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GLC20R-I

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**Cell Model**

The goal of the Cell Model project was to create a model of either a plant or an animal cell. The cell had to consist of all of the organelles in a cell and had to have an additional index which listed the organelles and explained their functions. The model was completed by me and Tarj Tandel in the second semester of the school year 2016-2017 and evaluated by A. Nesbitt.

I feel our project was quite well done and it is very important to me. Tarj and I made the model out of a Styrofoam ball which was painted brown and plasticine for the organelles. The model also required an electronic component, we achieved this by spinning organelles and cilia on motors to represent the movement in the cytoplasm as well as having LEDs (Light Emitting Diodes) in the mitochondria to represent that energy was created there. The electronics were run on an Arduino using the code that I made to run the project.

We encountered many challenges while building this project and the end result depended on our ability to overcome these challenges. When I was designing the code for the Arduino board I had an issue where I could not control the speed of the DC (Direct Current) motors. To solve this problem I devised a circuit from my knowledge from Computer Technology (TEJ2O0). The circuit consisted of an NPN transistor with a pin connected to the base of the transistor, the ground to the collector and the motor to the emitter, this allowed me so I could send out a speed value from that pin and control the speed of the motor. Another problem we encountered was in our initial plan we had made a clay semi sphere however the end result was extremely fragile. The issue was that we did not have a kiln so the clay took a long time to dry however eventually it dried and through our testing we learned that the end result of the clay would be too fragile for our use. Since the clay was so fragile we had to develop an alternative and that alternative was using a Styrofoam base instead. One final issue we discovered was that the DC motors had very little torque with a priority on speed this meant that since we lowered the power the torque diminished even further. This caused an issue since we put a load on the motors with low power the motors would stall, to fix this issue I devised a method where I would turn on and off the motors at a rate so that it would move slowly enough but still turn this is commonly known as PWM or Pulse Width Modulation.

If I were to do this cell model again I would have done some things differently. I would have used servos instead of motors since I can set the position of these and develop a function which will allow me to slowly and continuously turn without stalling issues. I would also have used more electronics, the reason I did not for this project is because the program and circuit designing was very time consuming however I would have definitely focused more on having different electronic functions. I might also have included more organelles, I feel that the major thing lacking from our cell was quantity, it had detailed explanations and attractive appearance however we had fewer organelles than I had hoped.

**Non-Infectious Disease Project**

In the second semester I was given the project to design a brochure for a non-infectious disease. The brochure had to give information on all parts of the disease and include the knowledge we have gained from the Biology unit. I was partners with Tarj Tandel for this project and we had to create a brochure on Lou Gehrig’s disease also known as ALS (Amyotrophic Lateral Sclerosis).

We made the brochure on the website canva.com which allowed us to create trifold brochures and to make changes to the document simultaneously online. The brochure contains 6 components a title page, “how it works”, “symptoms”, “treatment”, “causes” and “stem cell research”. The title page gives an attractive look to the brochure and sets the stage for the rest of the brochure. “How it works” explains how the disease actually works and relates the issue to the Biology unit with how it works at the cellular level. “Symptoms” described how the victim was affected and how it can be identified. “Treatment” describes all the different ways ALS can be treated and how ALS survivors deal with the condition. “Causes” is all about how people contract ALS and how it develops in people. Finally “Stem Cell Research” is about how stem cells and different experimental methods are being used to treat ALS patients and the future of treating ALS patients.

This assignment taught me many things and I will remember this project whenever I learn or work with Biology. I have learned everything I could want to know about ALS from its symptoms to how it’s treated. I have a new sense of sympathy for ALS sufferers since now I know the pain they have to go through it has shaped my perspective of the condition and how people react to those who have diseases. I have also learned more about stem cells and how they can help. I previously knew how stem cells worked however having a real example has helped me visualize how they work and how they can be used. Finally I learned the design process, this brochure taught me how to plan out and design something for the purpose of spreading information.

**Robotics Pong Bot Competition**

The Robotics pong bot competition challenged us to design and build a robot which could put as many ping pong balls onto the other teams side. I completed this task in the first semester with two other partners Eashan Monga and William Pirie. We were given an instruction booklet however the goal was not to finish the booklet but to build onto the design and make it better.

We used the main frame of the robot from the instruction booklet however we made some tweaks to the design. We threw out the whole idea of a claw because we discovered that it was horrible at picking up ping pong balls and that it could only grab one at a time. So we designed a shovel, the shovel was made of cardboard with aluminium reinforcing for the best balance of strength and weight. The shovel was also controlled by a motor so we could move the shovel up and down to position where to pick up the balls. We also slightly tweaked the gear ratio for the drivetrain to allow the bot to move faster while losing torque however speed carried a greater priority in this competition. I also made some changes in the code of the robot, our driver Eashan did not like the controls of the robot so I created a new program so that I could choose what controls are used and I could make tweaks to the program to make the bot work that much better. This came in handy when we created the shovel because I now had the ability to set the controls so we could actually move the shovel with our chosen controls.

The pong bot was an interesting challenge because we had very little direction so our problem solving skills had to be perfect. The biggest issue we encountered was developing a faster and better mechanism for capturing ping pong balls. We had many ideas and prototypes however the end result was we created a cardboard shovel. We chose this design because it was light allowing us to move faster and it could pick up a large amount of ping pong balls, since we could carry so many we overwhelmed the competition since other teams would carry one at a time. Another issue we discovered was that the motor on the claw was extremely fast and was uncontrollable. To fix this issue I programmed in a constant speed so the motor would move at that constant speed rather than the maximum speed which is was at. We also changed the gear ratio to one which gave more torque so that it would slow down however also retain some of its power. A final issue we had which was extremely important was we had breakers tripping and motors stalling, as someone who has been in the robotics club I knew that this was devastating. The breakers tripping meant we had too much load on the motors this meant we had to do a streamlining of the entire bot. We had to get rid of all of the dead weight so this robot could run at maximum speed, this included stripping many useful parts off of the bot however it was necessary since it could not function without this.

If I were to do the pong bot challenge again with the knowledge I have now I would have made some changes. The big problem with our bot I believe was that we followed the instruction booklet too much, if I were to do it again I would have done a completely different design. I would have had a drive train that was a lot light since this would have increased my speed and lowered the change of the bot stalling. I also would have done a throwing robot, a lot of the competition was spent with robots moving back and forth from the walls. I would have put 3 motors on the lift and had a static claw so that the lift would move fast enough to throw balls, I also would have tensioned the lift with rubber bands to give the lift fling for throwing.

**Trebuchet Competition**

For the Trebuchet Competition we were tasked with designing and building a trebuchet from scratch with no instruction booklet. The trebuchet had to be made out of wooden blocks only and had to fit into small size constraints. The competition was whichever trebuchet could throw the farthest distance would win the competition. I completed this in the first semester in a group with Kush Parhar and Thinh Nguyen and we worked to build this trebuchet together.

We built the trebuchet so it would just touch the size constraints, pieces were cut with fine precision to maximize the space used while not extending over the constraints. We built a square base while the trebuchet itself was angled compared to this square so the arm could be as long as possible we knew this was the best because Pythagorean Theorem states that the hypotenuse of a right triangle is longer than the opposite or adjacent side. We knew that the arm length was the most important part because the higher it is thrown the farther it will travel so we developed a way to cheat the size constraints. When the trigger was pulled an extra piece of wood extended which put the counter weight even farther up allowing a farther and therefore faster drop created more force on the ball. We used a J Cloth and tape to create a pouch that was spherical for the ball since it was light and the rounder the pouch the better the throw is.

This trebuchet was very important to me because I had never worked with anything that used projectiles so I had to completely learn the physics and discover the best ways for an object to be thrown. A big issue we discovered with the trebuchet was that often times the ball would release too early or too late so it would not go the maximum distance it could theoretically achieve. We found that the problem was with the pouch so we tested multiple designs and decided that this one design was the best, it was a pouch made of J Cloth and shaped with tape to create a spherical indent for the ball to sit it. We discovered that this design was one which was most reliable, though it did often not throw at the right angle it threw the farther most consistently.

If I were to do this project again there are somethings I would do completely differently. I learned from this assignment that it is less of the force applied to the ball that matters and more of the way it is released that decides how far it does. So I would have just made a standard, simple trebuchet but I would have tested different kinds of pouches and perfected the design. I also might have made the things simpler and sturdier, our design got to become more complicated as we went on and this caused problems I would just go for a simple design without any special features. One final essential thing that I think we did wrong was that we spent too long designing and not enough time actually doing work. We attempted to get the best design with crazy features however this caused us to rush when we actually had to build this, if we had focused more on building than we would probably have a lot better performing trebuchet. The build quality became a problem when we were rushing we attempted to get everything to work in time however this caused the overall build quality to be terrible.

**SciTech Extracurricular: Vex Robotics Club**

Joining the Vex Robotics club has been an amazing experience for me. It has taught me so many things and has benefited me as a person tremendously. I joined the robotics club in September 2016 because of my passion for programming and engineering.

The club has provided me with the skills I need to succeed in my post-secondary education and further into the workplace. One of the things I have learned about is feedback loops, feedback loops are incredibly important in the workplace, almost all engineering applications use feedback loops. Feedback loops are when a program adjusts to account for errors, in robotics we would use feedback loops so the robot could drive straight correcting the errors in the drive. Another things I learned is that of PWM (Pulse Width Modulation). PWM is how nearly all motors work since it is efficient and the standard way to control motors. How it works is that the board will send signals in pulses, the frequency of these pulses average out and allows the board to control the power sent to the motor. My time in the club has taught me how gears and gear boxes work. I learned how different gear ratios change how a machine functions and how to tune the gear ratios so that it is the best balance for the machine with enough torque and enough speed. Finally I learned about PID (Proportional, Integral Derivate) loops and how they function. PID loops are a type of feedback loop however they are a lot more complex than the standard feedback loop because they rely calculus. The PID loop is used in many cases where an application requires extreme precision to complete a task, a robot performing surgery would most likely use a PID loop. Though we only used a PI (Proportional Integral) I still learned the fundamentals of how to use a PID loop which is extremely advanced and important for any engineering job.  
 Through the robotics club I was able to go to Kentucky to participate in the Vex Robotics World Championships 2017. I was able to come to the robotics world because the grade 12 team had qualified through provincials. I was brought along as well as Jeffrey Boluch so I could learn how the grade 12s work since I will be the president and have to run the club next year. Overall it was a great experience I was able to see how the grade 12s work and I also was able to work myself to help the robot. I was able to work with Shaiv Kumat and it was fantastic, Shaiv is a genius programmer and seeing how he works has changed my entire programming style and how I think about it. Shaiv and I would be awake at 3am coding the robot he had a passion in him and I believe now that his job has been put on to me that passion has transferred onto me. It was also great to get the experience of the world championships seeing the over 500 teams from all over the world has changed how I view robotics and the importance of it, there were teams from Ethiopia, Bahrain, China and many more.

**Non-SciTech Extracurricular: Running**

Ever since the ending of Grade 9 I have continued my passion for running. However I have stepped away from the Cross Country club and have focused on more completive competitions. I now run with a group of people outside of school and compete in competitions that are open to the public since they are more competitive with a larger pool of people so I can see my real performance. One such competition I went to the Mississauga Steelheads run where I was able to get in the top 10% of runners.

I have pushed harder now that I am out of the Cross Country club because running in a big competition feels more real than Cross Country which felt small compared to these competitions. In Cross Country I would compete with 50 people in my age group however when I ran the Steelheads race there were hundreds of people or when I ran the Mississauga marathon 5km there were nearly one thousand participants. Running outside of school also allowed me to practice on my own time, often at Cross Country we would run a route and then finish now I have my own routine that helps me perform the most. I love running and the move to go outside of school has benefited me tremendously.