

Robots are for Girls

By Melissa Canales

Entering VEX Robotics wasn't what I had in mind as an incoming 7th grader to Joe Walker Middle School, but when I look back now, I can't imagine what my life would be, and who I would be, without it.

While I walked into the room for my interviews I was surprised because I wasn't really nervous, in fact, I felt great walking out of the room. Two weeks later, I walked out to get the mail and there was an acceptance letter into a year of VEX Robotics as a VEX JET. I didn't know it then, but I was in for a year that would change everything for me.

As I walked in that first day, I was still unsure on what position I would take as I hadn't had a lot of exposure to building or programming prior to the team. However, on the first day, we all heard as our teacher said that we didn't need experience to become great in the class. He asked each of us our preference of jobs and I took the one job no one else seemed to want: the engineering notebooks. Again, I didn't know where to start with them, but I was a great writer and after being explained how to do it by by captain Nassim Tavakoli, I was off and running. At first, she always read through my entries and then signed her name in the witness line, but soon I was writing too fast and too much so she simply acknowledged she had seen me.

I knew the notebooks weren't anybody else's first pick, but I was getting really good; I had daily updates and pages taken up for one project. I evaluated every tournament and I even taught two of my teammates. After just a few short months of writing, Sadi Noor, won our first design award of the season quickly followed by a second and secured his team a place in the state championships. My team, Team 4073A, had gotten a state bid through tournament champions and I was determined to prepare the notebook for state.

I spent countless hours at home and school, but before state rolled around, I was experiencing many more milestones and accomplishments.

During the first days of January, I met up with my friend Leia, the third engineering notebook designer. We had written a script for an educational video on (but what else could it be?) our engineering notebooks. We included the instructions we needed to have explained to us before we had become experts and details we discovered from trial and error. We collaborated on the script, the filming, and voice overs, until all that was left was for her to video edit. I wasn't sure what we expected from submitting our own video, as we were both new to the program that year.

However, just the process what so much fun that we put ourselves out there to see how we would do. And it definitely paid off. In no time flat, we were staring at our computers seeing our video as a finalist of eleven entries. We were excited and worried at the same time, but all there was to do was wait until the results came. And they came. In one word, they were amazing. We had placed 2nd in the 2015-2016 Educational Video Challenge! It was a success like no other so far and it blew us away to have seen such an accomplishment of girls in the engineering field. Maybe it wasn't hands-on with the robot, but it was an important aspect of VEX that so many overlook. We didn't get a bid to worlds, but we still celebrated, now with a \$500 gift card for VEX parts.

It wasn't just this achievement that marked my first year of VEX as extraordinary, but it was also going to the PLTW State Conference in Riverside with 3 other VEX JETS to talk to over 50 teachers about how we worked in our program. Nassim Tavakoli covered 3-D printing and Autodesk Inventor while Amber Stricklen spoke on building and captaining. Aaron Reyes got the programming field and I pitched in on the engineering notebooks and the work of a pit boss, a job I had been mastering at tournaments. Of course involvement was reward in itself, but we got a celebratory cheesecake at the Cheesecake Factory! Yum!

Now, referring back to my everyday routine of spilling ink on the notebooks; by the time I knew it, I was onto a second journal and the state championships had already arrived. Unlike other tournaments we went to, every member of the class went on a bus to get the experience. There, we did the usual system, checking in, submitting our notebooks, playing our matches, and talking to judges. It all went rather well, but we didn't win tournament champions.

Now, it was all down to the awards to see if we would continue onto next level (world championships) or start preparing ourselves for next season. The excellence award was presented and we didn't win, but it blew me away to hear "...and the winner for the Design Award is Team 4073A!" It was my team's first design award based on our notebooks and interviews. Our very first of the season, and I do dare say the wait was worth it to win it at the state championships above all other. We stood there holding the trophy and smiling. It didn't receive a world bid like other times, but that was the least important thing in the world right then.

On Monday, we went back to class and started working on a new project: everyone learning Autodesk Inventor so that anyone could do it in the future. However, just that Friday, before going off to break, our teacher gave us some huge news. First, he told us that he was retiring and by the time spring break was over, he would be gone. A silence hung on for about 30 seconds before he spoke again.

Can you guess what he said? He was kidding! He had a good laugh while the rest of us were sighing in relief saying that was not funny, but truthfully, it was. The

real news had been announced as he turned on his projector to show an email. We read silently and the ones done reading first were in disbelief. The email said it all...Team B was going to the World Championships!

Of course the celebration was amongst all VEX JETS as we were thrilled to know we had made it in with awards we had won previous to the state championships. In the two weeks off of school, we reunited in the classroom as our teacher told us who could go on the trip as we couldn't afford 30 plane tickets to the world championships in Louisville, Kentucky.

It was a matter of contribution to the team and dedication that was put into our everyday work and it was thrilling to know I had made part of that group of eleven VEX JETS going.

We planned how to raise money for the plane tickets, food, and other expenses, but we got a lot of support from our community. First we set up a GoFundMe page, but we didn't stop there. Amber, Sadi, and I attended a meet at the rotary club and they gave us about \$1000 in donations. We also went to the school



district office who kindly donated a great part to cover the costs. Before we could blink, the day had come and eleven VEX JETS boarded a bus that took us to the airport straight to Louisville.

Well, actually, we got a flight to Indiana because landing in Kentucky would have been a nightmare with every other team getting a flight there as well. We landed at

the airport (ending my first airplane ride) in the middle of the night, and drove to our hotel. The first two days there were about exploring some attractions such as the Louisville Slugger Museum and Factory and the Kentucky Derby.

It wasn't until the third day that we got to the competition. In one word it was grand. There were countless teams with their equipment for VEX IQ and VEX Robotics. The ages ranged from 6th graders to college students. The robots big and small, the booths containing teams from around the world and had made such a long journey to compete just like us. So many teams had buttons to offer, as did we, others had candy, different teams brought items from their homeland such as a popular snack for Paraguay, Japanese candy, glowing keychains from Chinese teams, a deck of cards with their country on it from Puerto Rico, and one team had a map to pinpoint here everyone came from!

We helped our pit boss, Alexis Rodriguez, set up our space with our banners and equipment. As soon as that was completed, we began to scout for other teams.

A lot of them spoke English (so helpful!) but or some Latino teams, my sisters and I pitched in with our ability to speak Spanish.

During the competition, we took turns going up on the field, sitting on the stands cheering, meeting teams, and spending each moment smiling. I was also extremely obsessed with the snack from Paraguay! By the end of the competition, we were in 42nd place (the highest the Vex Jets have ever placed in worlds) and were so close to being alliances with the 1st place team in our division. They said they would have chosen up if they could have lifted us up. During the entire experience, we also interviewed in a rather isolated area with judges for a chance to the win Excellence Award! Unfortunately we didn't win, but we still brought



back an award to our classroom when we were honored to win the Build



Award! Once we were out of the competition match-wise, we immediately rush to Freedom Hall to watch the final match between the two 1st place alliances from both the divisions, Spirit and Opportunity divisions. We also saw as the new game for the 2016-2017 game was unveiled. We witnessed as the game flashed before our eyes. Just like that, it was over and we landed back in Los Angeles, California and took the bus to Lancaster.

In no time flat, school was over and the experience of 7th grade were memories that would stay forever, but my story as a VEX JET didn't end quite there. It was a journey filled with so many milestones of the VEX JETS, my team, and myself that another year as an 8th grader was an easy decision. Before school ended, I gave my returning interview and was admitted once more. Little did I know that the same program, would give me a whole new insight to what Vex was.

Coming back from our summer break, we got down to business pretty quickly. Immediately, we began to brainstorm different ideas for our drive and two groups began to work on prototypes. After about a month, the VEX JETS held the captain elections to officially settle teams and teammates. I decided to run for a captain position along with 4 other teammates in VEX because after all I had gone through as a 7th grader, I felt I could help my team, and all VEX JETS experience the same thrill of being in a robotics program.

The election took about two weeks in which each of us took turns answering questions other teammates had and giving short speeches. However, standing in

front of everyone wasn't so easy for me despite previous experiences I've had in other years. It took a while, but to aid me in the process of my fear, I made a small video that would cover some key points I wanted to express while I filled in some blanks in person. Miraculously, I did win the election and became captain of Team 4073A while two other of my teammates were captains of 4073 B and G.

Immediately, we decided which people were going to which team to make sure each team had builders, programmers, Autodesk Inventors, and engineering notebook designers. After that was decided on and everyone assembled, my team began to brainstorm ideas for our robot, as the prototypes that were being constructed were going to be Team B's and G's.

After a team vote, we concluded on an H-drive for a chassis and later on we would design a forklift with a six-bar. However, we soon faced the first complication of many in our engineering process that would be sizing into the 18" by 18" by 18" limitations. We saw that having an H-drive with a six-bar placed in the center with the length of ours would no doubt extend much farther than the rules permitted us so we evolved to a U-drive with mecanum wheels, and a speed ratio.

I first began to work as a builder on the construction of the chassis and later the six bar. However, managing the work along with being a captain was quite some stress on me. My team's programmers had questions on what needed to be programmed and what task each specific motor needed to perform, the Autodesk Inventors were building up our robot and preparing it for stress testing, builders needed to discuss with the team about ideas and vote on each one, team meetings needed to be held, and all the while I was running around being called this way and that to aid my team. They always said being a captain wasn't easy, but I suppose I didn't believe them until I live for myself. Of course I was still enjoying VEX Robotics, but I had to adjust to all the new responsibilities I was facing: captain, builder, and I was still writing the engineering notebook as I had done in my 7th grade year.

Even without the captaining job, I faced complications in building because it was my first time building just as the rest of my team. As I wrote earlier, in my 7th grade year, I specialized in the engineering notebook because I was good at it and I loved it. I wrote all day in the classroom and spent hours by myself outside of VEX completing each log. I maintained my writing this year, but I never got hand-on building before now. Luckily, teammates outside of Team A assisted us when we needed them and we managed to get through.

Even with their unconditional help, we were having various troubles figuring out the six-bar lift. First, the measurements of each c-channel needed to fit perfectly with the rest of the six-bar to gain full length. Next, somehow,

Six-bar with two boxes



somewhere, we made the mistake of creating a six bar that had only one box instead of two. This was a grave mistake that needed to be re-done rapidly and yet carefully because the three-robot tournament between the three teams at Joe Walker was going to take place in 10 days.

This small tournament was occurring for the first time for the VEX JETS so that we could determine the two of three teams that would be allowed to compete in our Joe Walker tournament. Our teacher had decided to limit programs to two teams per group so that more people could have a chance at participating.

Along with the significant modification that the six-bar was undergoing, we faced complications with the attachment of the forklift because of the measurements of the chassis and length of the six-bar. Sadly, our six-bar wasn't long enough to reach the end on the chassis which would mean that the fork would be at an alarming slant and would most likely attain nothing when in a match. One of Team A's builders had already begun a much smaller and lighter chassis previous to this problem and at first I was hesitant to change the chassis for such a small one. However, the issue with the six-bar couldn't be solved unless the mechanism was re-built to extend farther. While that is a valid solution, we were under an even more restricted time limit and we made the drastic decision to change our chassis for the smaller one.

By that time, it was the day to compete for our three-robot tournament and we had yet to add the forklift on. Instantly, we grasped for hinges and added the device, but it wouldn't bend upwards and we were out of the measurements by many inches. Without the time to solve it with nylon rope as we had planned, we rushed to the field to compete with what we had. Needless to say we were taken points off for not fitting the 18" by 18" but we kept on.

As I had predicted with the new small chassis, it was too light to take on the support of the entire robot and stalled in about 45 seconds. For the most part, we were pushing stars underneath the fence to score points as the chassis also tipped with the weight of pulling back. Stuningly, we did manage to be one of the two teams to compete for the VEX JETS at our tournament, but we knew there was a lot of work ahead. To top it off, it needed to be done in one week before the tournament,

First, we switched back to our original chassis to prevent the stalling of the PTCs (or Potential Temperature Coefficient) of the motors and to have a stronger center of gravity. Next, we modified the six bar with longer c-channels so that it could reach the end of the chassis for the forklift. After we transformed these aspects of the robot, we wanted to add the nylon rope to have the forklift pull itself back up. Soon enough, we found no room for it and it led to a prevention of adding

on the forklift itself. We wire managed everything and added our power expander, but we were faced with a truth we didn't like. We were a push-bot.

It wasn't the best feeling as captain to know you didn't succeed for the first tournament, but it's so amazing we participated because things really turned around for Team A there. Yes, we were a push-bot but we were doing pretty good as one and even made it to the semi-finals. Not to mention, we took the first Design Award of our season.

I know it was a team victory, but I can't help but take it personally as I remember the long nights documenting and trying to balance my two other full-time jobs in VEX. Of course my team were there to provide me with a couple of entries of their own, information, code for the robot, and pictures, but it was like the state championships where my team won their first design award after the whole season. I'm just standing there and when they announced our team, it was simply incredible. It blows me away that the notebook that I spent ours on, the notebook that says "Team 4073A" right on top is the reason that after a long day of pushing stars and cubes, we're going to the state championships. Or so I thought.



It turned out that not all designs awards were eligible for state, information I was not aware of. It wasn't until much later that evening that it was officially declared that we did qualify for the state championships. And it blows my mind again.



From that day, we knew every tournament was prep for the state championships in March, and we had just started October. One of my teammates had seen a very nice design with a claw and because there were so many complications with the forklift, chassis, and six-bar, we voted that a new clean slate with a claw is perfect. First, we undid the six-bar and my teammates began constructing a claw. In place of the six-bar, we added in two-bars powered with one 393 motor on each; we had

also set goals to add the claw on before our next tournament at the Hesperia League in a week, but were unable to due to an indecisive choice on how to conjoin the claw and the two-bar. Therefore, the next tournament was another test with a push-bot, though not for long. While we were successful in talking to judges, we saw that chassis was still under stress and the lift couldn't manage to knock many stars either.

Of course we tackled these problems head on and found immediate solutions for a rapid operation. To fix the chassis, we noticed the wheels didn't have sufficient room while moving and would either hit our mecanum wheels or the chain. Our fix: to add a standoff on the inside of chassis to be able to move everything and allow more room for the wheels. The list was also struggling to reach its eight so we concluded to add in two more 393 motors and add a torque ratio that another VEX JET calculated for us. The ratio we need to be able to lift the claw as well, we switched to a 1:5 1:5 ratio (we wanted a compound ratio) or a 1:25.

Now, the next question we had to ask ourselves was: how do we attach the claw? No other team of ours was going for a claw method and we had to figure it ourselves. Believe me when I say that through tournament and tournament, we were re-attaching the claw till we got it right, but the story hasn't reached that point yet.

It was quite a while before we got our first idea, but this as the concept when it arrived: we were going to use one bars to bend it about 45 degrees. One end connected to the claw while the other went on the two bar lift. (I know, I know. You're probably thinking the metal is going to bend under the pressure, and you're 100% right, but we're learning as we're going.) We were pretty pleased with how it managed to attach and fit still in the 18" by 18", but the weight was a concerning factor if we were ever going to add a hanging device, which we planned to do.

Soon enough though, we were at the practice field and saw the metal bending very quickly when the claw went up. Luckily we saw this flaw fast and rushed back into the classroom for a new idea. With the help of some high schoolers, and former VEX JETS, we decided to exchange the one bars for rails. The rails were bent upward at the tip to reach the claw and keep it straight. By then, it was time to leave and we were glad to see a problem taken care of.

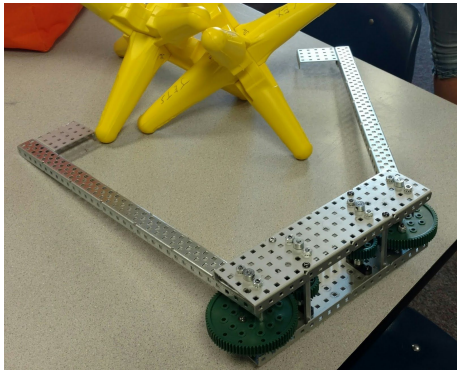
Now, as I mentioned earlier, we added in two more motors on the lift and on there was a total of 4 393 motors along with 2 High Speed for the claw and 4 more High Speeds for the chassis. As we got caught up in the excitement of adding the claw and completing the robot, we miscalculated one important factor: the cortex. Unfortunately, we wire managed and plugged in our motors to our ports in such a way that one half of the cortex had too much pressure on it and it fried. I wasn't there to witness it personally because I was discussing a few things Team G at the moment, but I was told that a bit of smoke began to appear. Of course this was no laughing matter and we had to get a new cortex as we reviewed how to spread the load of our robot evenly between the cortex. Luckily, we fixed that in time for our next tournament and we were off to compete.

Believe me when I say, we learned a lot about our design. Of course we noticed the rails connecting our claw starting to bend as it was lifted into the air, and yes, we caught that our claw overlapped its arms due to non-symmetry, and we

didn't forget to see our chassis still stalled, less, but it did. It wasn't the most motivational sight, but we weren't going to let these problems get the best of us. And we took it all in, deep breath, let's try again.

First, we dealt with the chassis and I had previously planned several options on where we could go on fixing it, most of which involved making the change to omni-directional wheels:

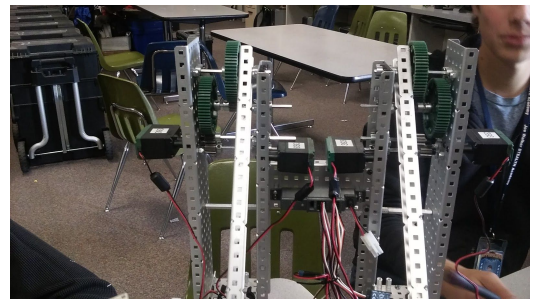
- Option 1: Keep the mecanum wheels and change our motors to 393s for more resistance
- Option 2: Switching the wheels to omni-directional one.
 - 2A: If we switch to omni wheels, we can make the chassis skinnier
 - 2B: Another approach would be to make it smaller
 - 2C: We could combine the two for a much smaller and thinner chassis but due to our previous experience, we weren't big on that.



The final vote was for option #2A, so while the mecanum wheels were replaced our chassis was also getting skinnier by about 2". Meanwhile, we also worked on lightning the claw by removing excess space between the gears and c-channels.

We were preparing very well fixing the details of the chassis and as soon as that was completed, we all knew we had to fix our gear ratio. The arms of the lift couldn't reach maximum height because it clashed with the silver gear up on top. The solution

we came up with: a compound gear ratio. We were maintaining the 1:25 ratio for strength but a compound gear ratio would allow us to reach maximum height with the two-bar. The project took about two days to adjust and when we had completed the task, we readjusted it on the new chassis. We also added on the two bar back on but noticed something new. Once the gears and motors were all intact, the two bar didn't move manually anymore. We were initially concerned, but after testing the motors and asking the our teacher, he explained that sometimes the motors lock and don't allow the mechanism to move manually.



We calmed down and finished our task before we got a week off of school because of Thanksgiving. Since this was a complete week that would not be used to advance with the robot, I took it home along with a fatmax and tool kit. This one

week was a whole week to figure out the robot myself since my teammates had family plans for the holiday.

This week was actually much harder because I didn't realize how much quicker I worked with my teammates at my side and how we assisted each other from the smallest task to the hardest. I suppose I had just always blindly counted on them and I can't imagine Team A without them!

I still had to work on the robot, but first was the disorganization of my supplies. The first day was a few hours dedicated to fixing the toolbox and separating every part into its own compartment. The next day, I made a secure spot for our batteries. It was absolutely foolproof from falling out. I know many teams may throw this aside as a miniscule task, we had witnessed many teams have batteries dragging on the floor and we did not plan on having that be us anytime soon. After that task, I worked on the main issue. We needed yet a new plan for the attachment of the claw. While messing with the parts and taking a simple trial and error technique, I did find a couple of solutions and decided on using multiple channels and standoffs. The first two c-channels would connect from the claw to each other while the standoffs connected the c-channels to the two bar lift. The project took about two days because, like I mentioned earlier, it was much harder to work alone. Once it was complete, I knew it was the best we've had so far.

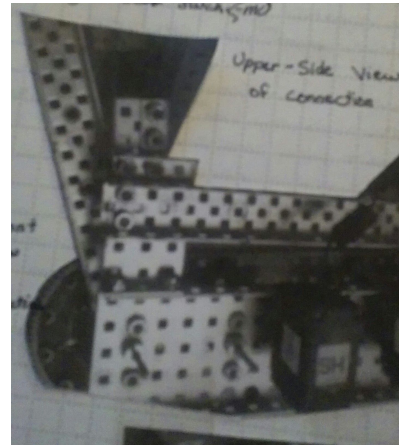
Returning back to school with the robot with everything in one piece was such a relief especially with the tournament ahead in just 5 days. My team was pretty proud of me it was amazing to be setting an example as captain for my team. However, we still needed to had in the gear holders so that they didn't move and fix the measurements of the c-channels connecting the claw.

We couldn't really attach the claw until the lift was ready set with the gears in place. We were able to finish in time for the tournament and got about two hours of practice time. This upcoming tournament was especially important for us because it was at Virgin Galactic and was a high school and middle school mixed event.

Once we got there, we saw so many advanced high school teams with incredible robots. We weren't doing so bad, but our chassis was stalling again. The major problem was with the lift; it still moved and went up, but the gears were skipping and we soon found why. As it turned out, one of the 60T gears were being driven by a gear, but a motor was also helping it rotate. Because of that, it was moving at a faster rate and caused the gears to skip. However, that tournament ended as a success because we were picked by the first place alliance and got to participate until the finals. This tournament was also the first Design Award won by Team G! We were all so happy for them, although it did not qualify for state. Next week at Torrance will have a design award that qualifies and hopefully they win once more.

To fix the problem with the gears skipping was solved was rather simple. We added one more 12-tooth gear onto the bottom of the compound gear ratio and moved the motors down to the two silver gears. This way, the two silver gears worked together and stopped the gear from skipping like they were previously.

Beyond this, we also, once again, altered how we connected the claw onto the robot, but I'm positive this will stick around for sometime. Karlie came up with the idea and it was nothing short of great. Her idea was inspired off a robot she had seen off the tournament and it was based on three c-channels. The three put together reached from the claw to the two bar and it was the sturdiest we've had so far. I'm so happy this idea was brought up because for once this season, I think it will last for more than one tournament.



I'm so happy and the captaining stress has been decreasing with everyday. Being a captain was definitely a big, huge, significant change in what I knew VEX was, but it's been such a pleasure and honor. My whole team is closer than ever and it amazes me every time I think that once, we were all strangers to each other.

It amazes me how each year, I see more and more girls are showing up. I helped in the interview process in my 7th grade year by checking people in for interviews and the number of girls arriving are increasing. What do I think of with Girl Powered? I think of everyday girls who haven't yet realized their capacity. I think of them measuring their potential and pushing the limits.. I think of girl who, just like me, will find their way to VEX Robotics and they're going to fall in love with it.

I believe the iconic image of VEX is the building and programming and documenting the robot. No one ever gets to see the behind-the-scenes of this program. No one ever gets to find out how memories made in this class are forever. The people you meet in this class will last a lifetime. No one warns you of the hours you'll willingly give up to write a notebook, or plan a team meeting, or finish the robot because no one ever tells you that it's the best thing that will happen to you. But it is. VEX was never part of the plan, but now it's so much more. It's part of my life, it's part of why I get up each morning, it's part of me. Now, with every girl rising to make a change in this field like we've already done in others, VEX is Girl Powered.

Credits-

Entrant: Melissa Canales

Title: Robots are for Girls

Team: VEX JETS

Team Number: 4073A

Software: Written in Google Docs; submitted from WattPad