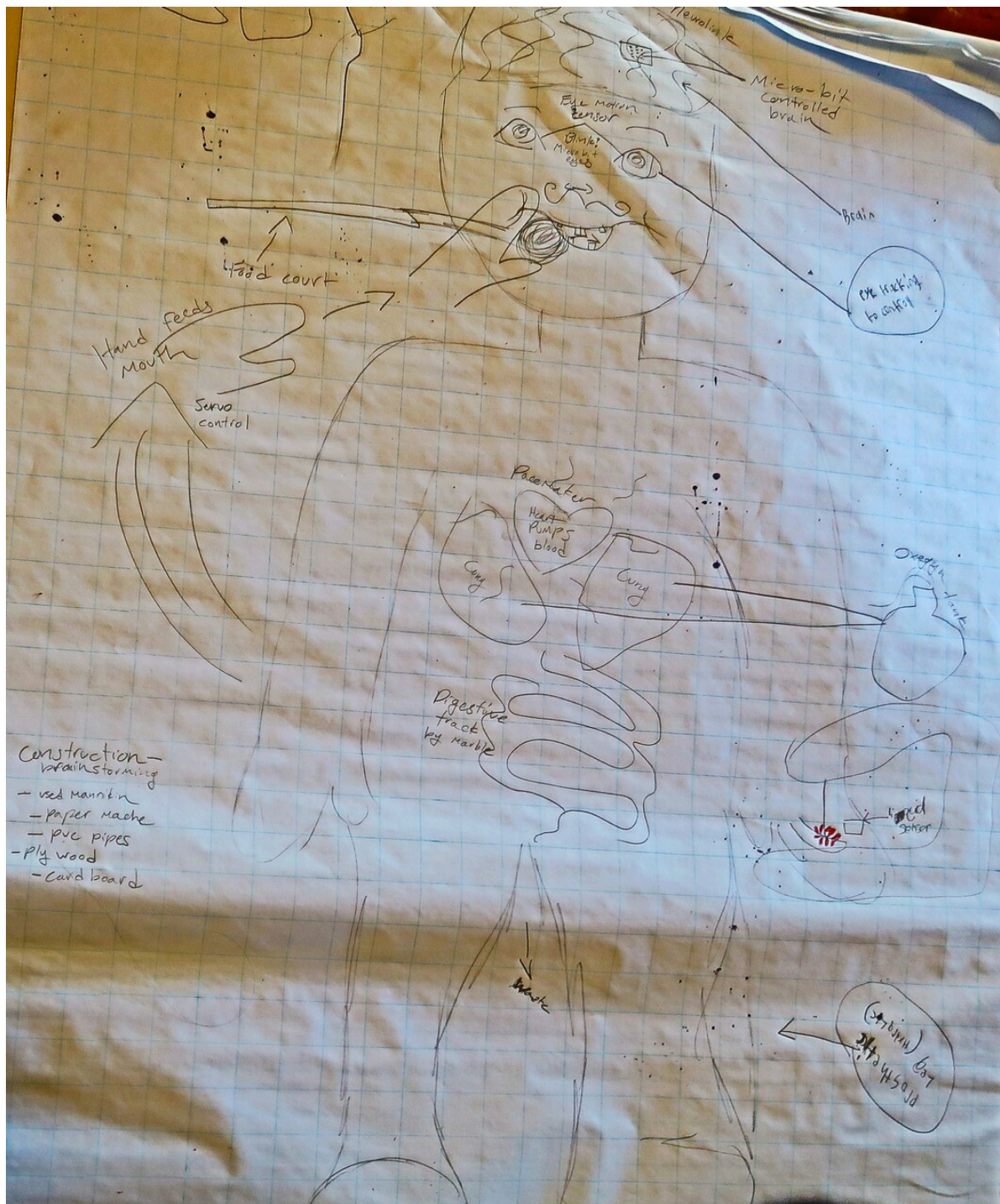
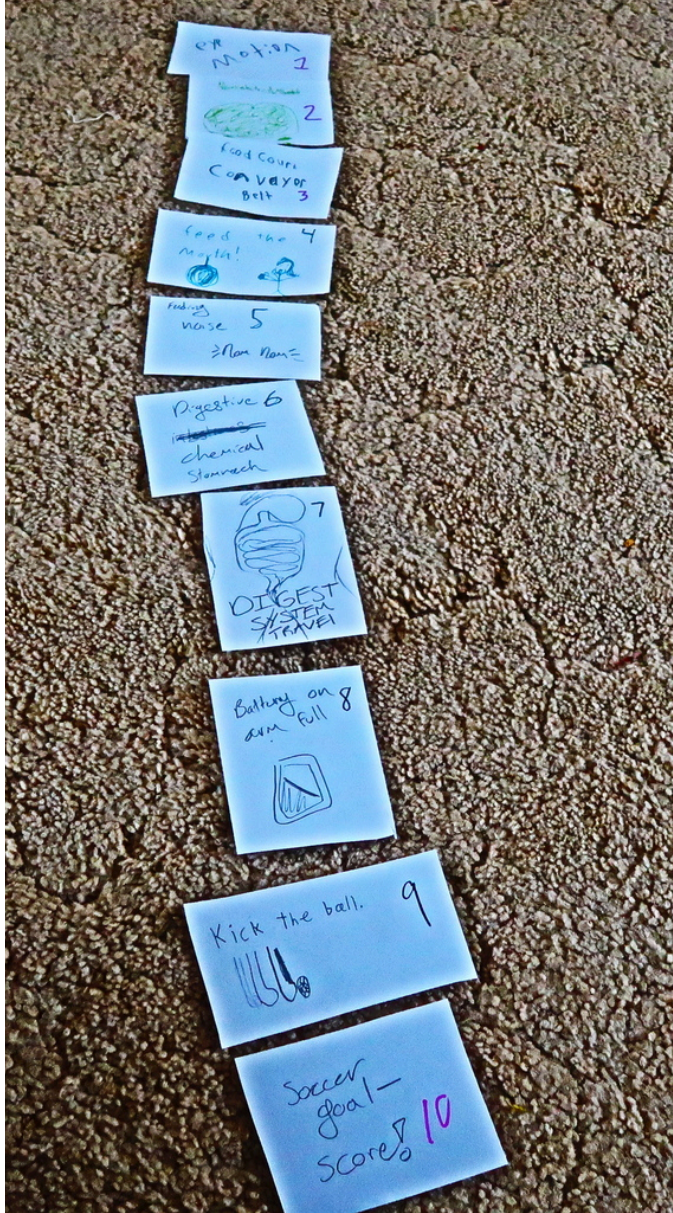


Planning the Machine



(Above) Drawing up a rough outline for our project. Includes brainstorming ideas, and loose design.



(Left) Our base steps. We started out by drawing our brainstorming ideas out on notecards, then aligned them in their proper order.

Our use of the STEM process...

While drawing out our plans, we first thought of the end product. What is the challenge or problem we want to fix? How will we fix accomplish that?

We ended up deciding that we wanted to help an amputee follow his/her dreams, in this case, playing soccer.

We drew it out, gathered materials, and began our build. Testing steps as they were

built allowed us to diagnose problems in their early stages and rebuild and improvise as needed for our machine. Multiple times, such as with the chemical reaction steps and prosthetic leg, we had to drastically change from what we had planned on before. Making alterations, and testing again and again, we worked hard to make sure our machine was efficient and reliable.

Building the Machine & Recycled Material List



(Above) Our frame in progress. We build it using 2x4 recycled wooden posts, screws, an impact driver, drill, and other recycled materials. Our frame is 100% recycled. (The only things we purchased for this project were the chemical reaction ingredients.)

Recycled vs. Purchased

Recycled

- Wooden 2x4s (70%)
- Plastic bottles (1%)
- Clothing (1.5%)
- Soccer cleat (1.5%)
- Nuts (2%)
- Bolts (2%)
- Screws (2%)
- Plastic netting (1%)
- Motors (1%)
- Battery pack (1%)
- Rubber bands (0.1%)

- Marble run (3%)
- Latch Mechanism (2.5%)
- String (0.5%)
- Paint Pail (1.1%)
- Castor Wheels (3%)
- Electrical Components (1%)
- Ball (1.5%)
- Paint (Leftover from another project) (2%)
- Micro-bits (0.5%)
- Funnels (0.5%)

Purchased

- Baking Soda (0.25%) \$1.20
- Vinegar (0.4%) \$2.50
- Yeast (0.25%) \$1.00
- Hydrogen peroxide (0.4%) \$3.75

Recycled materials: 98.7%

Total Machine Cost: \$7.70

Reflection

Watching our team grow was truly amazing. Working on this project together helped us to create closer friendships, learn new skills (such as coding, building, etc.), and even be able to gain experience with tools and more that we can then carry on and use in our day to day life. Though we hit bumps, we would work together to ride them out.

The chemical steps in particular were a big challenge, and it was hard at first to see how to make it so that they would work efficiently, allow easy cleanup, and trigger the following steps, but we were able to work as a team to create spill pans, find and make small recipes for elephant toothpaste, and make the rising liquid and foam connect wires to trigger our creation's prosthetic limb to kick that ball and make a goal! The time crunch due to the video submission needing to happen earlier than anticipated was tricky as well, but we were able to work hard to complete the tasks needed in time span given to us.

Overall this was a great experience and opportunity to grow. We can't wait until the next engineering design contest!

The Completed Machine



(Above) Near complete project.

- Step #1: Conveyor belt runs a weight into a cup attached to a clothespin, causing it to open.
- Step #2: Clothespin releases a pin.
- Step #3: Arm swings, pulling string to tilt cup.
- Step #4: Cup tilts, pours hydrogen peroxide into “stomach”
- Step #5: Stomach froths (elephant toothpaste chemical reaction), spilling into marble run.
- Step #6: Marbles release from froth, and go through “intestines” (marble run).
- Step #7: Marbles trigger latch, which pulls on string triggering next step.
- Step #8: Scoop dumps baking soda into bottle containing vinegar. Froths up, connecting two wires that carry an electrical current.
- Step #9: When wires connect, powers servo that releases a string attached to the leg.
- Step #10: Leg swings, kicking ball.
- Step #11: Ball rolls into goal. Score!

Bibliography

Below are the sources we used to inspire and teach us about how to make our machine, as well as some online tools we used for our project.

[Joseph's Machines](#) YouTube channel.

[MakeCode](#) Courtesy of Microsoft.

[YouTube](#) Various learning videos.

In-person Training Our coach had a lot of experience in engineering and building, and was able to help us gain skills in both areas.

