Summer Camp-July 16, 2018

We received 9 kids for the week long summer camp. They started off Day 1 by watching a piece being cut out on the laser printer. They seemed enthusiastic about creating their own piece. After everyone was settled, we let them get to know each other through a series of Icebreakers and games. We then continued with laser cutting and guided the kids through setting up the first CADing software, Gravit. Gravit is a design software that allows the kids to get their first taste of CADing. It is relatively simple, and involves using shapes and text boxes and importing pictures to allow them to turn ideas into reality with the laser cutter. We taught them the basic skills to use Gravit by having one coach (coaches are members of the team who are volunteering their time for the camp) run an interactive lesson. The kids are each provided a computer to follow along with the coach as he demonstrates the skills on the projector. As a way of letting them use basic engineering skills we gave them short engineering challenges. In this session they used spaghetti and marshmallows to create a tower as high as possible. This encouraged teamwork and creative problem solving. Then they returned to Gravit and we walked them through different types of things they can do. We gave them a break for lunch and then when they returned we gave them a challenge where they had to create a protective cage for an egg that would drop at a high height. After the alloted 90 minutes we gave them time to work on a woodworking project where the goal was to create a Jelly Bean dispenser. The kids had problems with using some of the basic woodworking and power tools, so we needed to teach them the proper ways to use them.
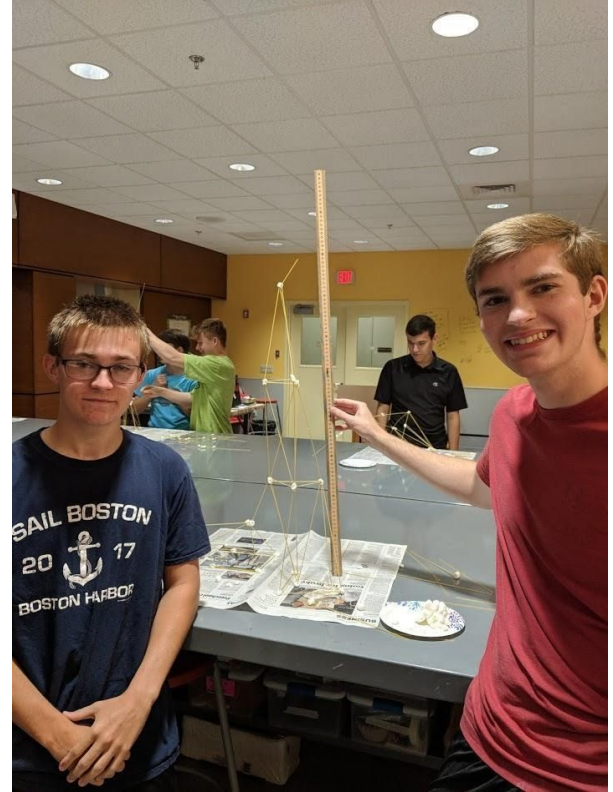
After the students left, the counselors had a meeting to discuss improvements. We decided that a more effective way to teach them would be to assign them a one on one counselor for the next day. We also decided, due to the kids' lack of knowledge about woodworking, instead of making the Jelly Bean dispenser, we would be teaching the kids basic woodworking skills like nailing and sawing through short challenges.

Summer Camp-July 17, 2018

Today, we started off the day again with icebreakers to refresh the kids on each others' names. We also had them go around and get to know each other by asking everyone to talk about their interests in relation to engineering. Then, we had everyone sit down and work on finishing their final designs on Gravit. Coaches walked around and helped out the kids with their projects, with each coach working one-on-one with a kid so that anyone who has trouble can still receive a nice finished product. After everyone's projects were cut and finished, we moved onto VCarve, and continued using the interactive lesson system combined with the floating coaches (coaches who walk around helping those who need help) system to teach them the next level of CAD software. VCarve is slightly more complex than Gravit because, although it involves 2D shapes

and outlines, it also involves vectors and toolpaths, so the coaches needed to make sure that all the specific metrics were set properly so that the machine would operate. The campers began to work on their final projects that would be carved tomorrow

Also, during the course of the day, we did some fun engineering challenges. One challenge we did today had the kids breaking up into groups of three to work on building a free standing tower that had a base of at least 1 square foot, out of craft materials like pipe cleaners, popsicle sticks, and paper cups. We used craft materials in most of the challenges throughout this week. Later on in the day, instead of doing another engineering challenge, the kids got to build their own rockets from model rocket kits, which we planned to launch the next day in a field. To choose who got which rocket (some went higher than others), we improvised and had the kids play a science trivia game using the website Kahoot, and whoever got the highest score was allowed to choose first.

The final activity of the day was the interactive Autodesk lesson. Autodesk Inventor is the third software we were teaching them this week (first two being Gravit and VCarve). The lesson included walking the campers through the creation of a simple screw model, which taught them how to use the basic tools of Autodesk, like Revolve, Extrude, Thread, Coil, Chamfer, and Fillet.

At the end of the day, the campers got to bring home their first finished product: the laser cut custom piece. The coaches once again had a discussion on the good and bad of the day, and we also concluded that the one coach per kid system was the best way to keep the kids on track and focused on the task while still having fun.

Summer Camp-July 18, 2018

We started the day off with another lesson for Autodesk, where we walked them through how to make a boat, which taught the skills of Shell, Chamfer, and subtractive Extrude. We did a lesson where taught the kids how to create a cylinder, and then engrave their names on it using Engrave. Then, each of the kids had to try doing it on their own to see if they understood the new skills. At this point in the 3D CAD curriculum, the kids had all the skills they needed to make their own 3D models to be printed. The next CAD activity was the continuation of the final VCarve/Routing projects. The coaches helped the kids with the final products, so that they could be cut for the next day.

Also, during the course of the day, we did fun engineering challenges. One challenge we did today had the kids using craft materials to create makeshift nets within a certain amount of time. The nets were then set up in front of a fan which had cotton balls, feathers, and fuzz balls in front of it. The goal of this challenge is to have the net catch as much of the soft objects that are being blown by the fan, and whichever team's net catches the most wins. The engineering challenges throughout the week encourage the campers to work together to find innovative solutions to fun and interesting challenges like this one. The other engineering activity we did today was the continuation of the egg drop. We had the teams that didn't get to test out their egg safety devices today by dropping them out of the third story window, whereas the tests on the first day had only been dropped out of the second story window. We also did a second round of drops for those that had already gone on the first day, but had improved theirs and wanted to try again. Most of the safety devices included some type of parachute, which was innovative, since

we had purposely not provided plastic bags, and yet they managed to make parachutes out of newspaper and straws. The last challenge we did for the day was a sawing competition, to see who could use their knew woodworking knowledge to mark wood with a straightedge and pencil, and then cut off the measured piece. Scoring was based on quickness and accuracy of the cut (based on how many degrees off it was from being straight).

At the end of the day, we had our coaches discussion again. We decided to do more of the wood working challenges over the last two days, since the kids seemed to like those a lot, and they were educational and taught new woodworking skills. We also decided to do all the routing for the final VCarve projects tomorrow, and to finish the final 3D projects by tomorrow so that some could be printed overnight before day 5.

Summer Camp-July 19, 2018

Today was the fourth day of the summer camp. We started the day off by beginning to route the final designs. We initially ran into some issues with the tool paths for the router, but we managed to solve them before it was time to begin routing. Many of the kids watched as the pieces were routed, because they seemed to find the router fascinating, especially the fact that they can see such a nice piece being made in front of their own eyes. The designs for the router pieces ranged from nice messages for sibling to engravings of footballs to pictures of the kids' dogs. Some of the kids had trouble with designing their final products on the previous days, and were not ready to rout yet, so the coaches worked them one-on-one to make sure everyone had something to bring home at the end of the day. After the pieces were cut, our team mentor and makerspace director Dr. Tonelli finished the pieces by staining them so that the wood looked even better. The next CAD activity was the starting of work on the final 3D CAD projects. Each kid could create whatever he wanted to be 3D printed, and since we wanted the products to be complete before the kids left tomorrow, we wanted them to be printed in a timely manner. To accomplish that, we add size constraints of 3x3x4" so that the 3D printed piece will look nice, but not take an inordinate amount of time to print. Some of the kids designed hammers (like Thor's hammer), some designed axes, one created a pencil holder, one designed his name in lock letters, and one designed a miniature boat, among other projects. They were able to design anything they could possibly imagine (as long as it was appropriate).

We also did more engineering challenges today. One such challenge involved building mousetrap cars. A mousetrap car is seen in the picture to the right. These contraptions were essentially cars that were powered by the lever and spring of a mousetrap. Before even giving the kids the mousetraps, the coaches had prepared the mousetraps by cutting off the part of the "hammer" (the part of the mousetrap that kills a mouse) so that only part of it remained, and it still acted as a lever but did not hurt anyone's fingers. The coaches also removed the "hook" that held down the hammer" and released the hammer to kill mouses, as well as the weight sensor of the mousetrap. To build a mousetrap car: First, tape the mousetrap to a wooden board. Draw axle lines with a straightedge at both ends of the wooden board. Screw in 4 eye hooks by hand into the board, 2 per axle line. Then, take metal axles and hobbyist car wheels and put them through the eyehooks to create the base of the car.
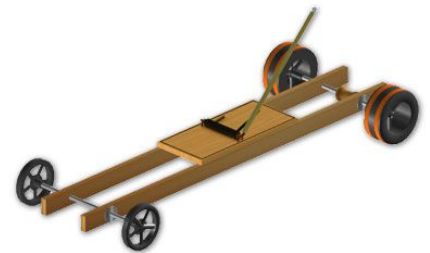
Afterwards, attach a wooden or metal rod with tape to the lever to provide more power for the car. The final step is to tie string to the axle opposite end of the mousetrap lever's wooden rod, and then tie the other end onto the wooden rod itself. This way, if you hold down the lever and spin the wheel to wrap the string around the axle, upon release of the lever, the wheel will be forced to turn as the string is unraveled and the car will shoot forward. After each kid had made his car, we had them race them against each other fun.

At the end of the day, we had our coaches' discussion and talked about how much smoother and streamlined each day has gotten as the camp progressed, compared to the chaos of the first day. As tomorrow was the last day, we briefed everyone on how to export the final CAD projects to the printers through flash drives. We also decided that each one of us would bring a flash drive so that multiple projects could print at once, since we had more than one printer.

Summer Camp-July 20, 2018

Today is the final day of the camp. The main goal today is to begin printing the final 3D CAD projects, and then to spend the period in which they were printing having fun and doing more engineering challenges. The process for exporting the projects was a little finicky, because sometimes projects would have incomplete portions that could not be exported, but the coaches worked with the kids one-on-one to resolve these, and then slowly, each project began to print. One problem we ran into with printing is that, if a project is printed without the "supports" option being turned on, it will print quickly but be tremendously fragile. After the first mishap, we had to make sure every new print had the "supports" option turned on. So that the structure would keep its shape and be sturdy after printing is complete.

As the projects printed, we spent the rest of the day doing more engineering challenges and gun activities. One project was to use an allotted amount of tape and paper in a short period of time to create the tallest freestanding tower possible. Some got as high as 3.5 feet! For bonus points, they could add weights to it to see how long it would stand, and blast air at with the air compressor to see how sturdy it was. Another challenge we did today involved using craft materials to create a long device to grab objects like ping pong balls and CDs and popsicle sticks that are beyond a line. No part of the person may cross the line as they try to grab objects. Once an object is retrieved, it can either be placed in a bucket for points, or added to the device to make it longer. Objects in the bucket are scored based on how far away they were from the line, and how hard it is to retrieve it (ping pong balls are harder to get than paper cups). One fun activity we did today was the launching of some of the rockets from earlier in the week. The rockets were reusable, so we decided that since the kids enjoyed it so much last time, we would do it again. We once again had them compete in science trivia using Kahoot, which they liked a lot, and whoever had the most points won the best rocket that went the highest. After we launched the rockets, we came back to the makerspace and gave a robot demo of our competition robot from last season, and they asked us questions about, since many of them had previously done FLL or Vex robotics. We also let them drive our demo robot we had built for public events, which consisted of a triangular robot with omni wheels that shot ping pong balls using a flywheel system. They also got to participate in a nailing competition, where they had to drive three nails into a piece of wood as fast as possible, Scoring was based on speed, number of bent nails (less is better), and dents on the wood from missed hits (less is better).

At the end of the day, they got to bring home their final projects that they printed. The coaches stayed back to clean up and talk about the camp.

Summer Camp Highlights:

Over the course of the week, we:

- Taught the kids 3 different CAD softwares: Gravit, VCarve, and Autodesk
- Taught the kids how to hammer, drill, measure, and saw
- Promoted teamwork and STEM through 9 engineering challenges throughout the week
- Launched rockets, did egg drops, played science trivia using Kahoot
- Had everyone go home with at least one laser custom cut piece on acrylic, one custom routed piece on butcher block wood that was also stained, and one custom 3D printed design
- Practiced lab safety in every activity conducted in the makerspace
- Gave lessons on the science behind some of the activities (e.g how do model rockets work compared to real rockets)
- Had fun!

Some takeaways from the camp for next year:

- Use the one on one system (one coach per kid) to make sure that all the kids are on track to take something home. Also allows us to cater to an individual's needs.
- Make sure to have plenty of fun activities and breaks (because of the kids' short attention spans)
- Be flexible, because some things will take more or less time than expected
- Always have back up activities planned, because they will usually be needed
- Try to get dense subject matter and lessons out of the way in the morning, and do fun stuff towards the end of the day to maximize learning
- Use Kahoot for science trivia again, the kids really like it
- Find more woodworking challenges, they were well liked. Many of the kids didn't know how to use power tools and woodworking tools, or even how to use a straightedge, so this was a good challenge.