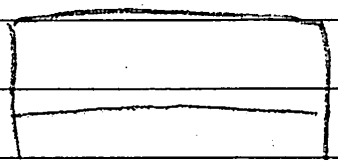
Today, we began building the frame of our trebuchet. We made the trebuchet 1'6" wide, 2'1" tall, and 3'8" long. We spent all of today assembling these pieces. We used pvc pipe and pipe cutter.

Day three 3/20/09

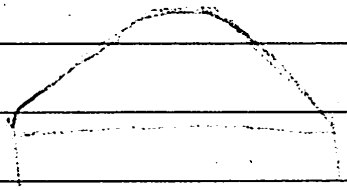
Today, we worked on the arm of our trebuchet. Since we plan on trying a scoop and having a fixed weight, we made the length of the arm 26in. Adding the fixed weight will make it 28in and we plan on finding a scoop that won't make the arm longer than 36in. We also used this day to talk about using sand or cement in the bottom of the trebuchet. We used [illegible] weight for the arm.

day 4 3/25/09

Today we began working on our smaller trebuchet. We made it 1'6" wide + 3'8" long. We decided to make it squared like this:



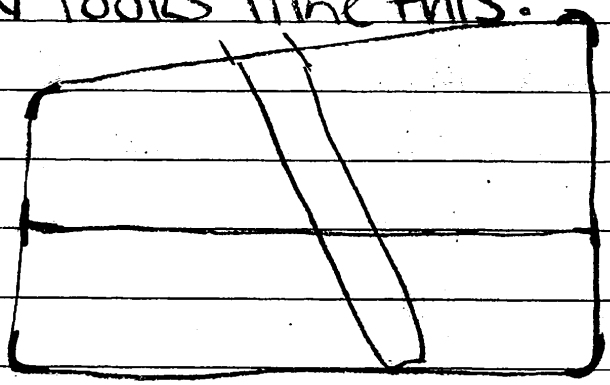
istead of at an angle like our other trebuchet, which looked like this:



We decided to do this because our smaller one is already sturdy enough because of the size. The arm is going to be in the middle of the trebuchet. Later we decided to reduce the width of the trebuchet to 1' because the threaded pipe was too short. The arm is

day 5

Today we reduced the width of our trebuchet once again to accomodate the length of the threaded pipe. The width is now 10 1/4". We added the counter-weight to our second trebuchet as well. Now we were able to launch it for the first time. The errors we see so far is that this trebuchet wasn't able to shoot the squash ball over 30 ft. To fix this, we adjusted that front height of the trebuchet to 18" compared to the back which is still 15 1/2". The trebuchet now looks like this:



Dayle

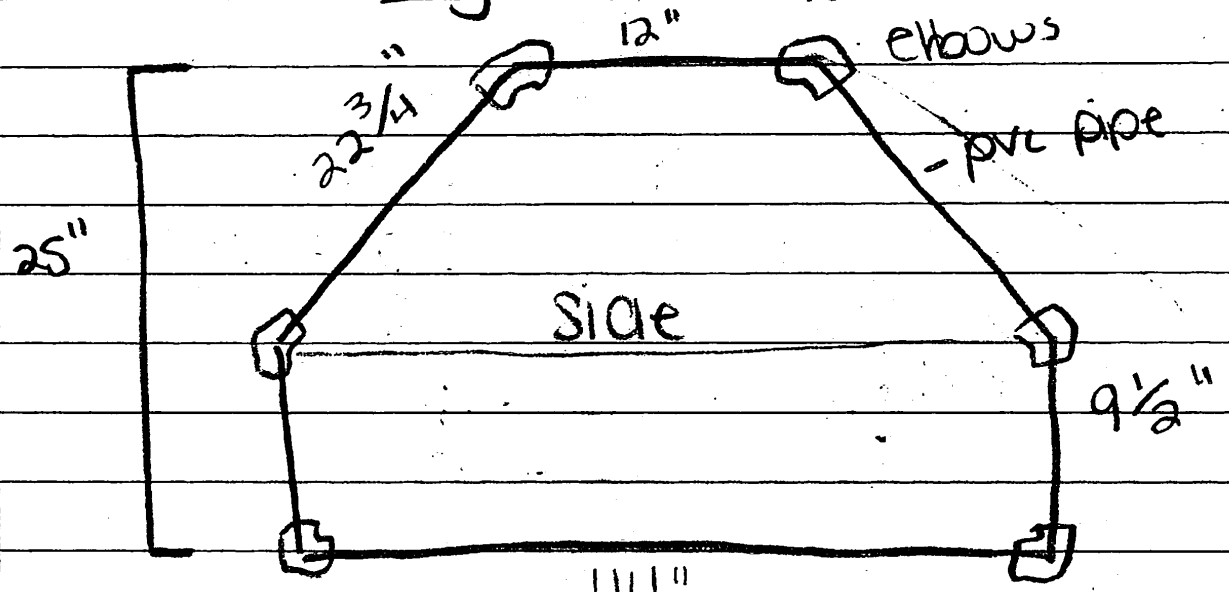
Today we added 2 spacers to the pivot point of our second trebuchet. Both spacers measured 3/4". We also changed our cap and hook; instead we moved it to the side with an angle of about 45°. Following, we adjusted the string of the sling several times to find accuracy while launching. Therefore, we will probably adjust the string several more times through trial and error. Last night we bought glue, primer, reducers, 1/2 inch C pvc pipe, thick String and 1/4" steel bar. We have yet to buy 13 1/4" threaded black pipe, sand, fabric for one of our slings

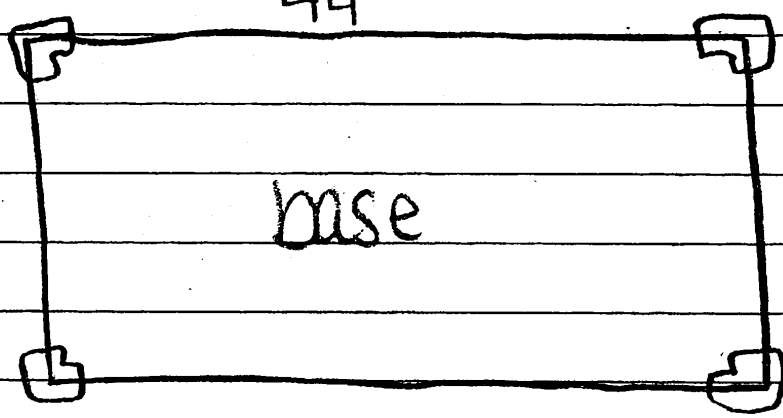
day 7

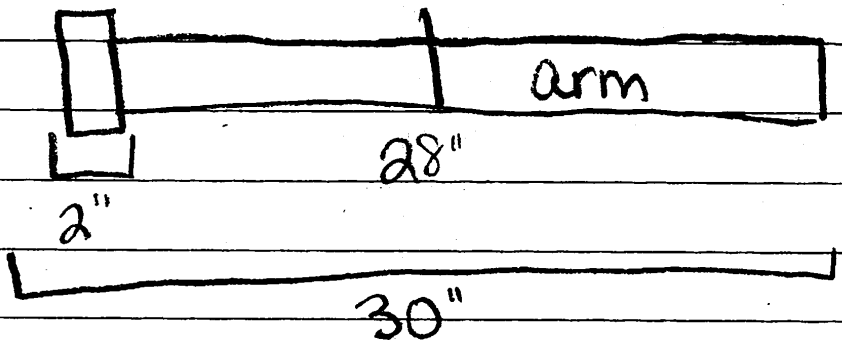
We have decided not to use a scoop on our smaller trebuchet due to time. We spent today getting all measurements to make our CAD drawing.

Design Measurements

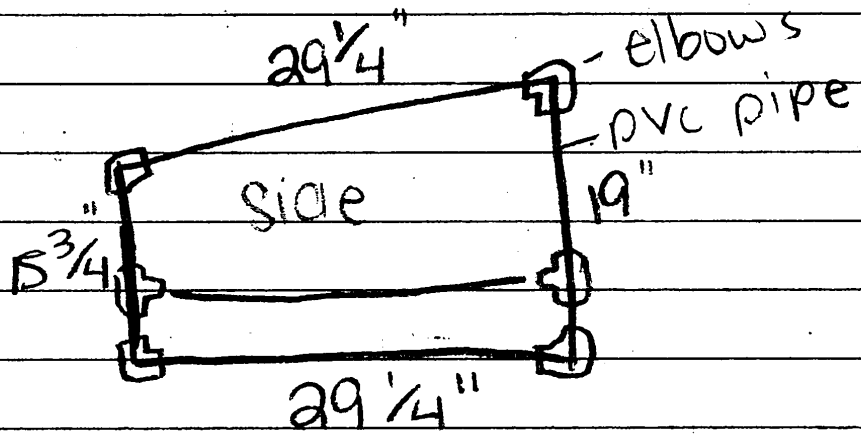
Big Trebuchet

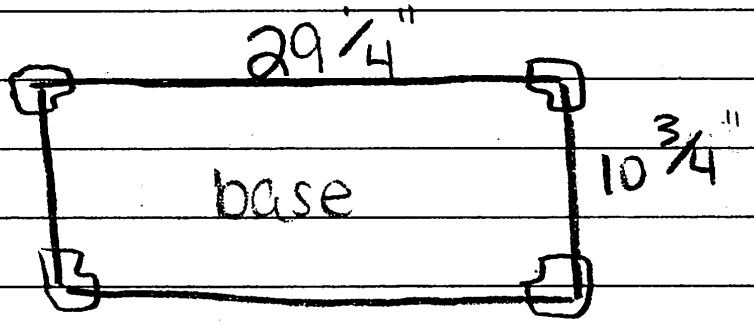


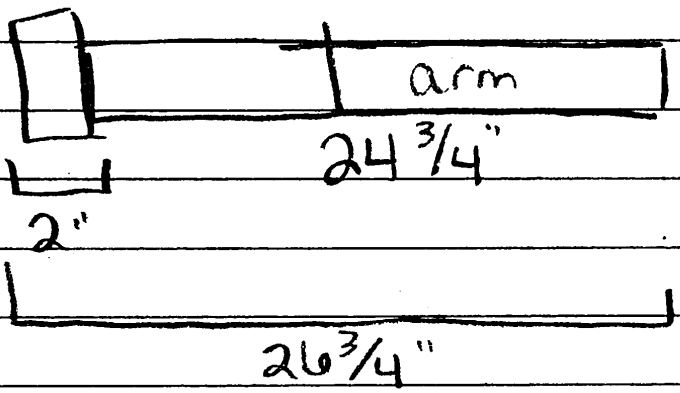




Little Trebuchet







materials

pvc pipe
90° elbows
45° elbows
pvc Ts
pvc intersections (+ slots)
bolts + nuts
glue / primer
threaded pipe
screw
hook
counterweight
8 pound string
fabric
½ cpvc pipe
graphite paste
sand
drill

Background / Research

While researching information on our trebuchet, we watched the episode of Junkyard Wars where they experimented with trebuchets. In the episode, we watched them make several mistakes with their hook. This made us realize we needed to adjust ours to make it release sooner for more arch and distance. We also did a lot of research on our sling. Since we know that it takes more energy to move a heavy sling, we decided to use a light weight fabric and string for our sling to increase the energy used to throw the ball. We wanted a simple design so we didn't do anything special to the fabric. Also, we even watched several youtube videos to get ideas from those trebuchets. We got the idea of our design from these videos since their trebuchets worked so well. Since we didn't want our trebuchet to move, thinking it would decrease the

energy put into the throw, we decided to put sand in the bottom. We wanted to use a fixed weight because we figured that the throw would be more accurate and have a directly straight launch. We also decided to use big bolts by the counterweight to add more weight. Most of our ideas came from watching people shoot the desktop trebuchets. This is where we got the idea to shorten the string to increase the arch. We also learned from this not to make the release hook too short because it decreases the distance.

Testing

First try - Big trebuchet:
After our first launch on our big trebuchet, all we decided to do was change caps. Changing the caps changed the angle of the hook which releases the string. Other than that, we didn't change anything.

First try - Small trebuchet:
After our first launch on our small trebuchet, we decided we needed to give it more arch. We did this by making the pipe in front longer in the front than in the back. We made the front 19" long and the back 15 3/4" long.

Second try - Small trebuchet:
After the second try we realized the change we made really helped. However, it still wasn't doing exactly what we wanted so we decided to shorten the string. We also adjusted release hook. After this, we were able to consistently shoot the ball about .25 ft.

Large Trebuchet

Trials	ft shot	any adjustments?
1	26	change caps
2	29	none
3	31	none
4	30	none
5	35	none

Small trebuchet

Trials	ft. shot	any adjustments?
1	12	made front pipe longer
2	23	shortened string
3	25	changed cap
4	26	none
5	26	none

Although the trebuchets aren't shooting as far as we hoped, they are very consistant and shot in a straight line. Hopefully, the distance won't be a problem.

Conclusion

Overall, our group experience with the trebuchets was very successful. We were able to construct two very consistant trebuchets. We only had to make a few changes to our trebuchets to make them do what we wanted. Simply changing the release angle, shortening the string, and making the front longer than the back on the small trebuchet did the trick. Everyone in our group did their share of work and put forth plenty of effort. We all learned more about trebuchets and the science behind it. We learned that the release point is very important in determining where our trebuchet is going to end up shooting. We also learned the same about the sling's string. Our trebuchets were [redacted] shooting at the distance we needed. They were also shooting consistantly and in a straight line. We believe that the Kitty Cats will be very

Successful in the competition. Although we made some mistakes, like making the string too short, we were able to fix everything. Building these trebuchets was a very fun experience that every one in our group learned a lot from.