About the BotBuilders:

We are the BotBuilders. We are a team of 6 students that go to 4 different schools and we have known each other for more than 2 years. The BotBuilders team started competing in FLL in 2016 for 'Animal Allies'. Two of our members have been part of the team every year while the others have been part of it for two years.

Much like last year, the BotBuilders have 3 coaches: Rebecca Pollard, Daniel Pollard and Derek Wood. We have truly appreciated their encouragement and guidance throughout the season.

Team member names are:
Left to right: Jackson: 15yo, Katelyn: 15yo, Ayzlin: 11yo, Joe: 13yo, Andrew: 15yo, and William: 13yo.

We are a group of students that love designing, building and coding robots! We like to go to FLL training as often as possible and we love listening to other people's ideas.

Each year, we have shared the resources, robot tables and training area with other teams and we believe that this allows every team to benefit from each other's experiences, ideas and feedback. We like that we can encourage the younger teams around us and that they can learn through watching us.

We all look forward to participating in FLL again next year, with some of us taking on a mentor / coach role over being a team member due to potentially moving on to participate in FIRST Tech Challenge instead.

Our Journal:

WEEK 1 DATE 13/08/18

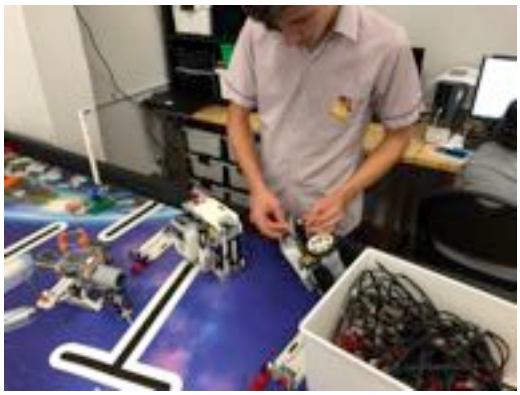
Today we had an overview of the various missions and the point allocations so we started to consider how to combine the missions to gain maximum points in limited time. At our first team meeting we decided to go with a box robot similar to last year because changing sleeves is much quicker than trying to put attachments on the robot. So Andrew and Jackson started working on the robot design straight away while Katelyn and Ayzlin were researching cosmic radiation. We feel this is a core physical problem in space travel.

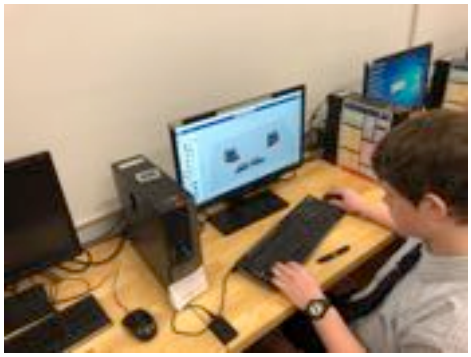
WEEK 2 DATE 20/08/18

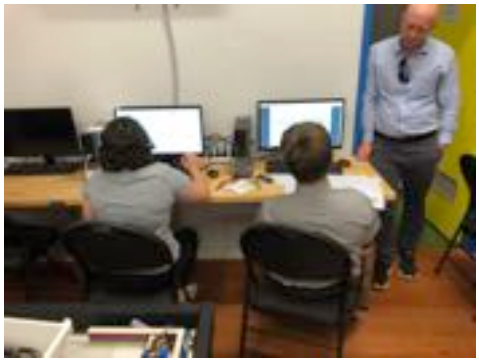
Andrew is putting the technical design for the robot together in digital form using LEGO Digital Designer this is so that we can supply documentation that clearly displays the link between the mission challenges and the ingenuity of the our solution. Ayzlin and Katelyn continued researching solutions to the harmful effects of the cosmic rays and deep space travel while Joe and William began to examine making our own MyBlock to code the robot.

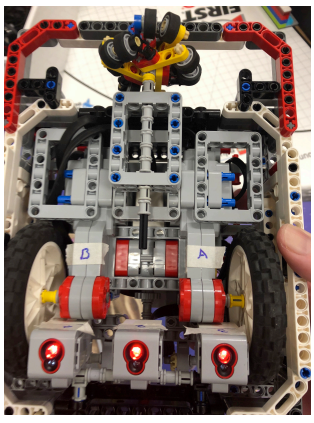
WEEK 3 DATE 27/08/18

Katelyn finished making our teams MyBlocks to suit this year's robot design. Forward, left turn and right turn have all been completed. Left point turn and right point turn MyBlocks need to be finished because they are still inaccurate when relying on calculations that determine angles/degrees. Our team finished building the second identical robot and also attached another medium motor to the left side of the robot. After Joe put in the cables we started programming it. Andrew continued working on the digital design of our robot while Jackson and Ayzlin were researching about possible solutions to cosmic rays. At the end of the session Joe and William had an overview of the various attachments for the robot.







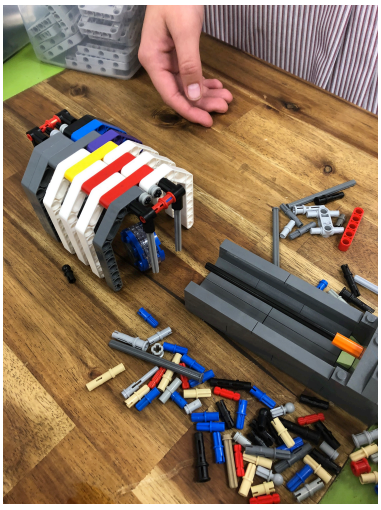


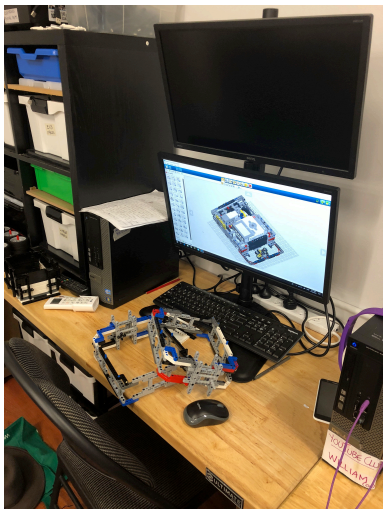
WEEK 4 DATE 3/09/18

We all had a quick team meeting where we discussed possible solutions to cosmic radiation. Currently the team is investigating a combination of solutions such as hibernation and magnetic shielding. There are two articles that we are reading. William and Joe made another sleeve for the robot. Andrew was rebuilding the second medium motor because he originally put it on the right hand side of the robot but most of the missions exist on the left hand side. Andrew also built our first attachment the ladder which we will use for the space travel missions then he adjusted the digital design model for the changes he made today. Jackson and Katelyn were coding to detect to two different white lines and to align to the white line so we can be more precise to commence our missions. Jackson and Katelyn also worked on the space travel mission with the new ladder attachment while Ayzlin worked on possible solutions to the radiation problem. William worked on a sleeve attachment for the tube module which will make it slide into place and he made an attachment for the food production so we wouldn't miss the green.

WEEK 5 DATE 10/09/18

William and Andrew built the space travel and solar array frame. The solar array part was weak so William strengthened the front wall so it would stop leaning. Joe adjusted the sleeves to accommodate the gear on the right hand side which will operate the ladder attachment. Katelyn and Jackson coded the tube module but their strategy did not work today so Jackson started coding the space travel and solar array mission using the new frame. It looks like it will work but may need tweaking. Andrew continued to work on the digital design for the changes we made to the sleeve and the frame and he also made the cage on digital design that Katelyn made to catch the core samples in the mission extraction.





WEEK 6 DATE 17/09/18

Jackson is coding the food production mission. He investigated the use of giros but it didn't work the way we wanted it to. Joe worked on the tube module mission and he is experimenting with the light sensors to align to the white and black line. William finished the space travel and solar array mission which will get 64 points while Ayzlin continued researching cosmic radiation. Andrew upgraded the sleeves to fit the gear on the left hand side while William, Jackson and Joe decided the missions the team will do. The solar array frame still needed strengthening so Ayzlin fixed it by stabilizing the top.

WEEK 7 DATE 24/09/18

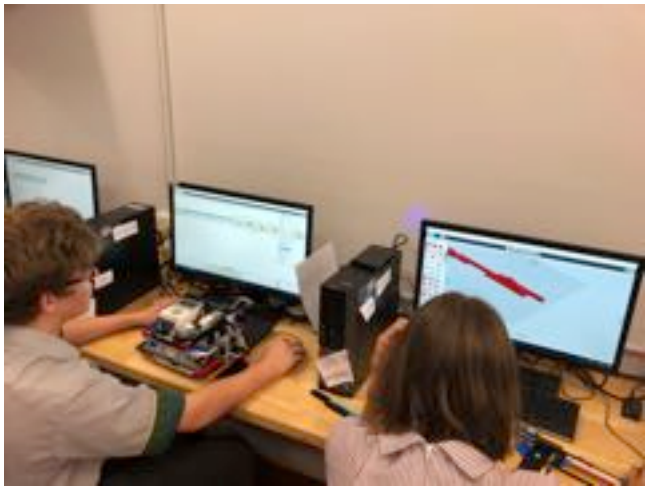
William upgraded the cage that Katelyn made for the mission extraction because her original design needed it to be moved by a motor so it now sits on the left side of the robot with an alligator mouth at the front and back to prevent the samples from coming out once the robot has driven past. Joe started to code the mission extraction with the new cage which looks like it should work and Andrew built a frame for the observatory mission and made an attachment for the food production and the lander touch down missions.

WEEK 8 DATE 1/10/18

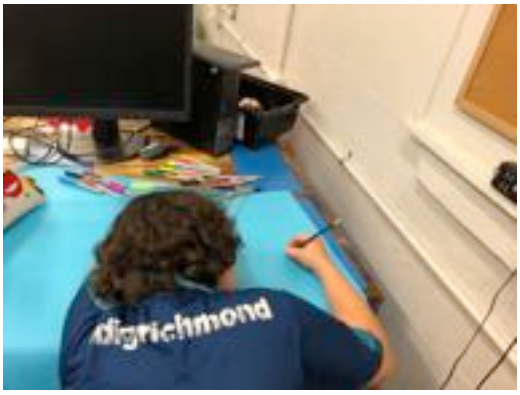
Andrew continued to design the attachments on digital design and Ayzlin worked on the speeches for our robot presentation. Joe and William continued to work on the core samples mission extraction and the tube module while Jackson and Katelyn worked on the observatory mission with the 2nd robot.

WEEK 9 DATE 8/10/18

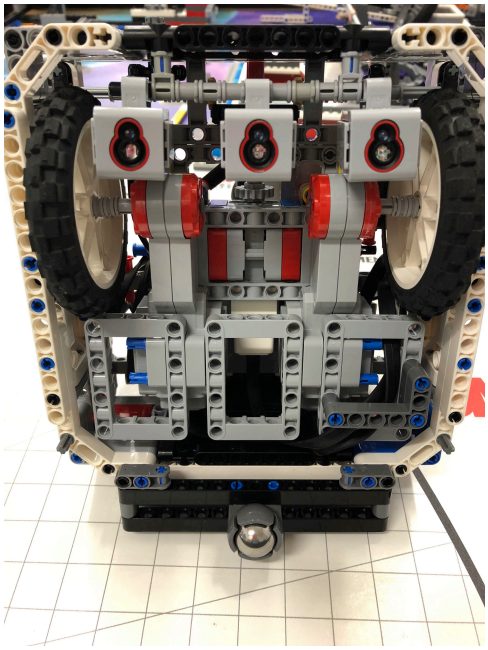
Andrew and Katelyn worked on the digital design for the solar array frame and the observatory frame and Ayzlin continued to work on the speeches for the research presentation. She is doing a great job. Jackson continued to work on the space observatory mission while Joe and William created new code for the extraction and tube module mission because the previous code was unreliable. William found a problem with the wire at the bottom of the robot because it was causing friction and he fixed it by putting a piece of lego technic on top of it to prevent the wires from touching the surface. The Team tried a new caster wheel because the previous wheel was unreliable.

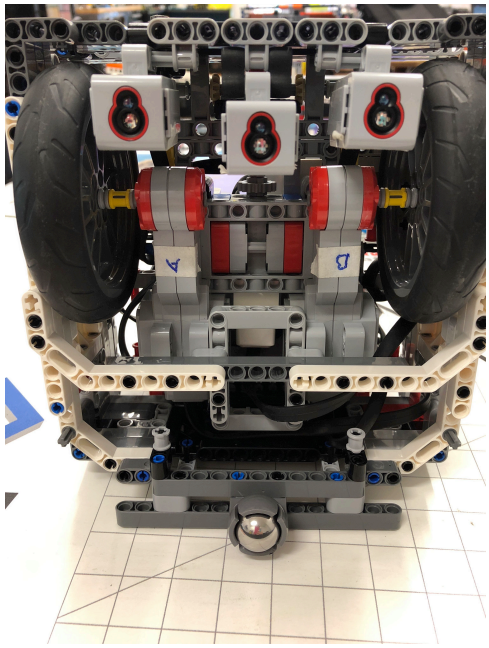


DATE 10/10/18
Joe and William finished the tube module part of the mission which gets 16 points but it is only consistent half of the time. Katelyn and Jackson and worked on the space observatory mission and the success rate is 95% of the time and Ayzlin started on the core values poster and while Andrew kept working on the digital designs. William had an idea to finish the robot on the orbit lines with the 2 satellites so we can get 16 points. The team had a discussion about a back up mission. The Team is still undecided.



DATE 11/10/18
William changed the wheels on the robot to slightly larger, wider and firmer wheels. This is because the other tread on the wheels was soft and it kept making the robot veer to one side and it was difficult to get consistency in the code for the robot to be successful. The change of wheels did have an slight impact on the robot because it lifted it one stud higher and there was less space in the chassis cavity. Because of this, we had to adjust our code and the sleeve for the Ramp mission. The payloads had to now sit one stud lower on the ladder. Andrew started building an attachment for the dock module so that we can use it as a back-up mission while Jackson finished off the observatory mission up to dropping of the satellites. It is working quite well.





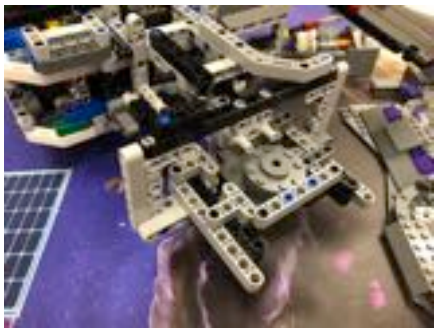
FROM THIS ----------→ TO THIS

DATE 13/10/18
Jackson and Katelyn finished of the observatory mission which gets a total of 68 points. The most challenging part was to get the front motor to slowly release the water onto the food production model. Once the motor releases the water the robot is coded to stay there for a second for prevent the sample from falling off and it works most of the time. Joe and William continued to work on the core samples mission and to make it more reliable and Ayzlin finished the writing part of the core values poster. It looks amazing.

The team have decided to add/change the order of the missions. We are now going to do the 3D printer, crater crossing and try to eject the meteor to the meteoroid belt with a new sleeve that Andrew has been working on for the 3D printer. Because of this, the dock module attachment was scrapped because we realised we had to move the dock module to the cone module's position and due to the size of our robot this was going to be very difficult.

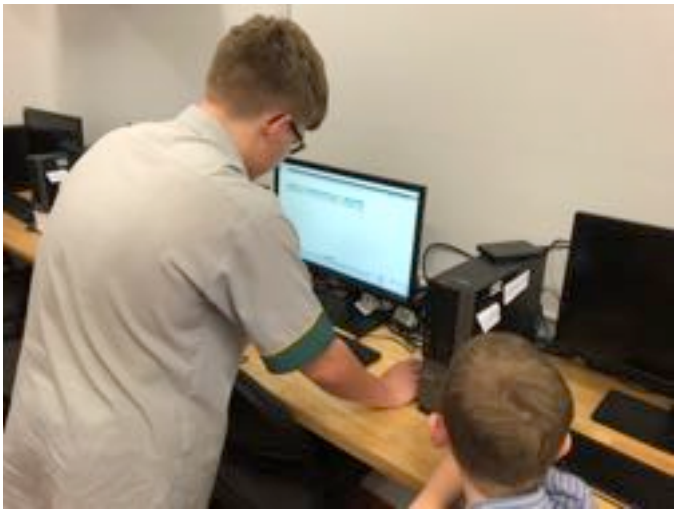
WEEK 10 DATE 15/10/18

Andrew, Jackson and William worked on the 3D printer mission but unfortunately the robot stopped working when we were programming it because the battery went flat so Jackson created a voice over for the power point which will be uploaded to YouTube so that we can share our research. Ayzlin and Katelyn continued to work on the core values poster while Joe continued working on the extraction mission and managed to line the robot up successfully nearly every time.



DATE 17/10/18

Ayzlin redid the team poster because everyone preferred our team logo to be in the centre of the poster while William assembled a spare parts kit for all of the teams to use on competition day. Jackson and Andrew refined the code for the 3D printer and Joe refined the code for extraction mission and also improved the lining up attachment.



DATE 20/10/18

Joe improved his code for the core sample extraction mission which gets a total 32 points. He also added fancy lights to the code. He is getting really good consistency. Andrew, William and Ayzlin were looking for a lost USB flash stick for nearly 20 mins which contains our research power point slides and we eventually found it; it was in Ayzlin's pencil case. Katelyn created the master program for the mission runs while Ayzlin continued to do the core values poster and Jackson restarted the code for the 3D printer mission..

WEEK 11 DATE 22/10/18

We are now at the point where the team can start practising the mission runs. However William and Joe had to fix the space travel mission because it seemed to stop working. Katelyn and Ayzlin continued to work on the team poster and made it look like it had 'watermarks' over it which look really good while Andrew fixed some of the attachment sleeves and Jackson finished the 3D printer mission.

DATE 24/10/18
The Team practised the mission runs again and also prepared the speech for the robot design. Katelyn and Ayzlin continued to work on the core values poster and Jackson had to re-record his voice for the YouTube video because the order of the powerpoint slides had changed. Then William made it into a video and uploaded it to YouTube.

DATE 27/10/18
The Team practised the research project speech in the back room for nearly 30 minutes and then we all continued to practise the mission runs on the robot table. The hardest thing is remembering everything that needs to be done or attached to the robot. William listened to one of the other teams (InteliBots) do their research speech. William refined the space travel mission and Jackson and Andrew worked on refining the 3D printer mission code.

WEEK 12 DATE 29/10/18
The Team practised their robot mission runs and the research speech again. We have decided that we will be wearing two different coloured socks on competition day: mulit-coloured blue on the left foot and a white sock on the right foot. This looks really good with our new teams shirts that were collected today. The team had a meeting and read over the marking criteria/rubrics for competition day and we discussed it how we might answer particular questions.

DATE 31/10/18
The Team practised the mission runs and the research presentation again. Andrew put labels on the cables of the second robot while Ayzlin prepared the palm cards for the speech.

Our last day of training was on Friday 2nd November. We only practiced the robot mission runs. Jackson and William trained together and then Andrew and Joe trained together. The most frustrating mission is the 3D printer mission but it works most of the time. We know we just have to be careful when we place the robot on the table. We are looking forward to competing at QASMT tomorrow, on Saturday 3rd November. It will be a great day.

Regional tournament

Saturday 3rd November

QASMT

ORDER OF MISSIONS:

Regional Competition, 3/11/2018

Robot Game 1:
Katelyn (robot operator)
Ayzlin (helper)

Robot Game 2:
Andrew (Robot Operator)
Joe (helper)

Robot Game 3:
Jackson (Robot Operator)
William (helper)

OPEN and RUN the MASTER PROGRAM

Run 1:
PROGRAM NAME: Ramp
TIME TAKEN: 20 seconds
TOTAL POINTS: 64

Lift Space travel ramp
Push Solar Array
Deliver Supply Payload
Deliver Crew Payload

NEED TO:

- Make sure the wheels are NOT touching the inside walls
- Carefully place the push frame in front of the robot
- Ensure that the frame is as far left as it can be with a slight angle
- Use the ladder sleeve
- Ensure the ladder is as low as it can go
- Place the supply payload on the highest axles that stick out on the ladder (left side)
- Place the crew payload on the lowest axles that stick out on the ladder (right side)
- Press the middle button

Run 2:
PROGRAM NAME: Core Sample
TIME TAKEN: 35 seconds
TOTAL POINTS: 16 (plus extra when samples are delivered)
Collect and capture all 4 core samples

NEED TO:

- Use starting corner frame
- Make sure to use the two thin bars on both sides of the starting frame
- Use the sleeve with the side cage
- Carefully place the robot on the table in the starting frame without dragging the wheels
- Press middle button
- Be careful with the core samples when the robot returns to base

Run 3:
PROGRAM NAME: 3D Printer
TIME TAKEN: 50 seconds
TOTAL POINTS: 46 points
Deliver grey sample to 3D Printer
Deliver agent vehicle to crater crossing
Eject meteor towards the meteoroid belt

NEED TO:

- Use starting corner frame
- Carefully place the robot in the starting frame without dragging the wheels
- Place grey sample in the front of the robot
- Place wheels on the arm on the left side of the robot (make sure it is at the correct angle)
- Place the blue meteor ball on the arm on the right side of the robot (make sure the angle is correct)
- Press middle button
- Remove corner starting frame

Run 4:
PROGRAM NAME: Food Production
TIME TAKEN: 30 seconds
TOTAL POINTS: 68 points
Turn Observatory to white
Deliver blue water sample to food production
Push food production to green
Move Blue satellite to outer orbit lines
Deliver two satellites to outer orbit lines
STOP ROBOT

NEED TO:

- Carefully place the long pushing frame in front of robot
- Carefully position the arm the flips the long bar downwards to the table
- Place the blue water sample in the front of the robot
- Carefully place the two satellites in the top cage (make sure the antenna stick out towards the front)
- Press middle button
- KEEP AN EYE ON THE TIME REMAINING
- Be ready to stop the robot on top of the outer orbit lines

****

BACK-UP MISSION IN CASE A MISSION FAILS

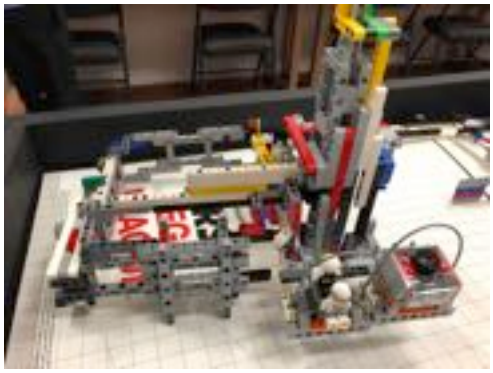
Run 5:
PROGRAM NAME: Tube Module
TIME TAKEN: 30 seconds
TOTAL POINTS: 18 points
Insert tube module into the west side of habitation hub

NEED TO:

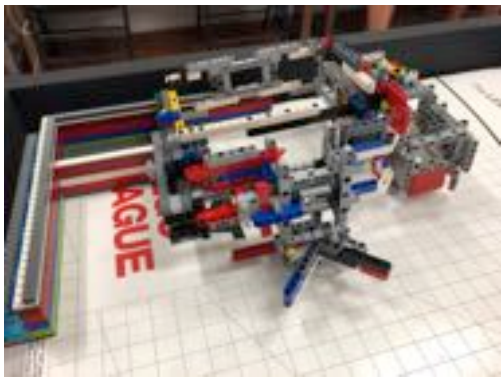
- Do not use starting frame
- Swap sleeve frame to the tube holder
- Insert tube module
- Make sure the robot is against the wall
- Find ‘tube module’ mission in list

ROBOT SLEEVE FRAMES

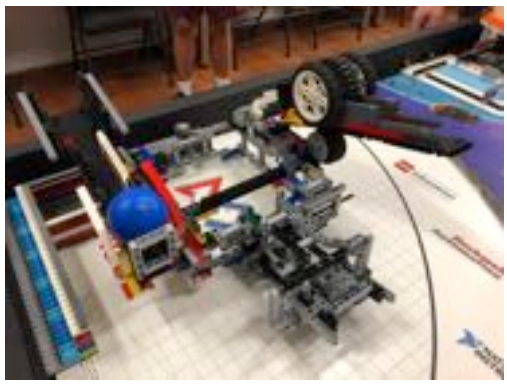
RUN 1: Ramp, Solar Array and payload delivery



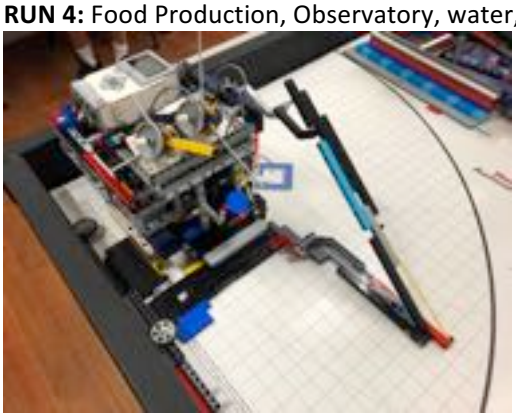
RUN 2: Collect all 4 core samples



RUN 3: 3D printer, Crater Crossing and Meteroid

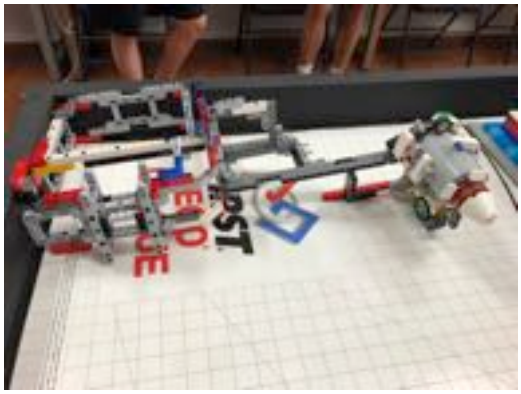


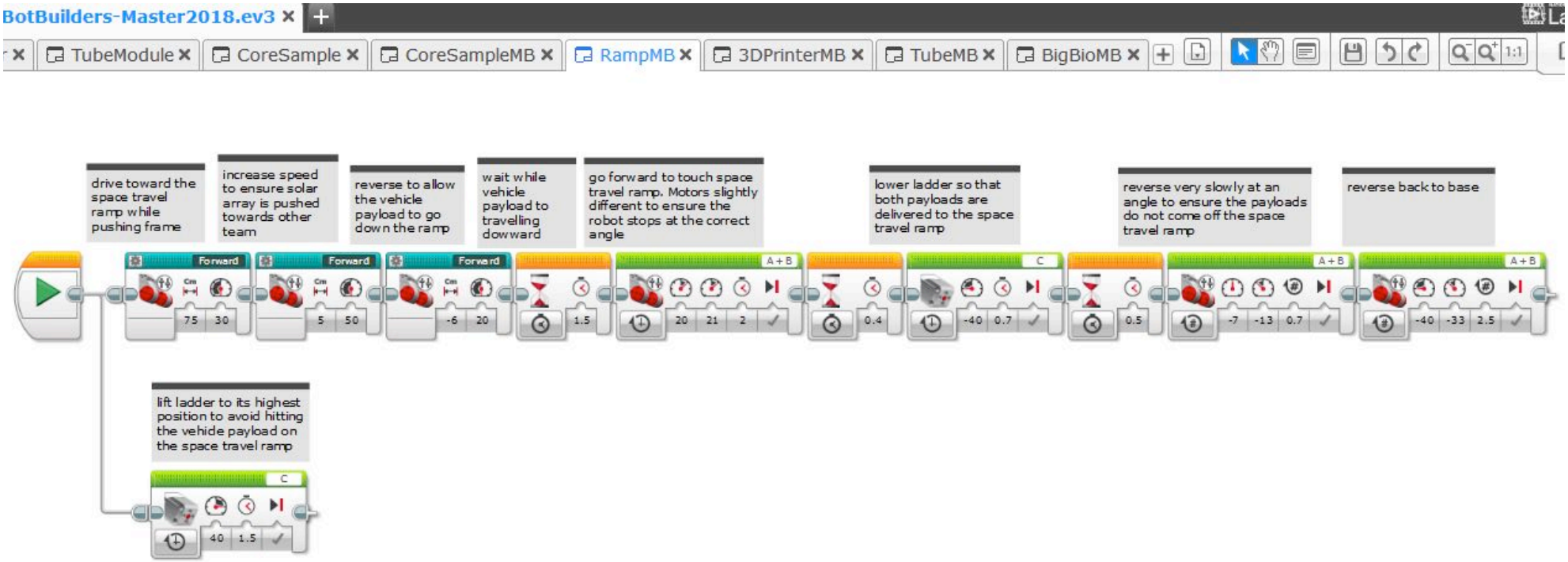
RUN 4: Food Production, Observatory, water, and satellites



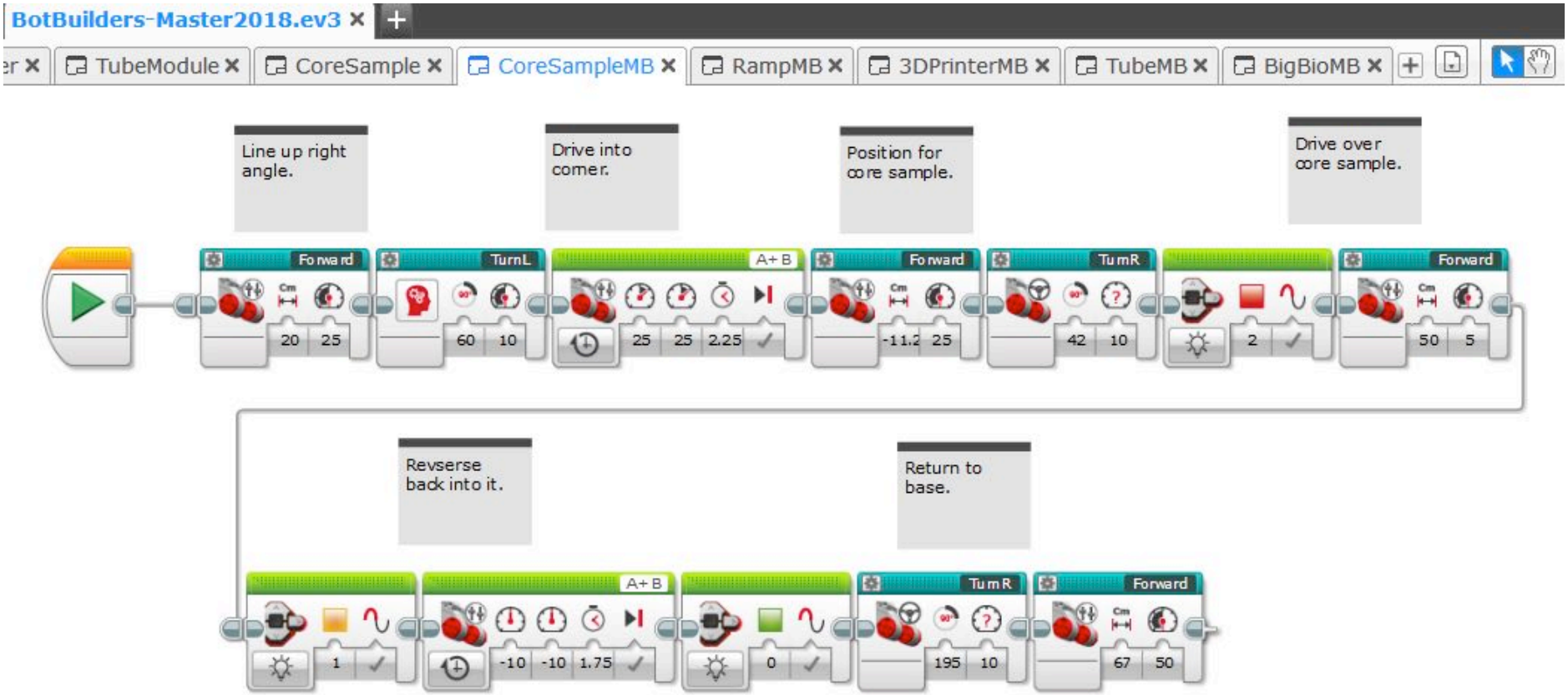
BACK UP MISSION

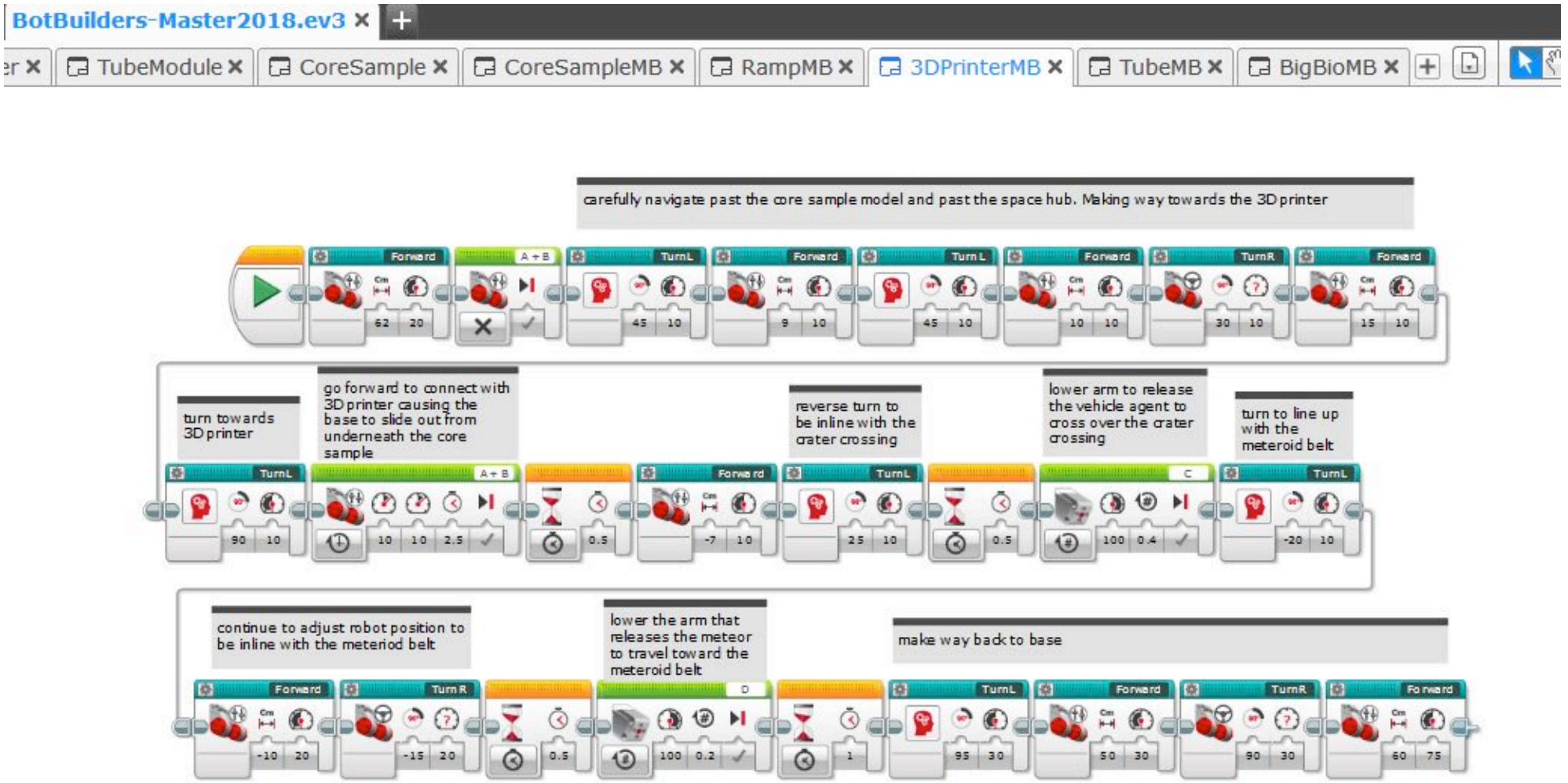
RUN 5: Tube Module

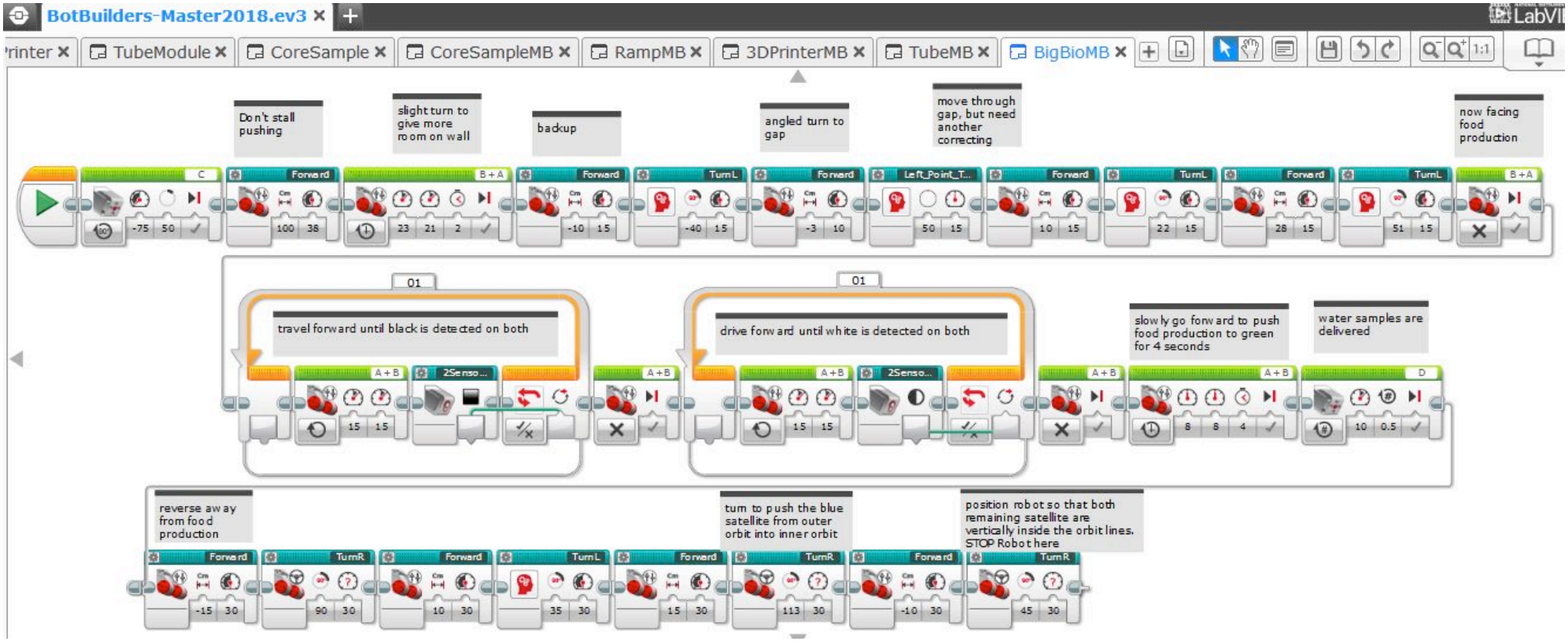




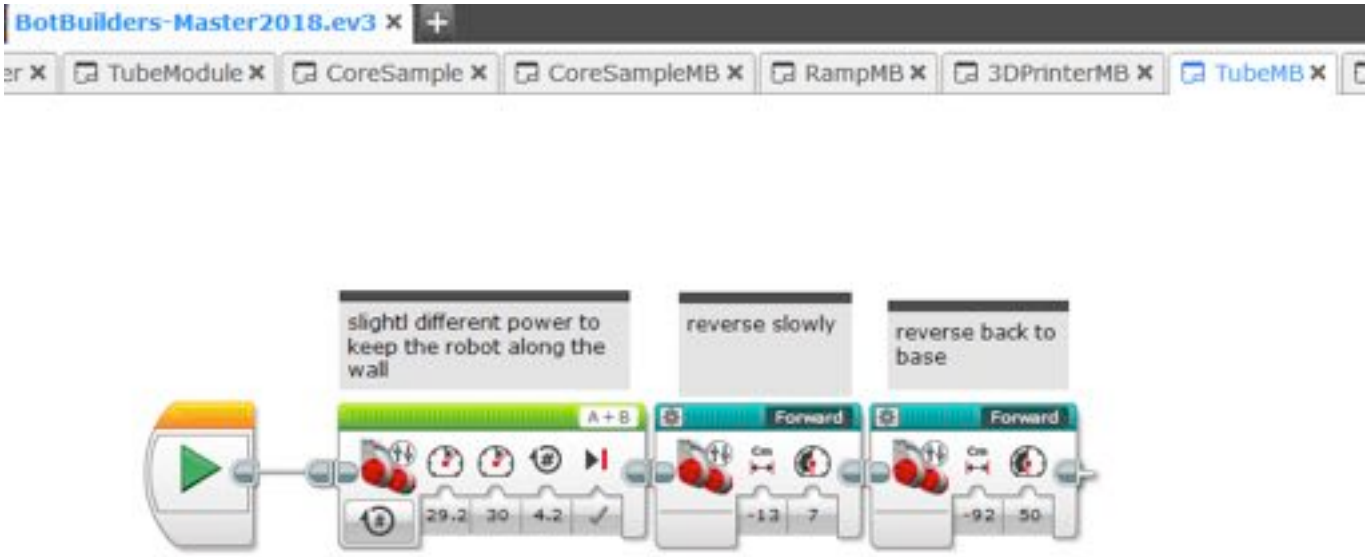
Code for our missions


BotBuilders-Master2018.ev3
TubeModule
CoreSample
CoreSampleMB
RampMB
3DPrinterMB
TubeMB
BigBioMB
Line up right angle.
Drive into corner.
Position for core sample.
Drive over core sample.
Forward
TurnL
A+B
Forward
TurnR
Forward
20 25
60 10
25 25 2.25
-11.2 25
42 10
2
50 5
Revserse back into it.
Return to base.
A+B
TurnR
Forward
1
-10 -10 1.75
0
195 10
67 50


BotBuilders-Master2018.ev3
TubeModule
CoreSample
CoreSampleMB
RampMB
3DPrinterMB
TubeMB
BigBioMB
carefully navigate past the core sample model and past the space hub. Making way towards the 3D printer
turn towards 3D printer
go forward to connect with 3D printer causing the base to slide out from underneath the core sample
reverse turn to be inline with the crater crossing
lower arm to release the vehicle agent to cross over the crater crossing
turn to line up with the meteroid belt
continue to adjust robot position to be inline with the meteriod belt
lower the arm that releases the meteor to travel toward the meteroid belt
make way back to base

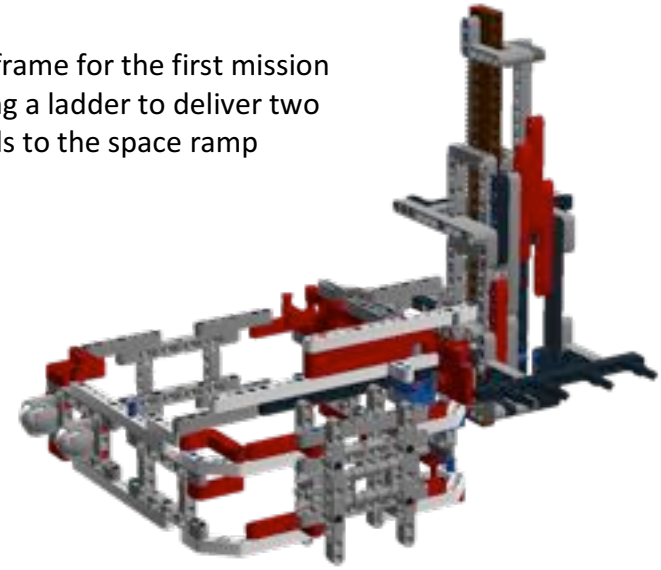

BotBuilders-Master2018.ev3
TubeModule
CoreSample
CoreSampleMB
RampMB
3DPrinterMB
TubeMB
BigBioMB
Don't stall pushing
slight turn to give more room on wall
backup
angled turn to gap
move through gap, but need another correcting
now facing food production
travel forward until black is detected on both
drive forward until white is detected on both
slowly go forward to push food production to green for 4 seconds
water samples are delivered
reverse away from food production
turn to push the blue satellite from outer orbit into inner orbit
position robot so that both remaining satellite are vertically inside the orbit lines. STOP Robot here

BACK UP MISSION – JUST IN CASE

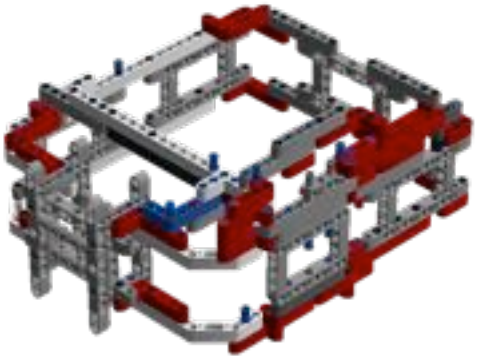


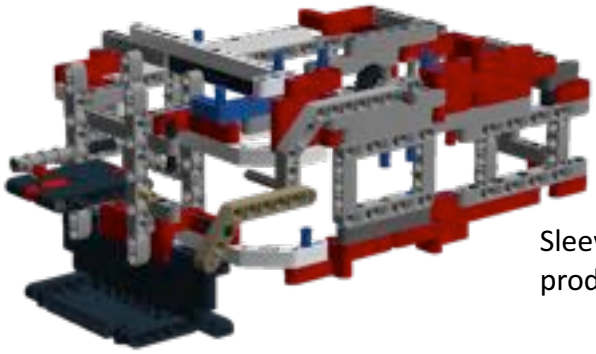
3D DIGITAL DESIGNS OF OUR ROBOT AND FLL ACCESSORIES

Sleeve frame for the first mission including a ladder to deliver two payloads to the space ramp

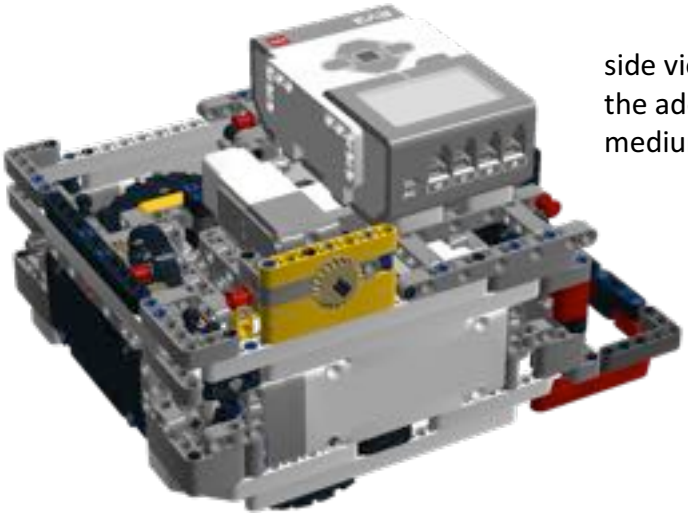


Original appearance of our sleeve frame without attachments





Sleeve frame for mission 4 (food production)

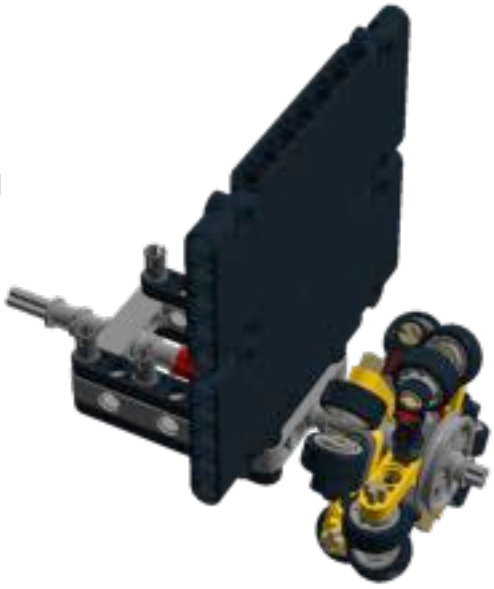


side view of the robot. Including the addition of the side facing medium motor

front view of the robot. Including the addition of the side facing medium motor

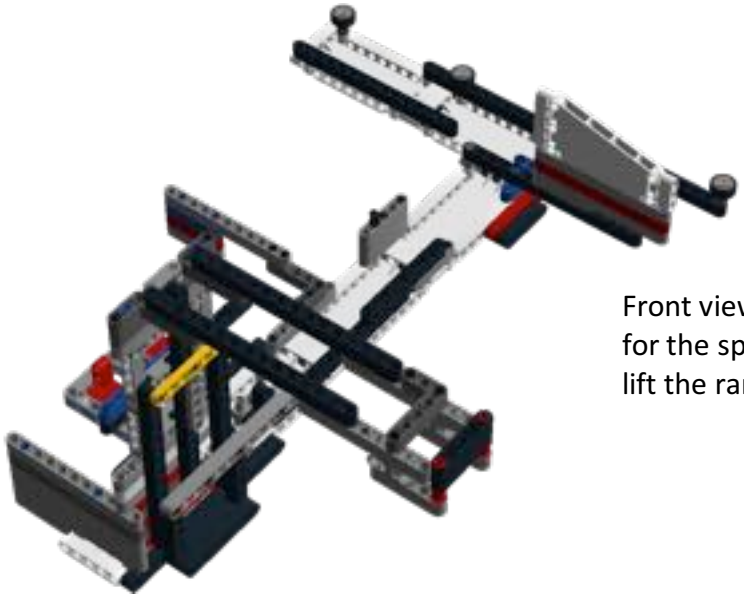
Back view of the robot. Including the previous caster wheel design. This wheel is no longer used.

Our original caster wheel

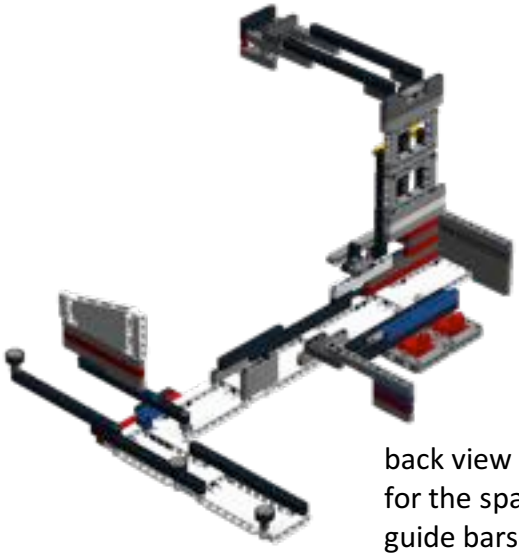


Light sensors placed at the front to detect black and white

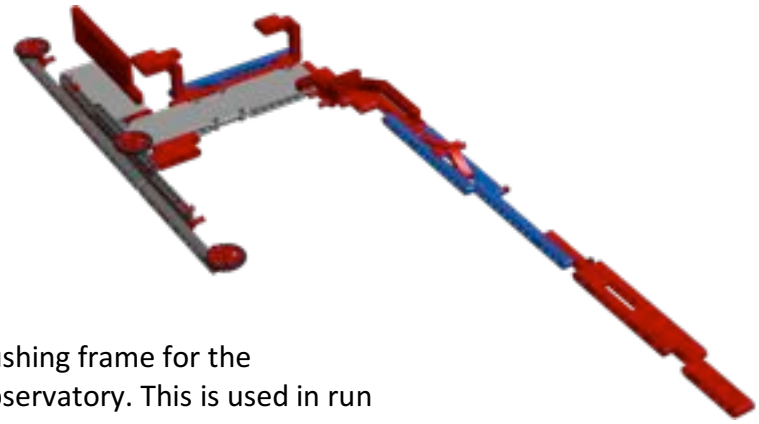
Our original wheels before replacement. The middle chassis of the robot



Front view of the pushing frame for the space ramp mission to lift the ramp up

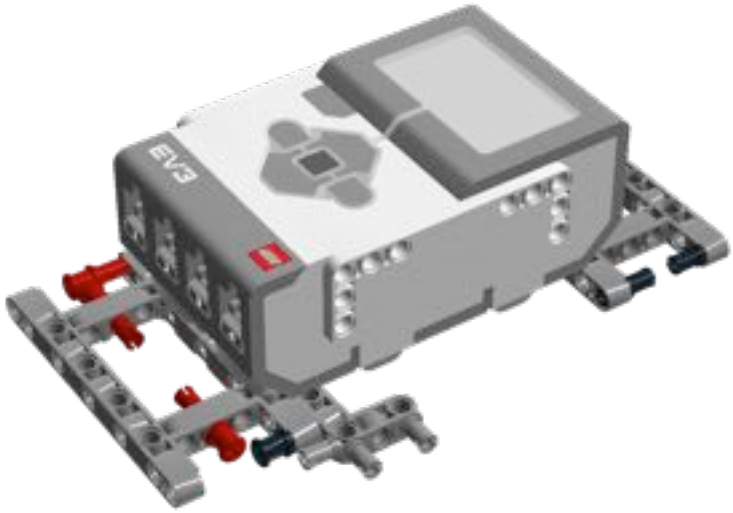


back view of the pushing frame for the space ramp mission. The guide bars for the underneath side of the robot is visible.



Pushing frame for the observatory. This is used in run 4.

Cover for the front of the robot to connect the sides of the robot.



EV3 brick attachment to the robot

RESEARCH PROJECT SPEECH: Cosmic Radiation

For Regionals:

Jackson: Good afternoon judges, ladies, and gentleman. Today I would like to introduce to you to the BotBuilders of 2018. My name is Jackson and I am the co-captain with Katelyn. The other members are (indicate with hand) William, Andrew, Joe and Ayzlin.

Today our mission is to propose a solution to what we believe is one of the most significant physical problems to space travel, cosmic radiation. We will look at the current technologies that are being evolved to help this issue and propose our own theories as well.

To us the harmful effects of radiation on both the humans and their aircraft are the most significant issues among the many that we have identified. The damage that cosmic rays cause when bombarding the brain can result in both cognitive and memory impairments, these can manifest in just a few months. Exposure to cosmic radiation can also lead to an increase in carcinogenesis and can affect the nervous and cardiovascular systems. William

In simulated tests with mice test results revealed significant impairments in both recognition memory and spatial memory. Here in graph A you can see the significant decrease in recognition memory and in graph B you can see the significant decrease in spatial memory.

Cosmic radiation, what is it? Well there are two types of radiation that comprise of Cosmic radiation. Solar Particle Events (SPE) and Galactic Cosmic Rays (GCR).

GCR's are a constant stream of radiation originating from ancient supernovas comprised of both protons and ions where the dosage is dangerous when accumulated over several months.

This crab nebula is a supernova remnant in our Milky Way Galaxy.

There are three countermeasures that we are proposing to you today. Magnetic shielding, nanomaterial and induced synthetic. For our solution to work we suggest that all three of these countermeasures are combined to reduce the effects of cosmic radiation. William

Magnetic shielding is conducted by superconducting magnets and is useful as it is not as heavy as the current solutions that can weight down the spacecraft, however new materials are needed such as aramid fibres and titanium sheaths to limit the mass of the magnets. Prototypes of magnetic shielding so far have shown a 75% reduction to radiation exposure. The only other aspect of this solution that is in a developing stage in the energy required on a spacecraft to generate the continual magnetic shielding.

This is a schematic view of the pumpkin magnetic shield prototype that is currently in a development stage.

Nanomaterial. Nanomaterial is being developed by Dr Mohsen Rahmani at the Australian National University. This is a thin film that consists of a layer of dieletric nanoparticles that are spread so thin that they are hust 0.00005 of a millimetre apart. With a change in temperature, the function of the new nanomaterial can either absorb, reflect or emit light and radiation. This material can be applied to any surface, including spacecrafts and spacesuits. Further research will be needed to bring this product to a commercialisation stage.

Induced Synthetic Torpor (IST) is defined as creating hibernating type conditions induced in non-hibernating animals. It is achieved through the medical research of therapeutic hypothermia and creating conditions for human stasis. IST reduces the metabolic activity of the body and provides animals with higher levels of resilience to stress.

Experiments conducted using marmots and squirrels pre and post hibernation have shown that the effects of radiation exposure were mitigated by a radioprotective effect of hibernation. IST would also need to be accompanied by total parenteral nutrition which is where a person is fed with nutritional fluids. Andrew

Many benefits come with IST including a reduce in the spacecraft's total energy production, potential to reduce radiation exposure, reduction in consumables needed for the trip, minimised psychological challenges for the crew, reduced pressurised volume needed for living quarters, reducing the need for ancillary crew accommodation such as food/ eating area and entertainment etc. Another benefit is that the research and implementation will further help organ transplantation and critical care patients. These are some of the many benefits that come with IST.

This is an artist's impression of the IST habitat for astronauts.

Our theory is to combine all three of these solutions to create a more efficient and reliable solution that will reduce the radiation exposure and its effects on astronauts.

We hope that you have enjoyed our presentation today and consider these possibilities for future space travel

WE SHARED OUR RESEARCH WITH:

Dr Gordon Cable
Australasian Society of Aerospace Medicine

Dr Marc Jurblum:
Psychiatry Registrar
St Vincent's Mental Health Service
Space life science committee member with the Australasian Society of Aerospace Medicine

Dr Tim Squires
Senior Radiation Oncology Registrar at Canberra Hospital.
Space life science committee member with the Australasian Society of Aerospace Medicine

A member of the Deep Space Network in Canberra

And, to YouTube: https://www.youtube.com/watch?v=6D3fcNeU2tI&t=75s
On Friday 2nd November our research video had received 72 views.

CONTINUATION OF JOURNAL

AFTER THE REGIONAL COMPETITION

DATE: 03/11/2018
Today was the date of the competition. All four teams at Building Block Studio were next to each other in the pit area. We instantly set up 2 FLL tables and shared the remaining 2 tables for computers, team journals and team robots. Our team was first on the list to perform the research project presentation at 9:30am. Our 3rd Coach (Derek, and mentor Mike) were allowed in the room as well. We think some of the questions were a bit hard to answer but overall we think we did pretty well. Unfortunately we didn't receive any feedback from the people we shared our research video with. I think the judges were also disappointed with that as well.

We went around the room encouraging the other teams from Building Block Studio and also practiced our missions as well. Our robot design judging was at 11:10am and we think we did quite well at explaining our robot and coding. We think the judges were impressed with our journal.

Katelyn and Ayzlin did the first robot game and they were amazing. They achieved 150 points. Unfortunately the 3D printer mission didn't succeed at all because the robot didn't turn correctly but everything else worked great. At this stage, we noticed that the FLL robot field mat was not in the position we thought it would be in and that it wasn't stuck down by stickers underneath. Once all four teams had completed their project judging, core values judging and robot game 1, it was really great to watch and cheers for the other teams while they performed at their 2 remaining robot games.

The EVBees were probably the best and most consistent of the other 3 teams but one of their sleeves seemed to be not working properly. The next best team was InteliBots. They didn't score as highly on the robot game but their score was in the middle of the ladder. We were told that their research project went really well. The last team was the BlockBots. The scored 0 in both of their first robot games but they got 82 in the final robot game.

Andrew and Joe did our second robot game and scored 84 points and again the 3D printer mission failed and the core samples mission didn't work straight away. Then, Jackson and William did the last robot game. Unfortunately they scored 0 points because not a lot of things went right and they had to pick the robot up several times. This was probably due to human error. But, we are still happy that overall we did really well.

We all helped pack everything up and then carried something to the car that would take all of the stuff back to Building Block Studio. Then Building Block Studio awarded each of the teams with a certificate and gave a speech about our progress throughout the season then we all walked over to be part of the closing ceremony. We are so excited that we were awarded with two trophies. The BotBuilders and the InteliBots both got an invite to the states in 3 weeks.

WEEK 13 05/11/2018
At training this afternoon the team had a discussion about what went wrong in the regionals and how we could improve things. A decision was made to no longer deliver the meteor because it is not very reliable and usually causes problems with the sleeve. We also discussed about how we could improve the research project. Our current proposal was to combine 3 existing solutions into 1 solution however at the regionals we discovered that it was hard to explain and we think the judges thought it was too complicated.

So we are going to change our research topic. We are currently thinking about either: water deflecting cosmic radiation, using thermal nuclear engines to increase fuel efficiency and ultimate speed of the space craft, OR we will research the effect of depression within astronauts. The Team made the extraction mission faster by increasing the speed and getting rid of the 180^{o} turn at the end of the mission and this saves nearly 15 seconds. We also added a solar array pusher to the food production frame so we can push the other team's solar array and get 22 extra points and hopefully give the other team 4 extra points. We changed the order of which team member does the missions to give different people a chance to go last.

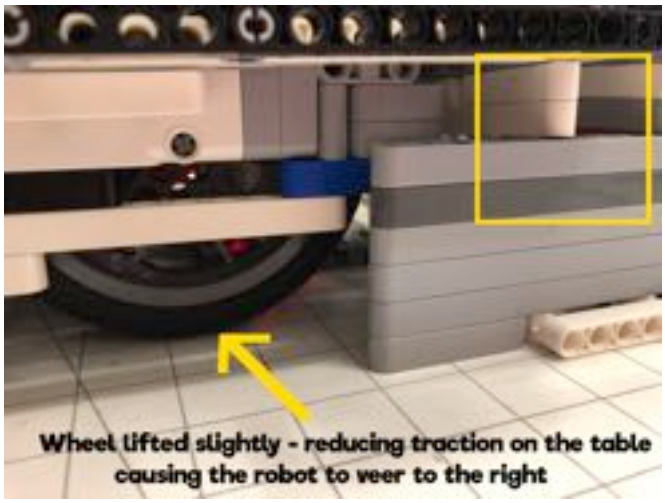
WEEK 13 07/11/2018
Even though Katelyn was away today the rest of the team continued talking about what we should research about. We still have not yet made a final decision. We received the judging rubrics from QASMT via email today. We are so happy that we did really well in both core values and robot design but sadly we didn't do that well in our research project which is what we expected. So, we are glad that we are now researching something new.

Jackson and Joe each worked on a different mission. Joe coded the observatory mission so it would hit the opponent's solar array more consistently while Jackson reprogramed the 3D printer mission because the amount of turns it made caused the robot to make too many mistakes. Our solution to fix that problem has two steps: 1) is to align to the wall so that the robot is always pointing in the right direction, and 2) then using the colour sensors code the robot to travel forward until the robot detects the black and white line in front of the core samples. At this point, the robot knows where it is on the field so it is programmed to go forward a certain distance and then do one left-hand turn towards the 3D printer.

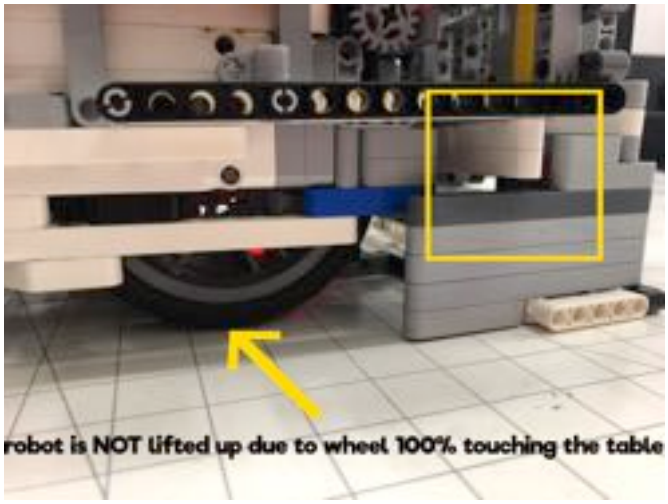
We think we have reduced drastically the risk of errors that the robot makes on this particular mission. After the big team discussion Ayzlin restarted the power point presentation that will go with our new research.

WEEK 13: 08/11/2018
While Jackson and William were practicing today, we discovered WHY the robot when crooked for Jackson and William at the regional competition. It was because one of the bottom bars at the front of the robot was accidentally placed on top of a section of our pushing frame that we use for the space travel ramp. Because of this, the wheel on the right side of the robot was lifted up a tiny bit which caused the robot to veer to the right.

So, William took one of the technic beams away and added a small bar that stuck out 90 degrees. This made sure that the robot went in the right position without being lifted up. We only discovered the flaw in our design after we made the same mistake and because we had time to think about WHY it happened without the rush of time ticking down at the competition.



BEFORE

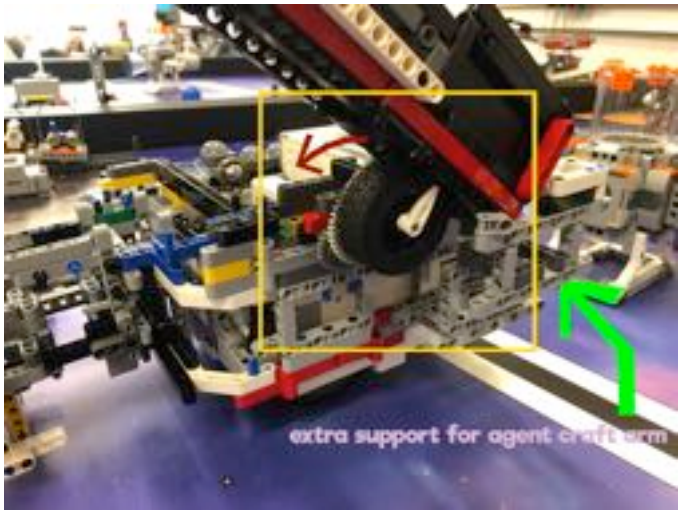


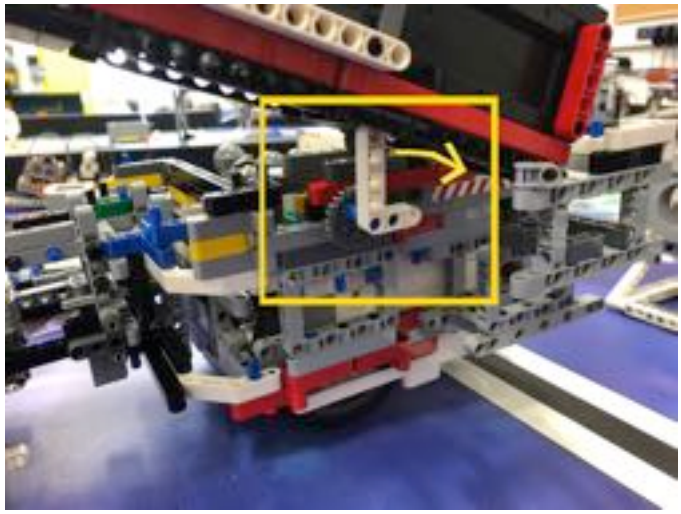
AFTER

WEEK 13: 09/11/2018
Today, Joe, Ayzlin, Andrew and William came to more FLL training after school. We spoke about who would work together at the robot table on State competition day. We think it's a good idea for Katelyn and Jackson to work together, Joe and William should work together, while

Andrew and Ayzlin should work together. We think this will reduce the stress for Katelyn and Jackson. We have further refined our research project to include nuclear power so that a trip to Mars will be twice a quick.

Andrew made slight changes to the sleeve that delivers the agent craft to the crater crossing. He removed the wheel that was being used to hold the flip arm up because it wasn't working properly. This was due to the tread on the wheel slowly making the flip arm slip down which caused the agent craft to fall off too early. He changed it to include a large 'L' piece to hold the flip arm up instead. Then, William changed the code so that the direction of the motor operating the piece which holds the flip arm up flipped backwards instead of forwards. It now much stronger and works much better. Andrew also gave the agent craft arm more support underneath so that is was stronger and the axle was more secure.





FROM THIS ----------→ TO THIS

William and Joe practiced the robot runs many times. They worked out the best and quickest way to cooperate to make sure that everything is done for a particular run before the button is pressed on the robot. They got the top score of 213 twice, while the average was about 165 points. Andrew and Ayzlin also practiced a few times as well.

Even though Katelyn and Jackson were away we all had another team discussion about our research project with no final decision being made.

WEEK 13: 10/11/2018
Today, Andrew, Joe and William were first to training. Joe and William practiced the robot runs over and over again trying to get a top score of 213 again but for some reason the last mission that does that observatory kept going wrong. We plan on fixing the code to that mission on Monday. When Jackson came, he was tasked with trying to distract Joe and William while practicing to try and simulate the pressure of competition day and it totally worked because William lost focus and started getting stressed but the highest score that Joe and William achieved was still 160. When Katelyn and Jackson started practicing, the robot sometimes did a few weird things when doing the core samples mission. We're not sure why. But they managed to score an average of 150 points which is pretty good.

WEEK 14: 11/11/2018
Today, we finally reached a decision on the new research project topic. We will research into the effects of depression and how we can alleviate this by increasing audio communication with deep space astronauts AND to help improve human-connection with family members through a simulated hug. We have found that NASA are already producing a special suit that will include sensors that will detect things such as pulse rate, blood pressure and joint angles. Why not add a few more functions to this suit to further improve mental health in astronaut's. We really like this idea. Katelyn, Jackson and Ayzlin will do some intense research on this topic and a speech will be formulated by the outcome.

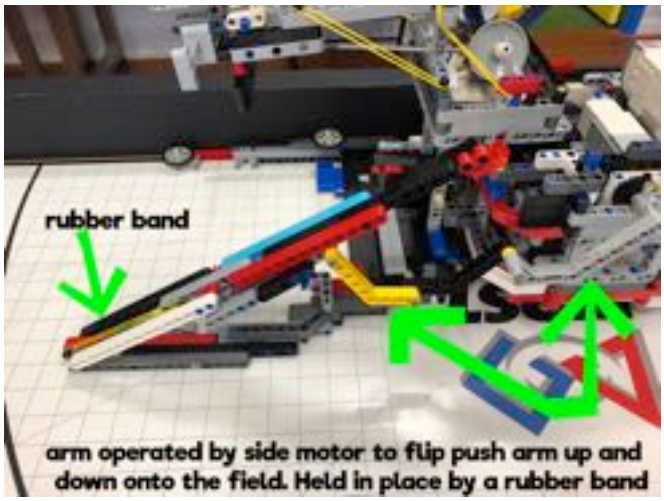
12/11/2018
Today, Jackson, Joe, Andrew and William came to training. Both Jackson and Joe read through the research project speech and suggested a few changes but overall they are pretty happy with the result. Then, Joe and William practiced their routine many times while Andrew and Jackson watched. Andrew quickly added a longer support bar to the side of the space travel push frame to prevent any possible veering of the frame when it moves forward. Joe increased the turn in the code when the robot turns toward the 3D printer. Joe and William scored a near perfect round of 211 points.

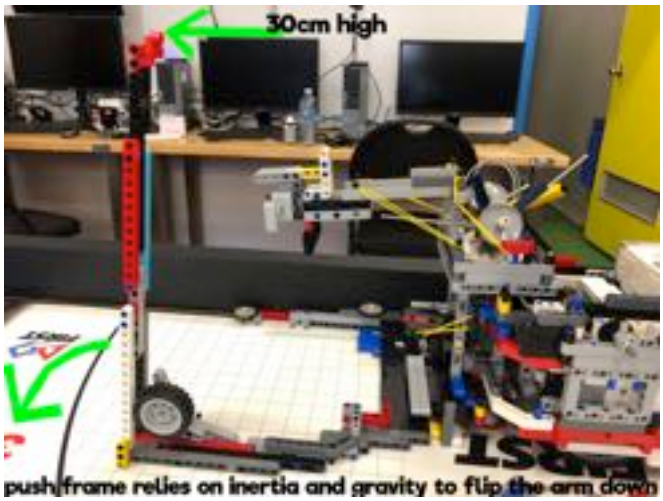
13/11/2018

Today, all the team came to training between 3:30pm and 6pm. Katelyn added more images to the powerpoint slide while Joe and William practiced with the robot and while Andrew was updating the caster wheel design in the digital form of the robot. Then, Joe edited the font in the power point slides while Jackson and Katelyn practiced with the robot and while William and Ayzlin practiced their parts in the research speech. At about 5pm, all the members put their team shirts on and rehearsed the research speech for nearly an hour. It took about 7.5 minutes at the first try but with practice the time came down to just over 6 minutes.

WEE15/11/2018

Today spent a bit of time making sure our attachments were strong. We decided to change the sleeve that we use for the final mission. We decided to remove the motor movement of the arm that flips down onto the table which is used to push the observatory to white. We did this because it was a bit tricky to get it in the right place regarding the motor (it often went lower because the arm was probably too heavy for the motor) and to make sure it was out of the way when placing the robot into position in the push frame. We just had to make sure that it was under 30.5cm high. Plus, it didn't work EVERY time. So now, we have decided to have the arm more upright and to use the robot's momentum driving forward and then stopping so that the arm drops down. This works every single time. The mission is now about 4 seconds quicker to set up.

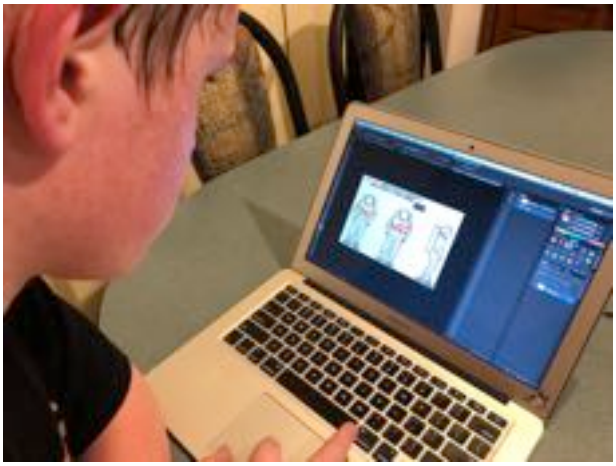




FROM THIS ----------→ TO THIS

16/11/2018

Today we got our first feedback for our new research project. It was from a lady called Melba. She works at the Florida Polytechnic University and she is responsible for the biology part of the 'happy space suit'. It was so great to receive her feedback as she mentioned that we should include a diagram of what our proposed solution would look like. So, Andrew did these on the computer. He made 2 images; one that shows where the speaker for audio will go and the one image that shows where the pockets of air would be located for 'hug simulation' as well as how the pockets would be filled. We think this is a great addition to our research presentation.



16/11/2018

Today, Andrew, Joe, William and Ayzlin attended another training session and Ayzlin bought choc-chip cookies again! Yum. Joe and William practiced with the robot while Andrew updated the digital designs of the robot sleeves until Ayzlin arrived at 4:30pm. Then, Joe and William read through their research speech in the back room while Andrew and Ayzlin practiced with the robot. They managed to get a perfect run of 213 points! At 5pm, all attending members interviewed Janice Gnomes. We spoke about depression and how it can affect people's lives. We also spoke about other types of audio that an astronaut would benefit from listening to; things such as waves at the beach, trees rusting in the winding and animal sounds. We have decided to incorporate this in our speech.

17/11/2018

We were all at training today. Ayzlin made changes to the speech while Joe and William practiced at the robot table while Andrew continued working on the digital designs of the robot. We did this for about an hour and a half. Then Andrew and Ayzlin practiced at the robot table for about 30 minutes until Jackson arrived at 11am. Jackson watched and tried "distracting" them in preparation for the state comp day. Katelyn joined in at 12:30pm and immediately starting practicing with Jackson at the robot table while Andrew worked on the digital designs, while Ayzlin cut out the new speeches and while William and Joe practiced their parts of the speech. Katelyn, Joe and Ayzlin left just before 2pm so, Andrew and Jackson continued practicing because Jackson had not had much time at the table. We realised that Andrew and Jackson made a fantastic team and they work together extremely well. So, because of this we have decided to change partnerships (again!) for State Comp day. It will now be: Katelyn and Ayzlin, Joe and William, Andrew and Jackson. Andrew and Jackson were able to get consistently at least 170 points.

WEEK 15: 19/11/2018

We were all at training this afternoon. Ayzlin made slight changes to the speech again while Jackson and Andrew practiced at the robot table. The team improved on the tube module mission by giving it a new attachment that includes angled arms to guide the robot into place when approaching the habitation hub. So, providing the robot was heading in the right direction it should be able to deliver the tube module every time. However, the tube module is still a back-up mission if something else fails. We also decided to swap our FLL practice table with the one that the Intelibots use because we weren't familiar with that table and because of different placements with the black border line. Both teams practised many times with the timer and while there was loud music playing to try and simulate 'competition day conditions'.

20/11/2018

Joe and William were practicing the mission runs again with the timer and a podcast that was trying to distract them. They practiced from 3:30pm – 5:30pm. Andrew completed 3 sleeves - 5th, 3rd and 4th- on digital design. Both Joe and William practised their parts of the speech so they can continue to memorise their lines. We also received the schedule for the state competition.

21/11/2018

All of the team came to training this afternoon. William and Joe practiced at the robot table for about 15 minutes and then Katelyn and Ayzlin practiced for about 45 minutes. The girls were able to get an average of 150 points each time with about 15 seconds to spare. They seem much more confident today. The average points for all 3 groups is 160 points. We all practised the speeches again and tried to memorise it. Andrew and Jackson have made a plan to do the tube module, first if the core sample mission succeeds straight away, or use it as a back up mission if something fails. They know if the timer is at 1min and 5 seconds then they have enough time. Tonight, Andrew was able to finish the digital design of the last robot sleeve for the 3D printer mission. Today is the last day that the whole team will train together before the State comp on Saturday 24th November.

23/11/2018

Only Jackson, Joe, Andrew and William came to training today. Andrew added three 7 hole technic beams underneath where the water sits for the BigBoi mission so that the ramp can only be pushed down a certain distance. This prevents the water from sometimes bouncing off the food production module. Other than that, we just practiced and practiced from 3:30pm – 6pm.

ORDER OF MISSIONS:

State Competition, 24/11/2018

Robot Game 1:
Katelyn (robot operator)
Ayzlin (helper)

Robot Game 2:
Joe (Robot Operator)
William (helper)

Robot Game 3:
Andrew (Robot Operator)
Jackson (helper)

OPEN and RUN the MASTER PROGRAM

Run 1:
PROGRAM NAME: Ramp
TIME TAKEN: 20 seconds
TOTAL POINTS: 64

Lift Space travel ramp
Push Solar Array
Deliver Supply Payload
Deliver Crew Payload

NEED TO:

- Make sure the wheels are NOT touching the inside walls
- Carefully place the push frame in front of the robot
- Ensure that the frame is as far left as it can be with a slight angle
- Use the ladder sleeve
- Ensure the ladder is as low as it can go
- Place the supply payload on the highest axles that stick out on the ladder (left side)
- Place the crew payload on the lowest axles that stick out on the ladder (right side)
- Press the middle button

Run 2:
PROGRAM NAME: Core Sample
TIME TAKEN: 17 seconds
TOTAL POINTS: 16 (plus extra when samples are delivered)
Collect and capture all 4 core samples

NEED TO:

- Use starting corner frame
- Make sure to use the two thin bars on both sides of the starting frame
- Use the sleeve with the side cage
- Carefully place the robot on the table in the starting frame without dragging the wheels
- Press middle button
- Be careful with the core samples when the robot returns to base

Run 3:
PROGRAM NAME: 3D Printer
TIME TAKEN: 35 seconds
TOTAL POINTS: 38 points
Deliver grey sample to 3D Printer
Deliver agent vehicle to crater crossing

NEED TO:

- Be sure to restart master program
- Use starting corner frame
- Carefully place the robot in the starting frame without dragging the wheels
- Place grey sample in the front of the robot
- Place agent craft (wheels) on the arm on the left side of the robot
- Press middle button
- Remove corner starting frame
- Be ready to collect the robot when it stops after delivering the agent vehicle

Run 4:
PROGRAM NAME: Food Production
TIME TAKEN: 45 seconds
TOTAL POINTS: 90 points
Turn Observatory to **white**
Push food production to green
Deliver blue water sample to food production
Push other team's solar array forward
Move Blue satellite to outer orbit lines
Deliver two satellites to outer orbit lines
STOP ROBOT

NEED TO:

- Be sure to restart master program
- Carefully place the long pushing frame in front of robot
- Carefully position the arm the flips the long bar downwards to the table
- Place the blue water sample in the front of the robot
- Carefully place the two satellites in the top cage (make sure the antenna stick out towards the front)
- Press middle button

****

BACK-UP MISSION IN CASE A MISSION FAILS

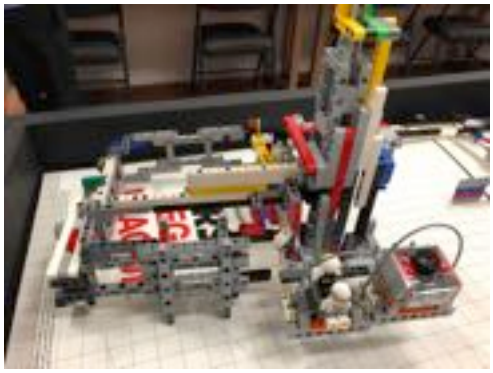
Run 5:
PROGRAM NAME: Tube Module
TIME TAKEN: 30 seconds
TOTAL POINTS: 18 points
Insert tube module into the west side of habitation hub

NEED TO:

- Do not use starting frame
- Swap sleeve frame to the tube holder
- Insert tube module
- Make sure the robot is lined up facing the habitation hub
- Find 'tube module' mission in list

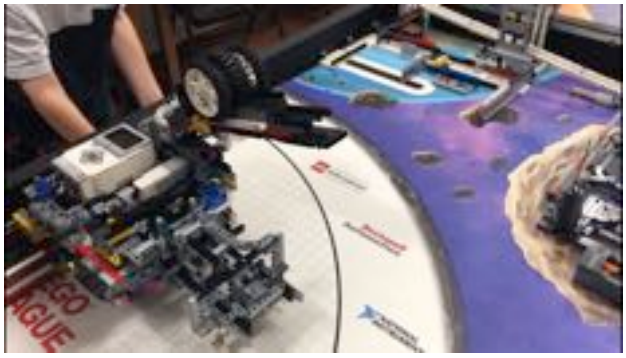
ROBOT SLEEVE FRAMES- STATE COMPETITION

RUN 1: Ramp, Solar Array and payload delivery

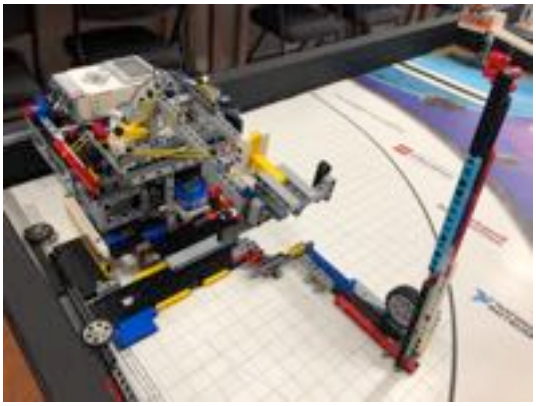


RUN 2: Collect all 4 core samples

RUN 3: 3D printer and Crater Crossing

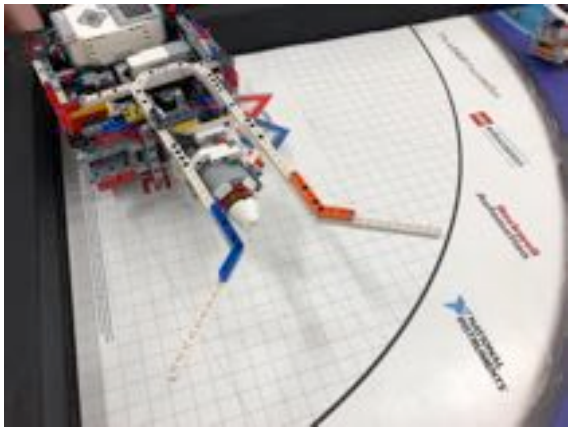


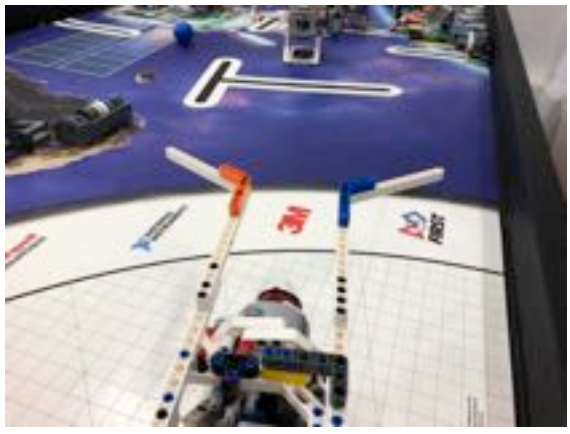
RUN 4: Food Production, Observatory, water, and satellites



BACK UP MISSION

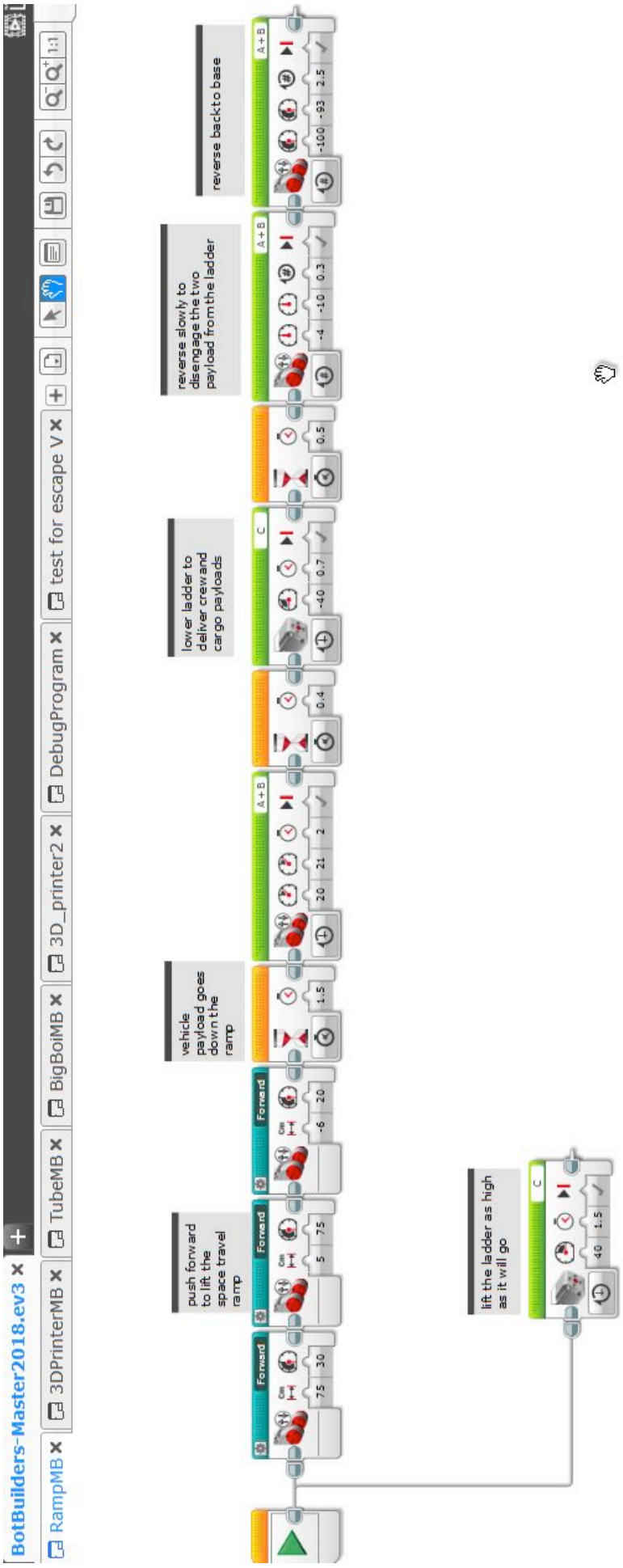
RUN 5: Tube Module

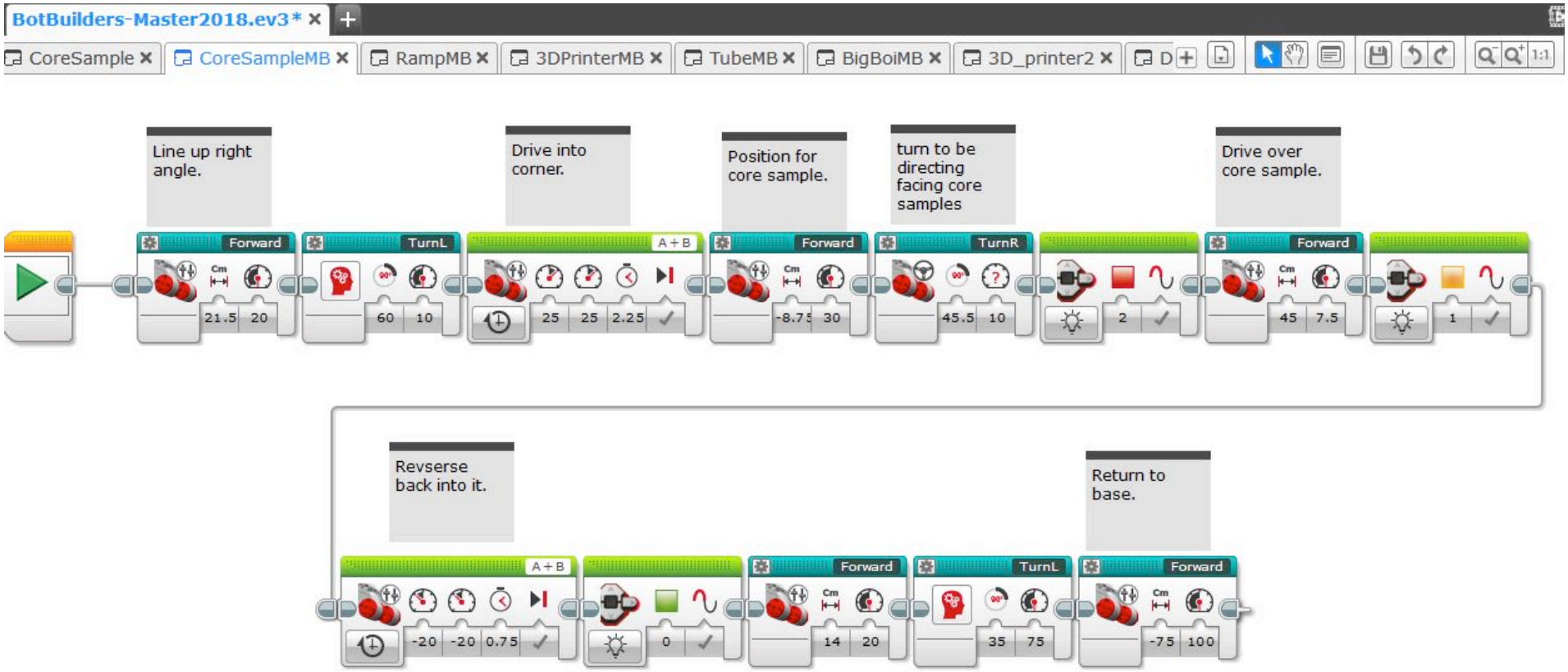




Code for our missions

Run 1: Ramp

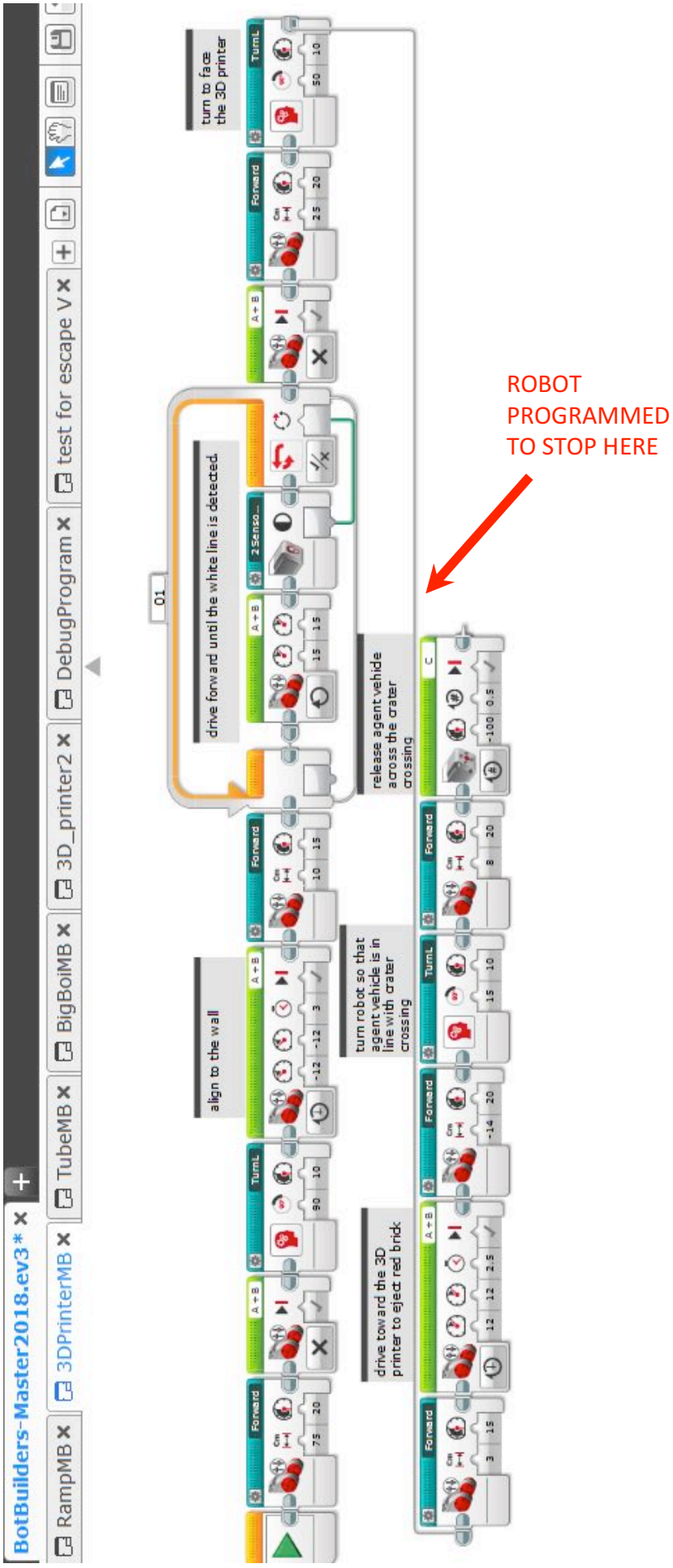



BotBuilders-Master2018.ev3*
CoreSample
CoreSampleMB
RampMB
3DPrinterMB
TubeMB
BigBoiMB
3D_printer2
Line up right angle.
Drive into corner.
Position for core sample.
turn to be directing facing core samples
Drive over core sample.
Forward
TurnL
A+B
Forward
TurnR
Forward
21.5 20
60 10
25 25 2.25
-8.75 30
45.5 10
2
45 7.5
1
Revserse back into it.
Return to base.
A+B
Forward
TurnL
Forward
-20 -20 0.75
0
14 20
35 75
-75 100

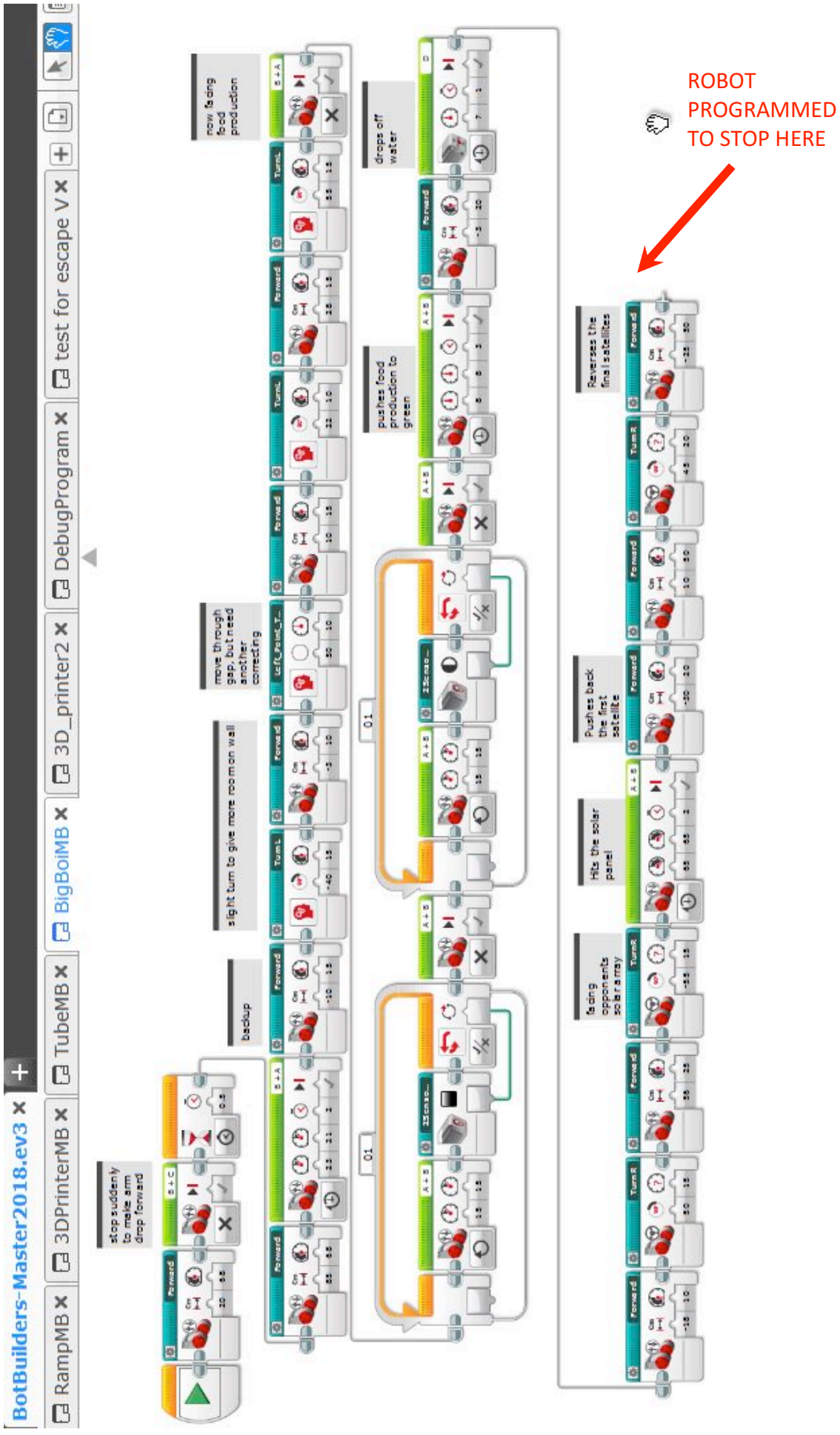
Run 3: 3D Printer and Crater Crossing

WE PICK THE ROBOT UP ONCE THE AGENT CRAFT HAS BEEN RELEASED.

THE ROBOT HAS BEEN PROGRAMMED TO STOP

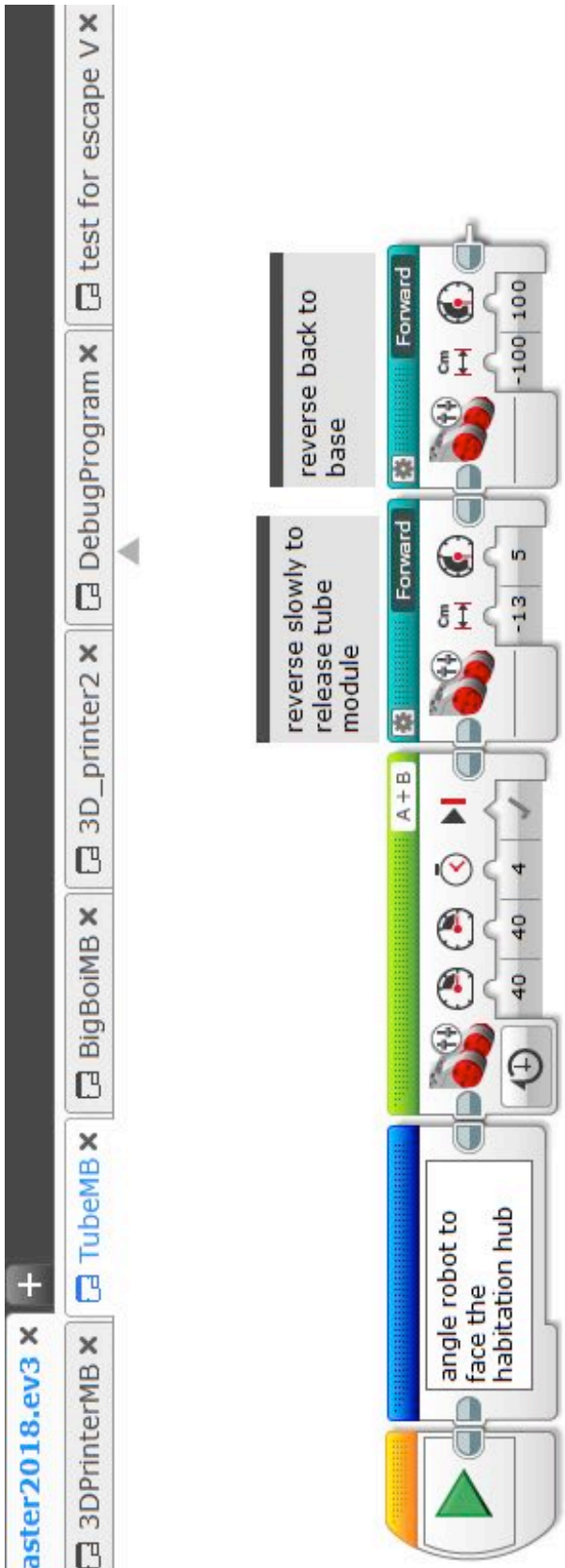


Run 4: BigBoi (Observatory, Food Production, Water, Satellites and opponents solar array)



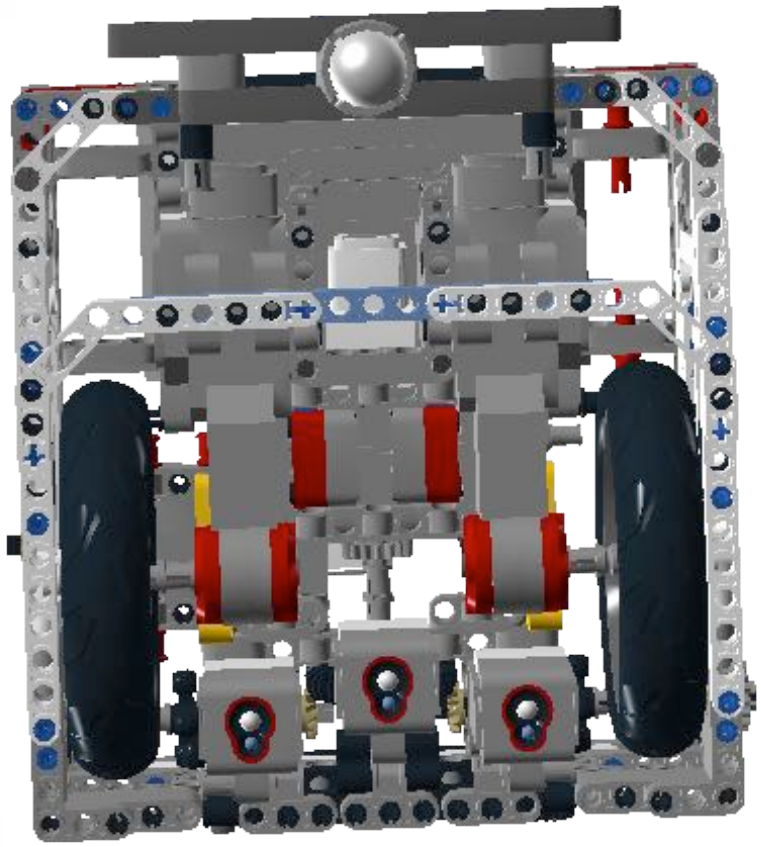
BACK UP MISSION – JUST IN CASE

Run 5: Tube Module

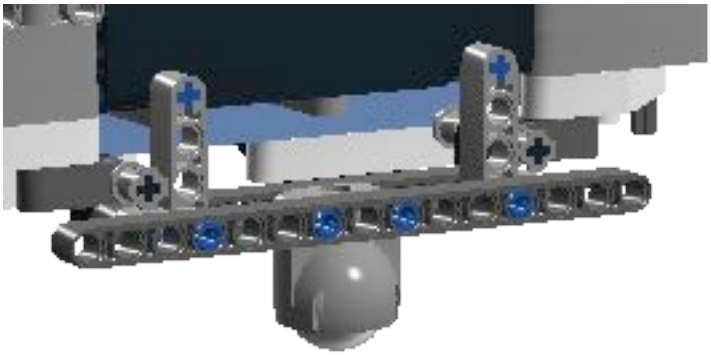


ROBOT DESIGN and ACCESSORY CHANGES FOR STATE COMP

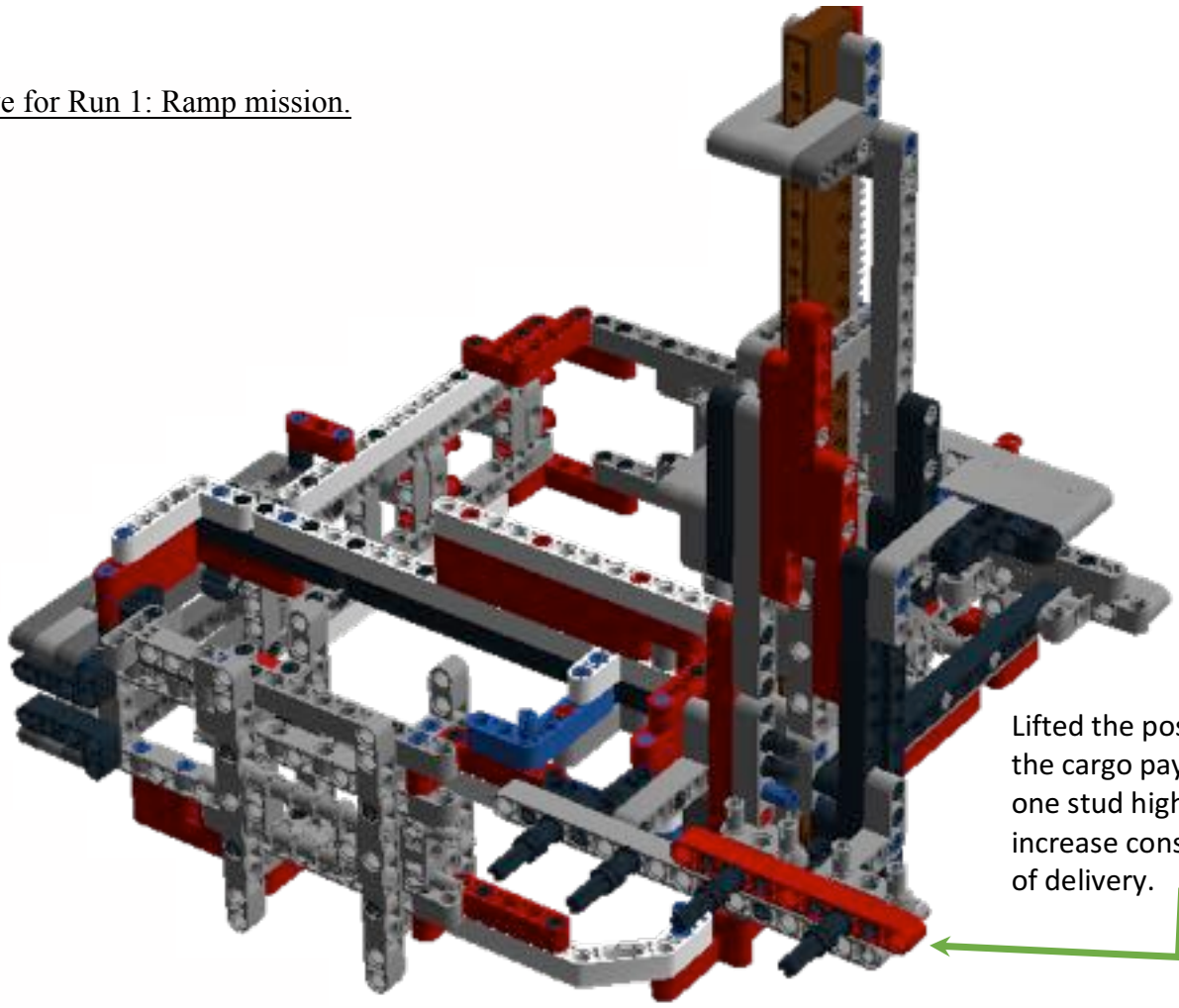
Different: wheels, position of light sensors and chassis support:



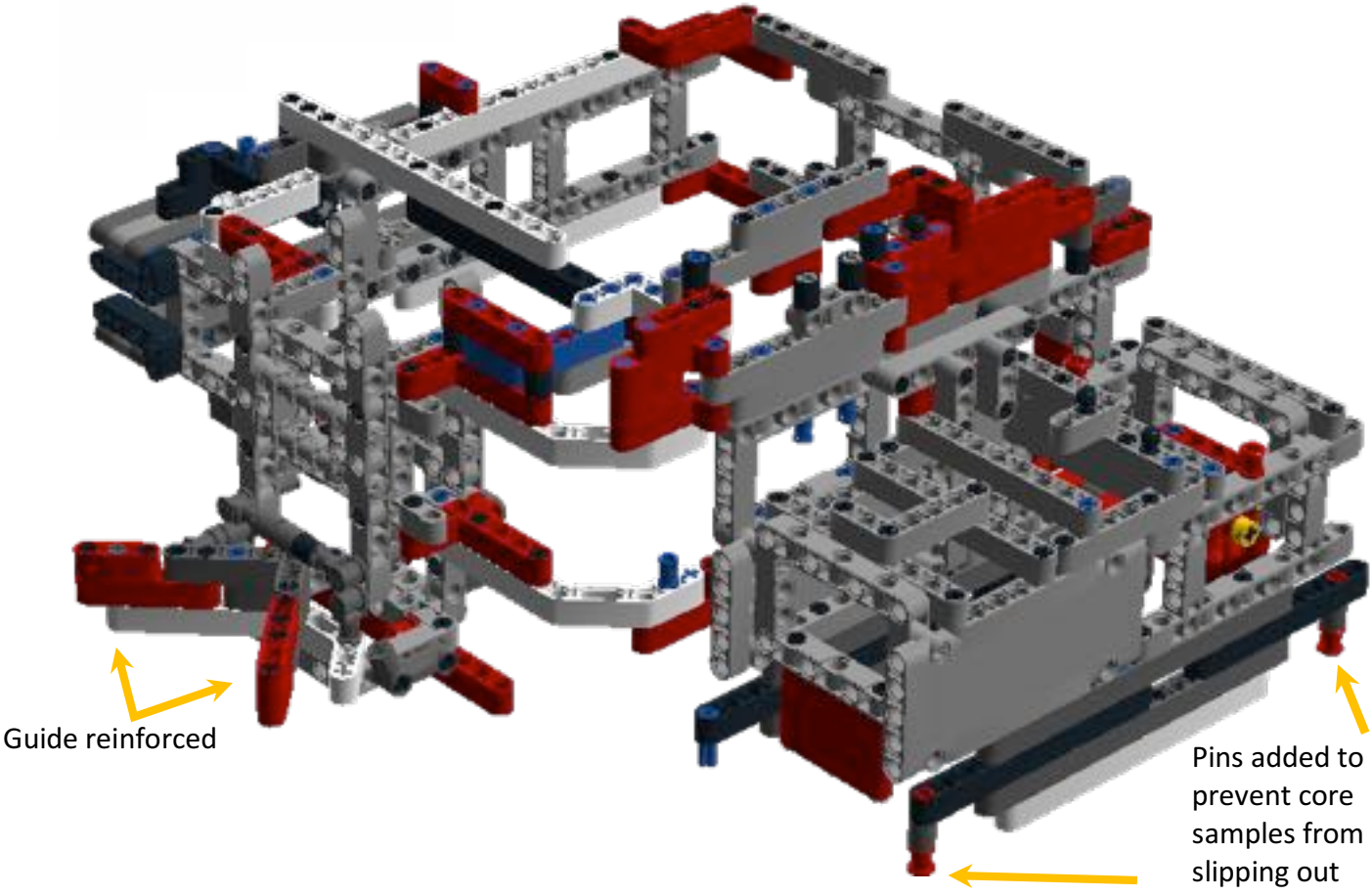
New caster wheel – now more stable and consistent



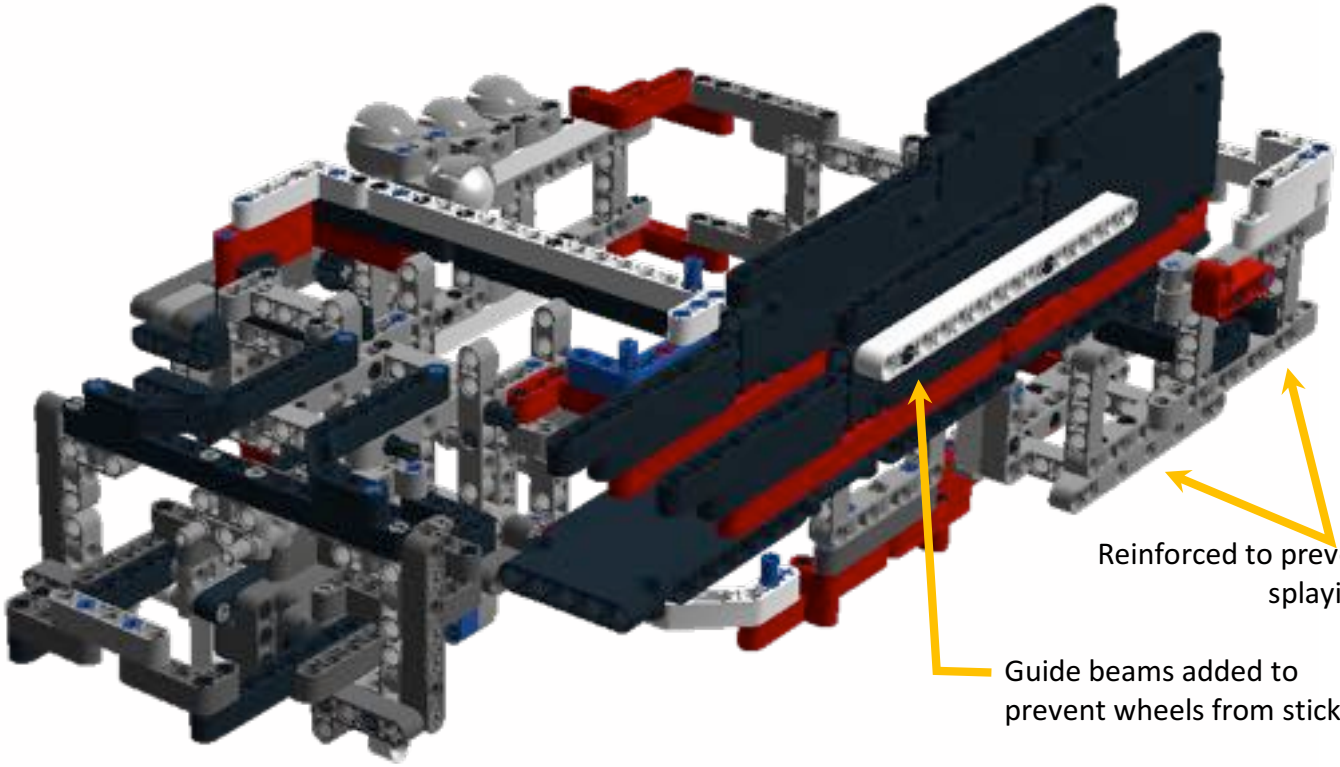
Sleeve for Run 1: Ramp mission.



Sleeve for Run 2: Core sample collection.

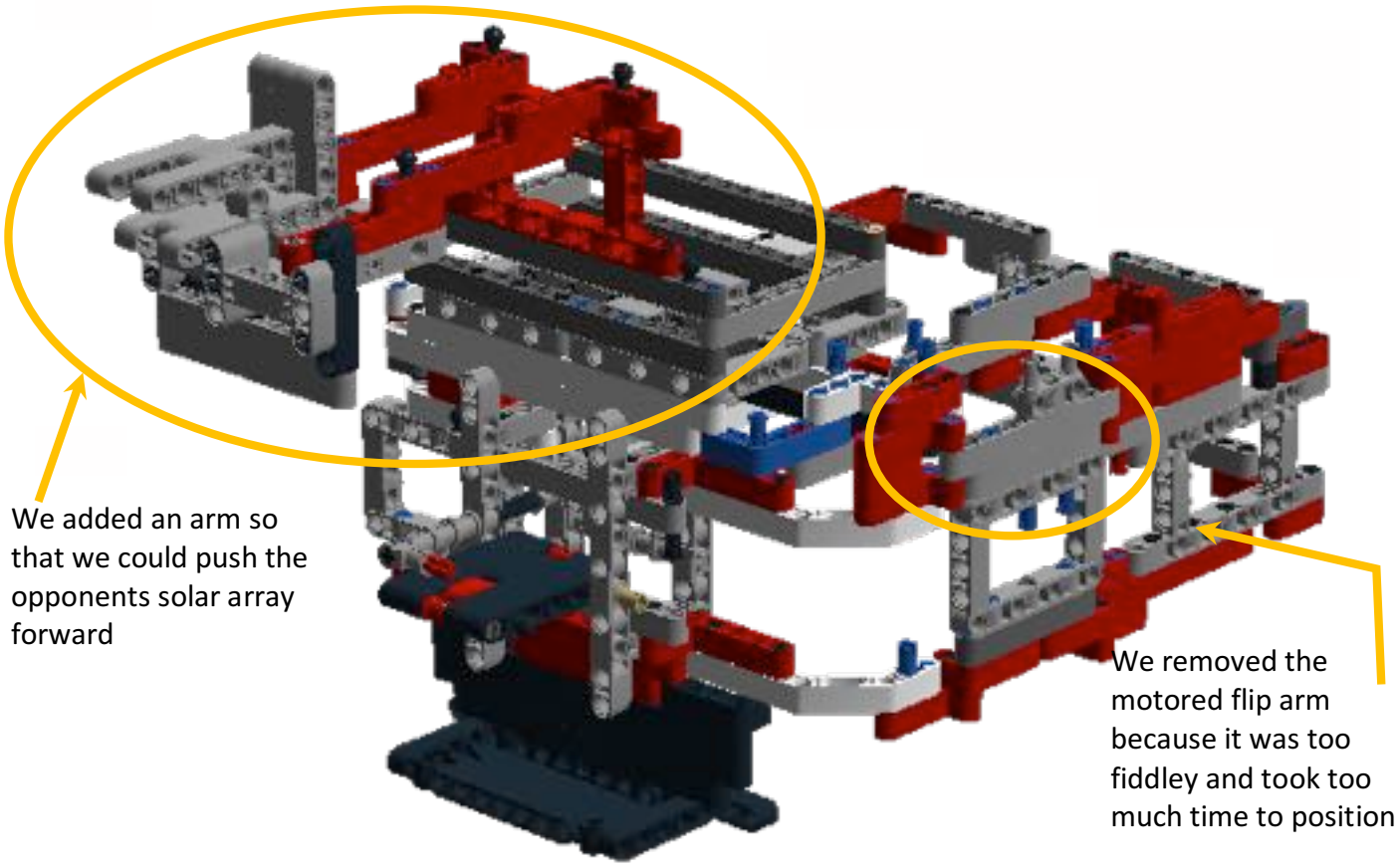


Sleeve for Run 3: 3D Printer and Crater Crossing.

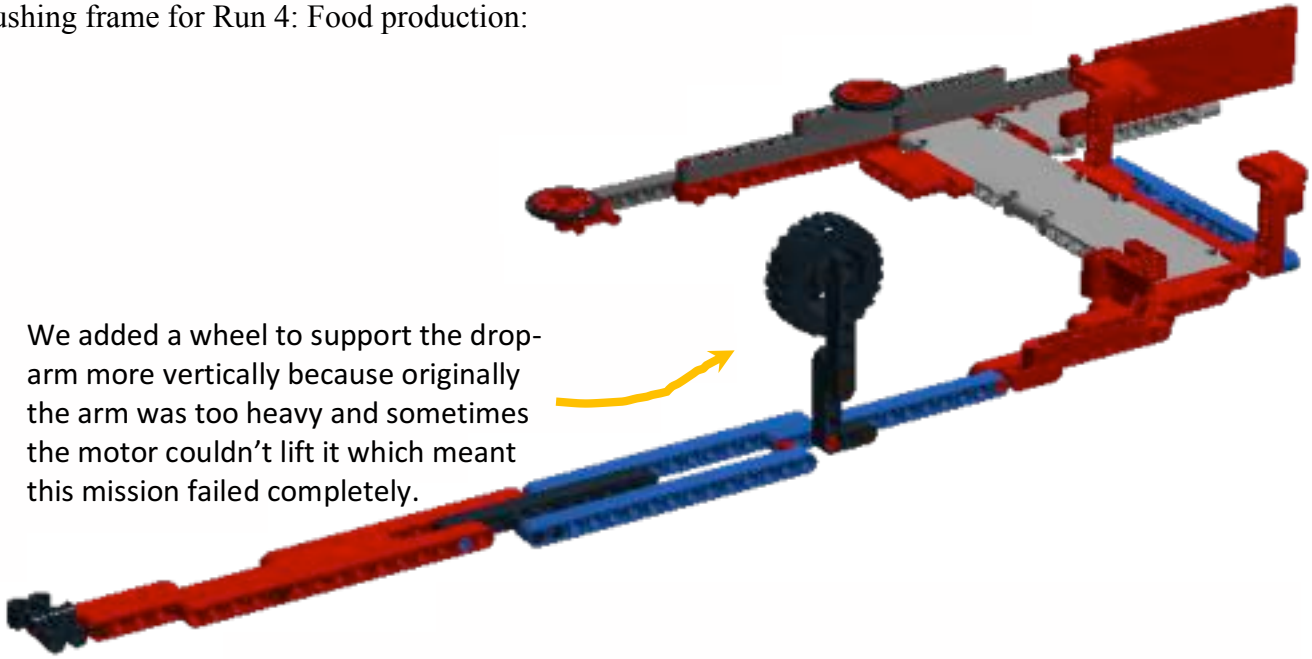


This sleeve originally also tried to deliver a meteor to the meteoroid belt with another drop motion arm on the other side. However, this was never put into our digital designs.

Sleeve for Run 4: Food Production (BigBoi)

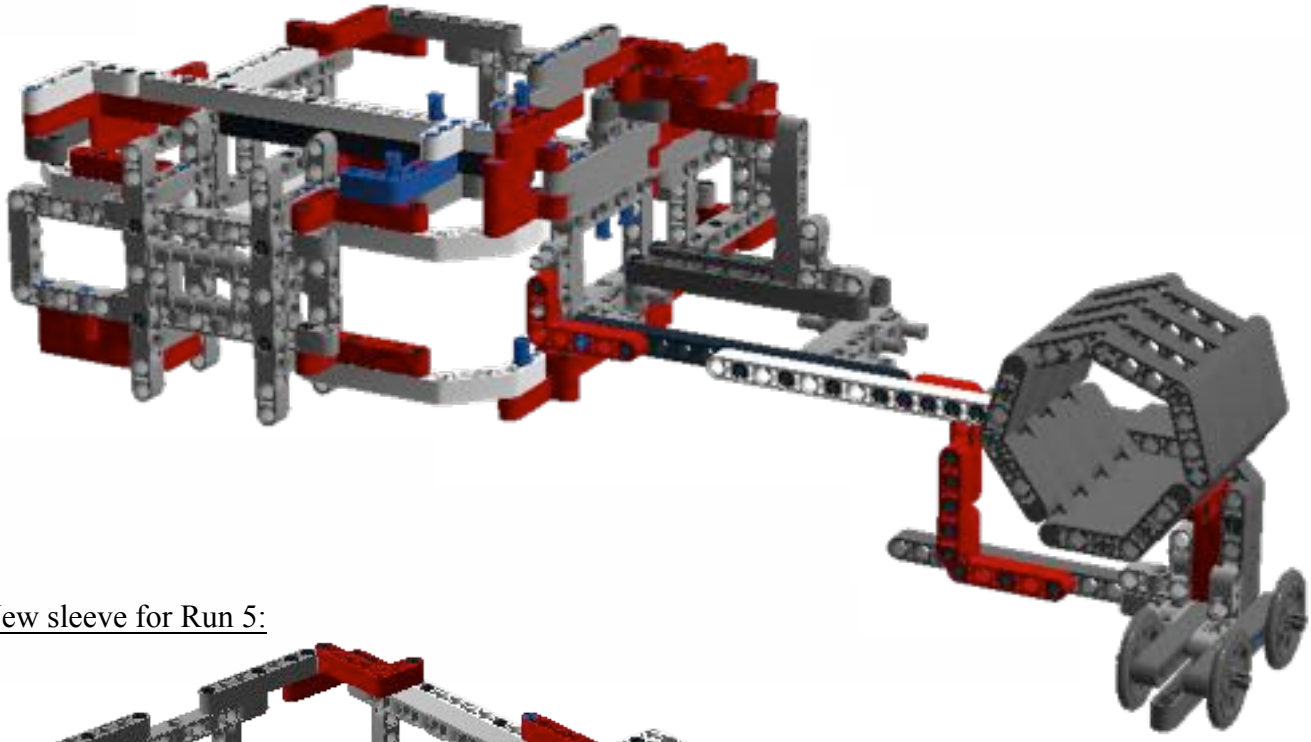


Pushing frame for Run 4: Food production:

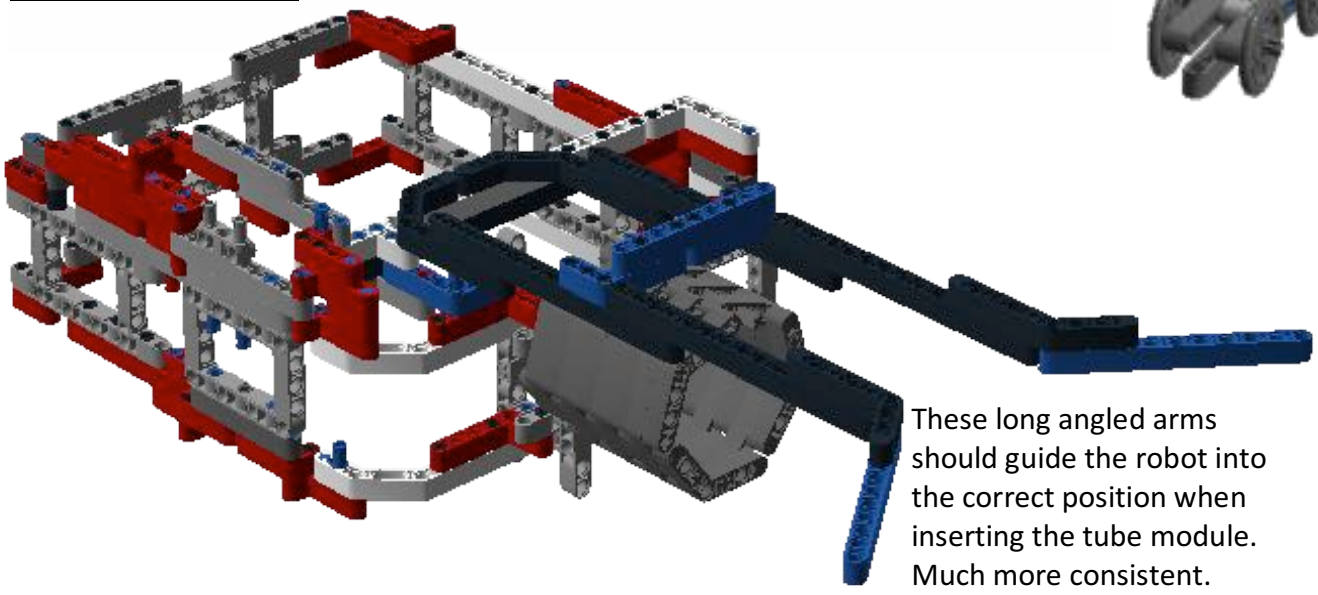


We added a wheel to support the drop-arm more vertically because originally the arm was too heavy and sometimes the motor couldn't lift it which meant this mission failed completely.

Original Sleeve for Run 5: Tube Module (backup mission)



New sleeve for Run 5:



These long angled arms should guide the robot into the correct position when inserting the tube module. Much more consistent.

ROBOT DESIGN EXECUTIVE SUMMARY

Robot Facts:
Our robot uses 3 light sensors which detects the white lines near the food production and near the core samples. The drivetrain of the robot has been built so that the motors are placed in the normal position and are not inverted. We program them to go forward using ports A and B. We have a total of 5 sleeve frame attachments which enable us to do the following missions: deliver both payloads, collect core samples, crater crossing, 3D printer, food production, deliver water to food production, and deliver satellites. The other missions we are doing are achieved by our pushing frames. The robot game mission that we feel is the most successful is collecting the core samples.

Robot Design Details
- Fun:
We decided early on that the robot would need at least 4 sleeves that would contain the attachments for each mission. One of the challenging parts of building our robot was to keep the cables out of way for when the sleeve frames were put on the robot and to also make sure that it was easy to know which cable was plugged into which port of the EV3 brick. It was suggested the we label the cables with 'A', 'B', 'C', or 'D', and '1', '2', '3' and '4'. This would make sure that if the EV3 brick needed to be swapped that we could do so without accidentally plugging the cables into the wrong ports.

When we first built the robot, we thought we'd only need one medium motor which we placed pointing towards the front of the robot. However, after a few weeks of programming we decided that we needed a second motor installed on the robot so that we could do additional missions. This was a bit challenging because the robot was already built with working sleeve frames. So, we attached the 2nd medium motor to the top of the robot pointing to the left side, however it was difficult to do this because there were only a few pin places available but we persisted and managed to get it on. This would allowed us to try and deliver the meteor by dropping an "arm" that held the ball. We tried for several weeks to make this mission work but eventually decided to scrap it because it added additional setup complexity to that particular mission AND because the ball hardly ever landed in the correct location.

We think the name of our robot is quite fun: 'Robo Buttercup'. We all love the name and always try to think of other funny names that have 'cup' in it or something related to flowers. We also all find it funny when the robot is completing the 'BigBoi' mission to push the food production because the first thing that happens is robot flips a small arm which causes a bigger arm to fall forward, slapping down onto the table which makes everyone blink.

- Strategy
Our strategy this year was to choose as many missions as we could that were near each other on the table. We wanted to achieve as much as possible with limited movements of the robot so that we could maximise our time and points while the robot was out in the field. To do this, we designed, built and tested 2 frames that the robot would push to a destination and leave there. This enabled us to do 3 missions that wouldn't require any additional programming. The two pushing frames that we built are used in 2 different missions: 1) lifting the space travel ramp while simultaneously pushing the solar array forward, and 2) pushing the observatory to white. The success of these missions is very high.

Another one of our strategies is to have the robot end its programming when it delivers the two satellites to orbit as both satellites will be vertically inside the two lines. This gives the robot more time to complete missions rather than code the robot to come back to base.

- Design Process:
We deliberately designed our robot to be a box. The general design remained the same throughout the season however slight changes were made to the side walls so that the robot could support each sleeve frame as they were built to undertake each mission. This meant the pins were changed and pieces with holes were added to add support for axles and gears. All of the team members contributed to building, either the robot, the sleeves, the pushing frames or prototypes that inspired other ideas.

- Mechanical Design

We intentionally chose a 'box' styled robot to make sure that all parts were inside the walls of the robot. We also find a box robot much easier and more stable to carry. A box robot also allowed us to make sleeved frames which were two studs wider than the robot in every direction. Each sleeve would be made the same but would contain a different attachment which would be programmed to complete a specific mission. Having sleeves like this means that the attachments could slide around the side of the robot, quickly and easily. Ultimately, the robot and sleeves were designed so that the robot could guide our push frames forward so that we could minimise the robot movements in particular missions.

Most of our sleeve frames have attachments which require the use a medium motor so we made sure that the gears on the sleeve which provided movement to the attachment were in the correct position to be meshed with gears directly on the robot when the sleeve frame was placed on the robot. Doing this, means that we could deliver the payloads to the space ramp using the front facing medium motor, deliver an agent vehicle across the crater crossing using the left facing medium motor as well as deliver the water sample to the food production using the front facing medium motor. We also attempt to deliver one meteor to the meteoroid belt with a second motor movement (using the front facing medium motor with rotation being changed to the side of the robot) after delivering a core sample to the 3D printer, however it doesn't always work. This depends upon a number of things: how the attachment arm is placed and the angle of the moving part which is connected to the gear that is attached to the motor as well as the angle the robot stops at before lowering this attachment. This is often a combination of robot and human error.

One issue we faced for much of the season was with the initial wheels that we chose for the robot. The tread on the wheels was 'spongy' and it caused the robot to often veer to one side. We thought we could cancel the effects of this through our code but it still wasn't consistent so we decided to change the wheels which were slightly larger and wider. It did mean that we had to slightly modify our existing code for the Space Ramp but it proved to be worth it. As a team we have practiced operating the robot under competition conditions. We have practiced all of our missions over and over again and even though we sometimes still make mistakes we are much more confident with remembering each step needed to achieve success.

- Programming

Programming in the EV3 Mindstorm language can be messing if only the green move tank blocks are used to make the robot move. So we decided to make our own reusable blocks of code which provided a specific function, such as 'forward', 'left' and 'right'. We also made similar blocks that would allow the robot to detect light reflecting values which we used to detect black and white lines. We feel that we have drastically reduced the likelihood of making simple errors in our code by using our MyBlock Functions.

After all of our missions were coded successfully using our basic MyBlock functions, we then turned the whole code associated with one mission into a Mission MyBlock Function. From here, we made a master program that would allow us to have the robot perform each mission but then be in a 'waiting' state for the next mission so that all the team member has to do is press the middle button for the robot to continue to the next mission. It saves a lot of time because now we don't have to find each individual program by pressing too many buttons. We have also left comments throughout each mission above certain blocks of code. The comments have helped us to understand and clearly see what the code is doing.

Using the pushing frames in some of our missions reduced the need for us to use light sensors in these particular mission, however we did decide that using the light sensors was important in two specific missions. First, when it came to completing the food production mission. To do this mission, we programmed the light sensors to detect the black line when the robot was facing the food production mission model. From here, the robot travelled forward (while keeping the sensors either side of the black) until they both went over black at the same time and then detected white. At this point the robot knows that it is a certain distance away from the food production model. We program the robot to travel forward slowly for a number of seconds, just to eliminate the chance of the robot stalling. The robot successfully pushes the food production to green every time.

The second time we use the light sensors was completing the 3D printer mission. We tried for a number of weeks without the sensors, however the robot just wouldn't consistently turn the same amount of degrees towards the 3D printer because it often veered slightly in one direction. So, we coded the robot to first reverse and align to the wall and then travel forward until the white line in front of the core samples was detected. From here, the robot should always be in the same place so it was then coded to travel forward again and turn a certain amount of degrees. We found this to be much more consistent.

- Innovation

We have built the robot so that we could potentially use 6 different located gears on the robot. At the beginning of the season we tried using a caster wheel made completely of small LEGO wheels and parts however it caused the robot to sometimes wobble when it first started moving so after weeks of trial and error we started using the traditional LEGO caster wheel but we braced it with a long bar at the back of the robot which meant we could use it to align the robot to a wall when placing it in home base. This gave much better consistency. We think the way we have built our sleeve frames and adjusted them to fit the gear on the side facing medium motor required a lot of problem solving.

Things about our journey:

How have we made coding the robot easier and quicker?
We have done this by making our own blocks of code called 'MyBlocks'. Katelyn, Jackson and Joe made these in August after we built the robot. They found out how many cm the robot went when the wheels did one complete rotation then we were able to work out how many rotations the wheels needed to make the robot go any distance. For the turning blocks, they used 'port view' to work out how many rotations one wheel needed to make the robot turn in a particular direction. We also turned the code of a complete mission into MyBlocks so that they could be used in a master program.

To provide additional information in each mission we have written speech bubbles above sections of the code that describe what the robot is doing throughout each mission. We did this so that it would be easier for each of us to understand, especially if someone was away. We have also used colour sensors to detect white lines in two missions to help the robot know where it is in the field. This increased accuracy quite a lot.

Are there weaknesses to our robot?
The structure of our robot is quite strong and it doesn't fall apart. One tricky thing with our robot was the limited space underneath to place our three colour sensors and the space we had to fit the two large wheels. This meant that there was only half a stud gap between the side of the wheel and the inside of the robot. That would probably be the weakest element of our robot because we need to always make sure that the studs do not move which might cause the wheel to rub against the inside of the robot.

Have we faced challenges along the way that can help us in real life?
YES! We faced several challenges throughout the FLL season.

1) Opinions of others: we often shared recordings of our missions on YouTube so that we can inspire other teams and give them potential ideas. However, in one of our videos we received negative feedback regarding how we collect the core samples. We were called 'dummies'. As a team, we decided to ignore this negativity and to focus our energy on encouraging each other to succeed in a positive way.

2) Time management: managing time for team training was at times challenging due to assignments being due at school throughout the FLL season. Often there were days when we couldn't all attend training which meant other members needed to do other tasks. The whole team was able to compromise, communicate and work together to achieve all goals even if we weren't all at training. This meant that everyone could complete their commitments outside FLL while still achieving all of our team goals.

3) Perseverance, Respect and accepting help: we had to persevere with all three areas of FLL. A) Research Project: as a team, we originally struggled coming up with a fixed idea for our research project and we changed our minds a few times throughout the season because the finished result didn't feel right. But, after several team discussions finally we came up with what we think is a fantastic solution to our problem. B) Coding the robot: this wasn't always easy as often the robot would move slightly differently each time. It took many hours to code up particular missions, with small changes being made. After several weeks we learned that we needed ways to make the robot stop in a known position so we made pushing frames or corner guides on the front of the robot. We were always keen to listen to ideas of our team mates as to how we'd solve these problems. C) Core Values: being in a large team of six members often meant that we all had different ideas with what was important. We always wanted to be a team that listened to and respected each other's differences. We always went with group consensus and included everyone in the team discussions.

Have we developed a strategy throughout the season?
Yes we have! We want to maximize the time that the robot is out in the field but minimise the time that the robot needs to travel back to base after completing a mission. So, our strategy is to code the robot to stop after particular tasks and then to pick it up to save time. We plan on doing this just after the robot has delivered the agent craft across the crater crossing. Also, we have coded the robot to stop just after it has delivered the two satellites from base to the outer orbit lines. This is where our missions end. Another strategy is to use as many push frames as possible to reduce the required movements of the robot and to enable us to do as much as possible as quickly as possible.

FIRST LEGO LEAGUE: 2018/19 Into Orbit

BotBuilders

Research Presentation Speech

1. JACKSON

<SLIDE 1>

Good morning judges, ladies and gentlemen. Today I would like to introduce you to the BotBuilders of 2018 and 2019. My name is Jackson and I am the co-captain with Katelyn. The other members are William and Andrew. Unfortunately, our other two team mates, Joe and Ayzlin could not be here.

NEXT SLIDE

JACKSON

<SLIDE 2>

Throughout the FLL season we have researched a number of social and physical problems relating to astronauts undergoing long distance space travel. Topics such as harmful effects from cosmic radiation and limited fuel supply were top of our list. Today however, we will identify and focus on a social problem that we feel is one of the most important to solve: depression and mental health. **HIGH 5 William**

NEXT SLIDE - <SLIDE 3>

2. WILLIAM - HIGH 5 Jackson

There are many factors that contribute to depression: (Young, 2014 ; Kanas, 2016)

1) Lack of sleep or poor sleeping conditions
2) Poor nutrition
3) Lack of exercise
4) The feeling of 'loneliness' and isolation - astronauts are known to have separation anxiety
5) Limited communication and human-connection with friends and family

The scope of our solution aims to increase frequency of communication as well as artificial human-connection between loved ones and long-distance space travelers.

HIGH 5 Katelyn

NEXT SLIDE - <SLIDE 4>

3. KATELYN - HIGH 5 William

Intensive training prior to launch, as well as development of tools to build coping mechanisms and resilience, are an important first step in dealing with the stresses of space should problems arise. But consider the effect of the factors that William mentioned on an astronaut undergoing a year or more of long distance space travel. According to Dr Janine Clarke, leader of Black Dog Institute's myCompass program, just by being in space there is a high risk that astronauts will experience many of these due to long-term social isolation and confinement, ongoing mental challenges as well as limited physical exercise and little to no contact with family and friends ("NASA Funded Clinical Trial", 2017 ; NCBI, 2016). Astronauts who have experienced a long duration in space have stated that maintaining emotional ties to Earth is extremely important to maintain their mental health. **HIGH 5 Andrew**

4. ANDREW - **HIGH 5 Katelyn**

The success of long-duration space missions to Mars will be at risk if an astronaut's mental health and wellbeing are not carefully considered and properly addressed (Research Gate, 2017).

NEXT SLIDE - <SLIDE 5>

This image shows the massive difference in neural activity in a human brain that is suffering from depression when compared to one that is not. This could be disastrous if performing a highly complex task or mission (Know Stress Zone.com, 2018).

NEXT SLIDE <SLIDE 6>

ANDREW

So, how can we increase the frequency of communication for long distance space travellers and how can an astronaut feel human-connection with a family member when they are so far away?

NEXT SLIDE <SLIDE 7>

Well, NASA and the Florida Polytechnic University are currently in the research stages of a new spacesuit which scientists have dubbed "the happy suit" (Chua, 2018 ; Slate, 2018). As you can see in this image the suit will have specially located sensors in it which will be used to detect a number of things relating to the astronaut general health: blood pressure, heart rate and joint angles. The information gathered by the sensors will be regularly uploaded wirelessly to the spacecraft which it will use to assess conditions and then adjust things such as lighting or oxygen levels to maintain healthy living. **HIGH 5 Katelyn**

NEXT SLIDE - <SLIDE 8>

HIGH 5 Andrew

7. KATELYN

We think a suit like this could do a whole lot more and could be used in at least two additional ways to help alleviate depression for astronauts undergoing a year or more of long distance space travel (Brogan, 2018 ; Chua, 2018).

NEXT SLIDE <SLIDE 9>

Firstly, we would increase the frequency of communication received by the astronaut. It would be proposed to NASA to include the following additional capability into the suit they are developing:

Using the small speaker already in place, audio messages can be received from relatives wirelessly from the space craft computer system and played back at a time of the astronauts choosing. Audio files are relatively small in size, and therefore would reach an astronaut in approximately 20 minutes. Receiving audio messages as frequently as possible would increase the amount of contact between an astronaut and their family which would increase the astronauts' feeling of connection to home. These messages could also include sounds of nature and family jokes, not just a family members voice. Just think about how happy and warm you feel when you hear one of your loved one's voices or the sound of waves at the ocean and how this instantly improves how you feel at that moment. This is very powerful and astronauts should be able to experience this at any time. **High 5 William**

NEXT SLIDE - <SLIDE 10>

HIGH 5 Katelyn

9. WILLIAM

Secondly, and most importantly, we would propose to NASA the following capability should be included in the suit to increase human-connection between an astronaut and their family:

> The ability to fill small air pockets within the space suit for a small amount of time to simulate a 'hug' from a family member. The pockets would only fill with air if a family member pressed a button on a paired device left in their control on Earth and only if this particular function of the happy-suit was turned on. The air pockets would be placed in the lining of the happy-suit and be specially positioned in areas where human touch is normally felt when being hugged by someone as you can see in these images. A pre-recorded message such as "Dad, we love you," or "Mum, we are proud of you," will play during the same time the pockets are gently filled with air. This will simulate the deep pressure received in a hug that is known to calm feelings of anxiety and loneliness.
>
> **HIGH 5 Jackson**
>
> **NEXT SLIDE -** <SLIDE 11>

HIGH 5 William

11. JACKSON

We have shared our research and solution with professionals from NASA, Florida Polytechnic University, Space Industry of Australia and a number of phycologists and we have received some very helpful feedback as you can see here in these slides.

NEXT SLIDE - <SLIDE 17>

Depression is a real problem but it is magnified for astronauts undergoing long distance space travel. Often just a sound of a loved one's voice can bring a smile to person's face.

The combined effects of increased audio communication received by the astronaut from their family (which includes general sounds from home) as well as the most important addition of a simulated hug through pockets of air within an astronaut's space suit, will have positive implications on an astronaut's mental health. This is because utilising both sound and tactile stimulation mixed with emotion can improve mood and help alleviate depression. This problem is very important to solve.

NEXT SLIDE - <SLIDE 18>

JACKSON

<SLIDE 18>

Thank you for listening. Do you have any questions?

NOW CLICK TO SHOW THE REFERENCES

NEXT SLIDES

<SLIDE 19>

REFERENCES:

Chua,J.M. (2018, February 21).How a New 'Happy Suit' Would Protect Astronauts from the Stresses of Space Retrieved from https://www.space.com/39754-astronaut-happy-suit-sensor-material.html

Brogan, Jacob (2018)
https://slate.com/technology/2018/02/smarter-space-suits-might-help-astronauts-with-depression.html

Black Dog Institute and MyCompass mental health tool
NASA-funded clinical trial tests Australian-developed mental health tool myCompass with the prospect of it reaching the final frontier, space. (2017, September 7). Retrieved from https://www.blackdoginstitute.org.au/news/news-detail/2017/09/07/black-dog-research-to-take-flight-in-space

Epstein, Robert. (2001). Buzz Aldrin: Down to Earth, Astronauts suffer depression years after https://www.psychologytoday.com/au/articles/200105/buzz-aldrin-down-earth

Ganon, Megan. (2017)
How NASA Will Keep Astronauts From Going Stir-Crazy on Long Space Missions
https://www.nbcnews.com/storyline/the-big-questions/how-nasa-preparing-astronauts-minds-long-mars-mission-n732711

Independent. (2016)
Retired NASA astronaut Scott Kelly comments on 'psychological stress' endured in space
(https://www.independent.co.uk/news/science/retired-nasa-astronaut-scott-kelly-comments-on-psychological-stress-endured-in-space-a6973506.html)

NCBI. (2016)
Acclimation during space flight: effects on human emotion.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4850672/

Kanas, Nick (2016)
Psychiatric Issues in Space. http://www.psychiatrictimes.com/psychopharmacology/psychiatric-issues-space

Kravits, Jamie (2018).
Does Cuddling Affect Depression? Yes & Here's The Science To Prove It
https://www.elitedaily.com/p/does-cuddling-affect-depression-yes-heres-the-science-to-prove-it-7873680

Know Stress Zone.com. (2018).
Depressed brain vs normal brain.
https://www.know-stress-zone.com/depressed-brain-vs-normal.html

O'Callaghan, Jonathan (2013)
Can astronauts phone home whenever they want?
https://www.spaceanswers.com/space-exploration/can-astronauts-phone-home-whenever-they-want/

Missing the people we know in Space-
vonDeak, A., and Abadie, L. (2018, August 21). Conquering the Challenge of Isolation in Space: NASA's Human Research Program Director Receives National Recognition. Retrieved from https://www.nasa.gov/feature/conquering-the-challenge-of-isolation-in-space-nasa-s-human-research-program-director

Research Gate (2017)
Conference Paper: Application of Virtual Reality for Crew Mental Health in Extended-Duration Space Missions.
https://www.researchgate.net/publication/320508189_Application_of_Virtual_Reality_for_Crew_Mental_Health_in_Extended-Duration_Space_Missions

Slate (2018)
Could Smarter Space Suits Help Astronauts Stave Off Depression?
https://slate.com/technology/2018/02/smarter-space-suits-might-help-astronauts-with-depression.html

Stony Brook University (2017)
E-mental health tool may be key for astronauts to cope with anxiety, depression in space
https://m.phys.org/news/2017-09-e-mental-health-tool-key-astronauts.html

Seppälä, Emma M. (2012)
Connect to thrive: Social Connection Improves Health, Well-Being & Longevity.
https://www.psychologytoday.com/us/blog/feeling-it/201208/connect-thrive

The connection between touch and emotion
R Canbeyli (2013, July 30). Sensorimotor modulation of mood and depression: in search of an optimal mode of stimulation. *Frontiers in human neuroscience, 7*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3727046/

The Guardian (2014)
Isolation and hallucinations: the mental health challenges faced by astronauts
https://www.theguardian.com/science/2014/oct/05/hallucinations-isolation-astronauts-mental-health-space-missions

N. Ravaja, V. Harjunen, I. Ahmed, G. Jacucci & M. M. Spapé. (2017,January 12).
Feeling Touched: Emotional Modulation of Somatosensory Potentials to Interpersonal Touch.
Scientific Reports 7.Retrieved from https://www.nature.com/articles/srep40504

Understanding the Psychological needs of Astronauts on trip to Mars
https://www.nbcnews.com/storyline/the-big-questions/how-nasa-preparing-astronauts-minds-long-mars-mission-n732711

Astronauts Hiding Mental health issues
Morris, N.P. (2017March 14). Mental Health in Outer Space. *Scientific American.* Retrieved from https://blogs.scientificamerican.com/guest-blog/mental-health-in-outer-space/

Lifestyle factors affecting Mental Health
Young, J.L.(2014, Oct 2). 9 Lifestyle Factors That Can Affect Your Mental Health. *Psychology Today.* Retrieved from https://www.psychologytoday.com/au/blog/when-your-adult-child-breaks-your-heart/201410/9-lifestyle-factors-can-affect-your-mental

We shared our research with the following:

David A Carek
Project Chief Engineer
NASA Glenn Research Center
David.A.Carek@nasa.gov

Dr Janice De Souza-Gomes
MBBS, FRANZCP
Consultant Psychiatrist
Metro South Addiction and Mental Health Service

Melba Horton
Assistant Professor of Biology: 'happy suit'
Florida Polytechnic University
mhorton@floridapoly.edu

James Holland
Research Assistant: smart suit technology within 'happy suit'
Florida Polytechnic University
jholland4134@floridapoly.edu

Arman Sargolzaei
Assistance Professor" 'happy suit'
Florida Polytechnic University
asargolzaei@floridapoly.edu

Dr Marc Jurblum
Psychiatry Registrar
St Vincent's Mental Health Service and Australasian Society of Aerospace Medicine
marcjurblum@gmail.com
Main research interest: the mental health of astronauts going to Mars

FEEDBACK RECEIVED:

On Sat, Nov 17, 2018 at 12:04 AM Janice Gomes wrote:

Dear BotBuilders and Rebecca ,

Thank you so much for asking me to comment on your project -it was a pleasure to meet with you all today.

Firstly, I am impressed with your decision to focus on the mental wellbeing of astronauts as this is just as critical as their physical needs. In my work as a Psychiatrist, helping people to manage anxiety and depression is a frequent focus, but I have never stopped to consider the mental health of astronauts!

You have highlighted that improving the emotional resilience of astronauts is an important factor in improving their mental wellbeing so that they can consistently complete their work to a high standard. The other very important long-term benefit of improved resilience is the prevention of future psychological difficulties or mental illness which can have repercussions for not only the astronaut but also their families and colleagues.

It is known that social connectedness is a protective factor for depression and anxiety.
So you are right to consider that improving the ability of astronauts to communicate with loved ones while away on missions is likely to be a valuable intervention.

Your idea to incorporate audio and tactile (touch) capabilities into the Happy Suit to facilitate this communication is definitely worth pursuing. I would suggest you try to extend this idea by increasing the variety of audio and tactile stimuli, and consider whether targeting other sensory modalities could also be useful. So for example, with audio signals, in addition to words, could the use of rhythms , sounds of nature , the sound of an animal such as a pet be transmitted.

Likewise, with the sense of touch or pressure - would it be practical to receive a stroking sensation, tickle , kiss , or the sensation of blowing a raspberry? As you also noted, receiving such communications or stimuli at an appropriate time is important. So if an astronaut can choose when they accept communication, perhaps they can also choose *how* to use these communications. Perhaps a "personal bank" of meaningful stimuli could be prepared prior to a mission to be used by an astronaut when they feel the need, e.g. when they are feeling low, or needing to relax .

Thank you for sharing your work with me. I look forward to following your progress!

Kind regards ,

Dr Janice De Souza-Gomes
MBBS, FRANZCP
Consultant Psychiatrist
Metro South Addiction and Mental Health Service

FEEDBACK RECEIVED:

On Fri, Nov 16, 2018 at 1:10 AM Melba Horton <mhorton@floridapoly.edu> wrote:
Hello Rebecca,

Thank you very much for the email and for inspiring your students to take innovative challenges for future technological advancements.

My area of expertise is on the biological aspect in the development of the “Happy Suit” technology and my other colleagues are the ones that have the expertise on the computer and electrical aspects.

On the biological side, the power-point has stressed that very strongly so I think you have solidified that portion of the presentation. However, I feel like you have to add more substance on the “additions” that you are suggesting to incorporate on the suit which is more on the electronic and computer set-up. So, I have cc’d here our Research Assistant in the project, James Holland, and he might be able to give you more suggestions on the things that I pointed out.

For example, I suggest you provide a diagrammatic representation of how the “speaker” can be incorporated into the suit with the electronic settings needed to make it functional, as well as the other features (control of air packets during inflation for hug simulation) which in my opinion will have the most weight for the judges. I suggest you incorporate at least one or two slides that will show the feasibility of the suggested advancements.

Good luck on the competition!

Cheers,

Melba Horton
ASSISTANT PROFESSOR OF BIOLOGY
Florida Polytechnic University

FEEDBACK RECEIVED:

On Sat, Nov 17, 2018 at 2:31 AM Holland, James wrote:

Good morning Rebecca,

I'm glad to hear that you and your students have taken an interest in our project and in the pursuit of helping astronauts combat the mental toll of being in space. I really like the idea of using an actual, physical element to mimic human contact like a hug. My recommendation is to definitely to look further into using air bladders as this technology does currently exist. These devices are being used for children and those with special needs. However, your design is different by using an electric air pump rather than the hand powered inflator the current design uses. Another benefit of using a design similar to this is that the vest could also be worn outside of the suit. I've attached the link below.

https://www.dailymail.co.uk/sciencetech/article-2154774/Inflatable-vest-gives-hug-help-autistic--quiet-noisy-babies.html

In order to play audio files or to allow communication with others, I would recommend using the already existing speakers used in the suit. The current, and future, communication equipment used in the suits should prove to be sufficient for audio playback as its main purposes is to allow for clear and reliable communication amongst the crew. Using the already present equipment would also save space, weight, and cost by not needing additional components to be added.

I hope that I was able to be of some assistance and I wish your team the best of luck, keep up the great work!

James Holland
Research Assistant
Florida Polytechnic University

FEEDBACK RECEIVED:

On Sat, Nov 17, 2018 at 8:23 AM Arman Sargolzaei wrote:

Hi,

I checked it. It was great and interesting and I hope they win the competition.

Please find my comments attached.

> I like the fact that you guys mentioned the likelihood of astronauts experiencing the factors of depression since most people believe that astronauts are going to be stable under these conditions due to their training.
>
> Your idea of a speaker in the spacesuit is not very clear to me. You may want to explain it more and discuss its advantages.
>
> I like your idea of using air pockets to simulate a human-hug. I helped a group of elementary students on a similar competition and they proposed similar idea.

Please let me know about the result and let me know if you have any questions.

Best,

Arman Sargolzaei
Assistant Professor, ‘happy suit’
Florida Polytechnic University
asargolzaei@floridapoly.

On Sun, Dec 2, 2018 at 8:33 PM Marc J <marcjurblum@gmail.com> wrote:
Hello BotBuilders!

Apologies for the delay in replying, I've been absolutely flat chat but excited that I can give you some feedback before your big nationals competition! I'm a Psychiatry doctor and a Space life science committee member with the Australasian Society of Aerospace Medicine and my main research interest is the mental health of astronauts going to Mars. It seems we have something in common.

All your points are incredibly valid and important to consider. I've actually attached a really interesting article about a russian astronaut who had to return from space due to depression. Depression effects every part of an astronaut's performance during a space mission. Not only that, it also effects their companions too.

Depression causes sleep deprivation (which space already does!), poor concentration and emotional lability (lability means your emotions go up and down erratically so you can be angry, then sad, then tired. Wouldn't be much fun for your companions would it?). To put all of this in perspective, imagine trying to work with someone like that? Like in that article it would be hard not to get annoyed at them wouldnt it? No one wants a sulky astronaut!

What other big concern would you have for an astronaut who is sleep deprived and whose concentration is worse because they are depressed? Safety! Human factors research suggests that human error is a really common cause of dangerous situations especially in space. The only time a space station has been depressurised was on the Russian Mir station when a progress supply ship was being remote controlled towards its docking station by an astronaut onboard. The astronaut was sleep deprived, over worked and stressed. The progress supply ship actually smashed into the station and caused a major air leak in one of the modules. They were able to close it off and save the station but it was REALLY dangerous.

Progress collision: https://www.youtube.com/watch?v=0mBzP69cqmk
https://www.youtube.com/watch?v=feplKyucGkU

Never underestimate human error. If there is a fire onboard the astronauts may have only minutes (or even 30 seconds) to start fixing the problem. It would be really stressful being an astronaut. 6 Months on space station and even when you're asleep you need to be ready to react to an emergency instantly. This should demonstrate why its so dangerous to be depressed, unable to concentrate and slower to react to an emergency!

Your idea is really interesting in that its NOT resource intensive (small speaker, alittle bit of power, small packets of communication data) but it focuses on something incredibly important. Connectedness. Did you know that in psychotherapy (everything from see a counsellor to seeing a therapist or a psychoanalyst) the ONLY factor that can predict how successful talking therapy will be is the feeling of connectedness and the relationship between the therapist and the patient? It makes sense since if I'm really upset, I want to speak to someone who I feel understands me, or at least is honestly trying to understand me. Its the connection to another human being that makes me feel I am not alone with my problems. That is why your idea is so interesting. Its so unpleasant being far away from family and friends and its a really hard thing for astronauts to deal with. Being away for birthdays, not being able to come to their kids sports games. They get really sad from not having those connections. This also affects their families! Kids and partners suffer with their loved one so far away. You should watch Scott Kelly's "One year in space" documentary to see some examples of this. http://time.com/space-nasa-scott-kelly-mission/

Your idea is a really interesting way of helping build connectedness between the astronaut and the people close to them who are so far away. Playing audio messages, sending tactile messages (hugs, tickles, massages). We have 5 senses so why not use more of them? We're used to using visual (photos) and audio (sound clips, videos), what about smell, taste (the astronauts partners cooking) and touch (your hug machine idea!)?

Hope to see some of you in our Bioastronautics Australia Network on facebook or at our Humans in Space course in your future careers! The Australian Space Agency is brand new and working to employ many more people in the decades to come, remember you can never shoot too high. Better to shoot for an impossible goal and not make it all the way than to shooting for an average one and achieve it but never find the limits of your potential!) ;) Anyway fantastic work all of you, really interesting and if there are specific questions I can answer for you before the big competition I will do my very best!!

Best of luck, let me know how it goes!
Cheers,
Marc

Dr Marc Jurblum BBiomedSc (Hons) MBBS MPsych GradCert (Space)
Psychiatry Registrar
St Vincent's Mental Health Service | 46 Nicholson Street, Fitzroy VIC 3065
T: +61 409 863 734 | E: marcjurblum@gmail.com

JOURNAL AFTER STATE COMP, 24th NOVEMBER

WEEK 16 :24/11/18

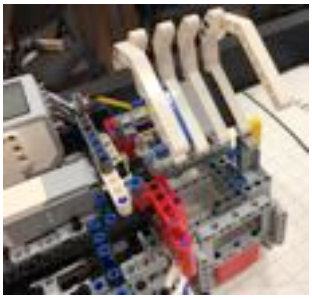
Today was the state competition. Early this morning we decided to make William and Joe go first on the mission run because it wouldn't be fair to Joe because he had a birthday party at 1:30. We did the robot design judging just before the first mission run. Jackson and Katelyn lead the conversation when talking to the judges because they knew how to express and explain it more. The first mission run went well and Joe and William got 151 points. We were next to the InteliBots during the first run and gave them 4 extra points. Later we came back to watch the RoboRoyals; they got 172 points on their first run. William went around to the different pit areas giving around lollies to the different teams. Immediately after that the core values judges walked in. Everyone was talking at the same time and we think the judges didn't like that. After the core value judges left we started practising for our research project speech until it was time for us to go to project judging and to present our speech.

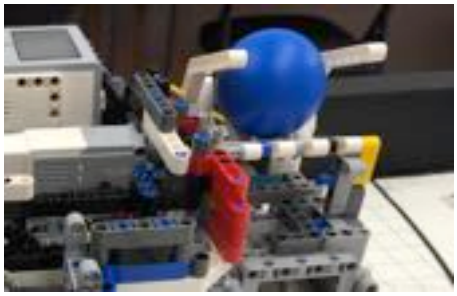
There was 1 question asked about if our solution may be already used and how it may be further used in the world and Jackson and Katelyn both answered it very well. Next was robot game 2. Both Katelyn and Ayzlin were very nervous to do the run but they pushed through and got 182 points. In the pits we were asking questions to the G.E.AR team and they were asking us some questions too. It was really great being able to share robot and coding ideas. Jackson and Andrew got ready for the third and final round. Jackson had to use Katelyn earmuffs to deal with the pressure because he was feeling very anxious. During the round Andrew looked pale in the face. By the end of the round they got 175 points. During the closing ceremony, the InteliBots won the Gracious Professionalism award and got an invite to the nationals. We won the Inspiration award and the robot performance award and we got an invite to attend and compete in the nationals.

26/11/18

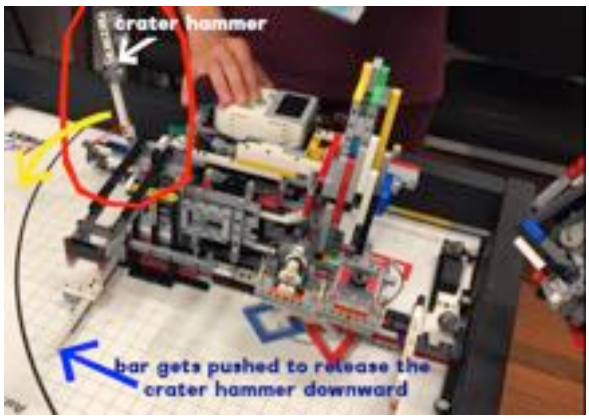
Today we had an overview of the state competition and we discussed how we could improve for the nationals. We watched a video from the RoboRoyals that gave us some ideas to improve. The RoboRoyals are a great inspirational team. We have decided to design and give out flyers, set up a research project stand which includes a spacesuit prop and our presentation on a big poster. We also want to give out little BotBuilder cards to other teams at Nationals. Jackson worked on the flyer and the cards straight away. Joe and Katelyn updated both the tube module mission and core samples.

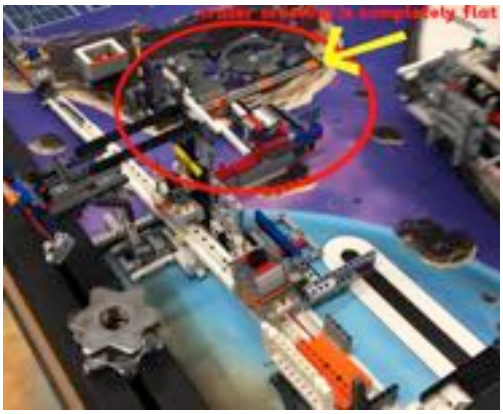
We have added an extra element to the core samples mission; to also deliver a meteor (which sits just above the core samples cage). We also want to do escape velocity and try to rescue Gerhard the astronaut. We have decided to remove the 3D printer mission because it isn't consistent enough considering the time it takes to set up and then potentially fail. However, we still plan on delivering an agent craft across the crater crossing. Andrew spent a bit of time getting started on the Gerhard mission attachment but the problem he faced was that he was trying to collect Gerhard from the side motor and couldn't find a way to do that so he started making an escape velocity attachment. The attachment will drop a huge weight on the structure making the rocket shoot up. It is planned to permanently attach this to the push frame that we use during our last mission.

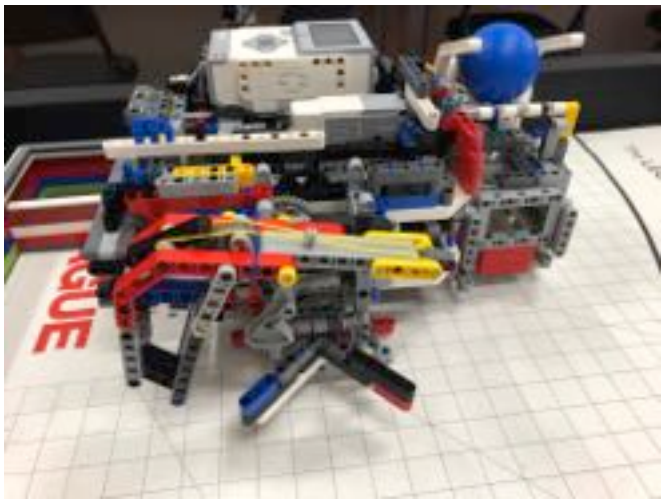




27/11/18
Today we decided to change the way that we delivered the agent craft across the crater crossing. We have decided to combine this with the same mission as the core samples. Andrew built a rubber band shooter for the crater crossing which is attached at the front of the core sample sleeve and he built a hammer to hit the crater crossing down while doing the space travel mission (this is done before the core samples). The hammer is attached to the side of the first push frame and is released when the bar comes into contact with the wall; this causes the hammer to fall down onto the crater crossing gate and lowers it completely flat. The rules clearly state that the agent craft (which must be made from LEGO) must pass from the east to the west and doesn't have to knock over the gate. Our agent craft is a genuine LEGO rubber band and a single half bush. Joe had to adjust his code to allow for these changes. William spent a bit of time making several of these to take to the Nationals. Andrew also repositioned the guide arms for the tube module to be at the bottom of the sleeve rather than at the top. We think this will increase accuracy.



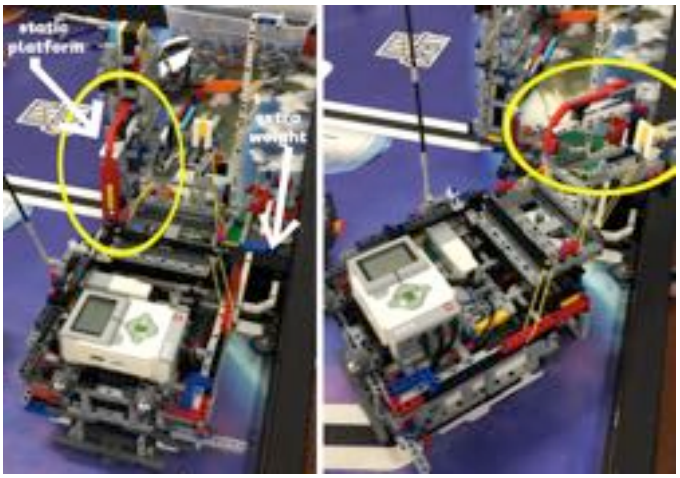




28/11/18
Today Andrew worked on the Gerhard mission attachment again and found a way to use gears to collect Gerhard. After that he tried to make an attachment for the cone module but was unsuccessful because it was too heavy to move with the centre motor that was changed to rotate on the right side of the robot. Katelyn tried to code Gerhard but it became a challenge because the attachment Andrew made would pick him up but not drop him off, plus it was very heavy and the gears kept slipping. We may end up scrapping this idea. Meanwhile, Jackson continued making the team flyer on his computer. Joe coded and improved on the core samples missions and improved the accuracy of the rubber band shooter while Ayzlin started working on the research project poster on 3 pieces of white cardboard.

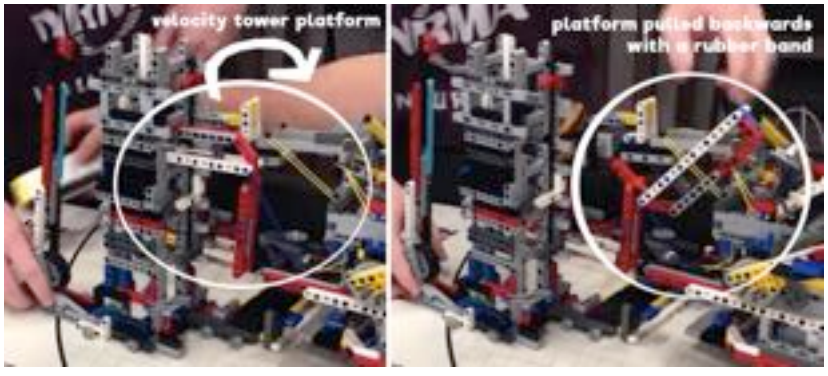
1/12/18

Andrew finished making the escape velocity attachment. The attachment drops 4 heavy lego bricks on the structure making the rocket shoot up. Andrew also had to make a platform for the weight to rest on. This was added to the robot sleeve which could then be pulled out as the robot reversed. The first attempt interfered with the opponents solar array and the robot nearly got stuck on it so we had to make the platform flip backwards once it was pulled away from escape velocity. This works great. The next problem was the upright support beams for the platform; we realised it was too low and they kept hitting the wall which prevented the robot from pushing the solar array forward. So, we lifted the support frame higher. Then after a bit of testing, we had to make the tower one stud wider (closer to the rocket) because sometimes when the weight dropped it missed hitting the bar which ejected the rocket upwards. We also had to add extra weights to the right side of this push frame to counteract the robot veering to the left caused by the extra weight for the escape velocity payload. This now works perfectly! After that Andrew, Jackson and William made 100 BotBuilder cards and laminated them. William, Katelyn and Ayzlin worked on cutting out the slides to glue them on the research poster. They are re-doing them onto black cardboard as we think it will look better. Joe continued to work on the crater crossing part of the core samples mission. Katelyn also drew little stars on the research project poster to make it look better when other teams are reading it.



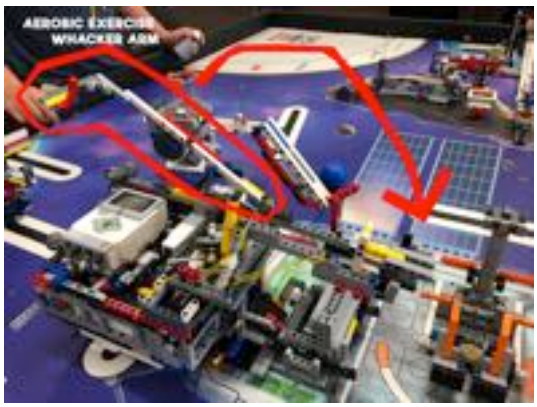
FROM THIS

TO THIS

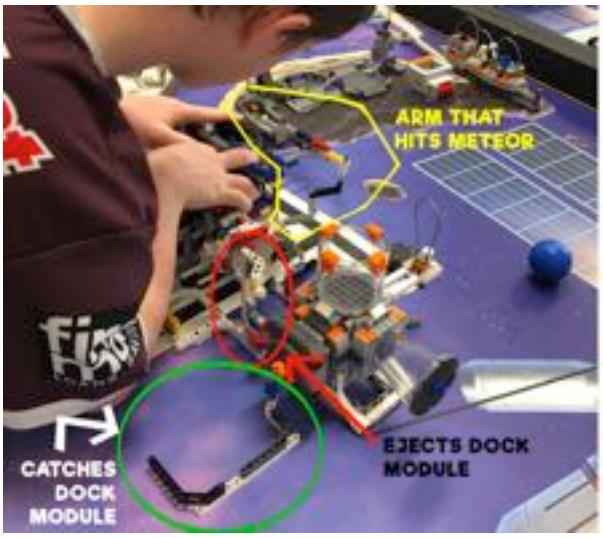


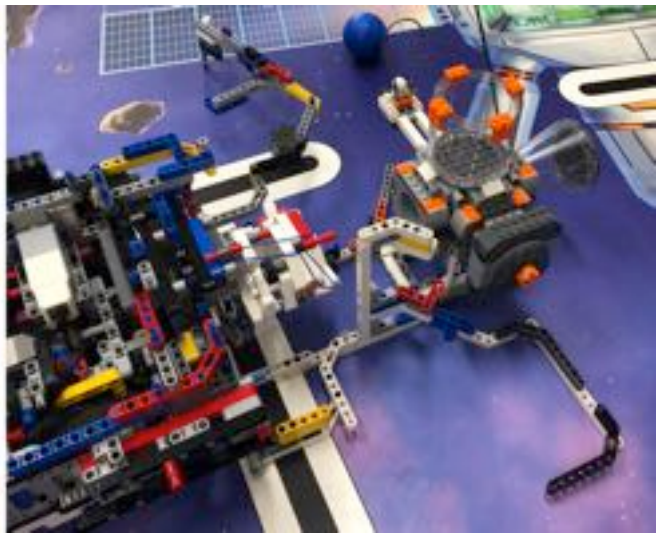
3/12/18

Now that Andrew and Jackson have finished school for the year they can spend more time making and coding things for FLL. This morning, Andrew spent a few hours trying to build an attachment that could collect the cone module without the use of a medium motor but he couldn't quite do it because it kept getting stuck. So, he decided to focus on removing the dock module instead so that it will give more space for when the robot travels between the habitation hub and escape velocity during the observatory mission. Taking advantage of the guide arms on the tube module sleeve the first attempt to remove the dock module was using straight beams placed so that they would go above and below the dock module and then reverse the robot just enough so that it could turn right and hopefully push the dock module out but the beams weren't very strong and it kept flexing. The second and final attachment that he made to release the dock module also captures it so that the robot can bring it back to base by pushing in two angled pieces above and below the dock module. This works every time, providing the robot drives straight. Plus, Andrew added an arm that can hit the second meteor at the same time the tube module is being inserted, but it is only half finished as it is still very flimsy. Andrew also made an attachment to wack the aerobic exercise.



Jackson spent a few hours coding up the new changes to the Tube Module mission and also the BigBoi (observatory) mission. Katelyn came in at about 2pm and she immediately started working on the research project poster on the black cardboard and when Joe and William arrived after school Joe continued to refine the code for the core samples. Andrew worked on updating the digital design models while Jackson finalised the flyers and printed out 100 of them. The day was ended with William updating the team journal, Joe had basically finished the core samples code and Andrew finished another digital design.



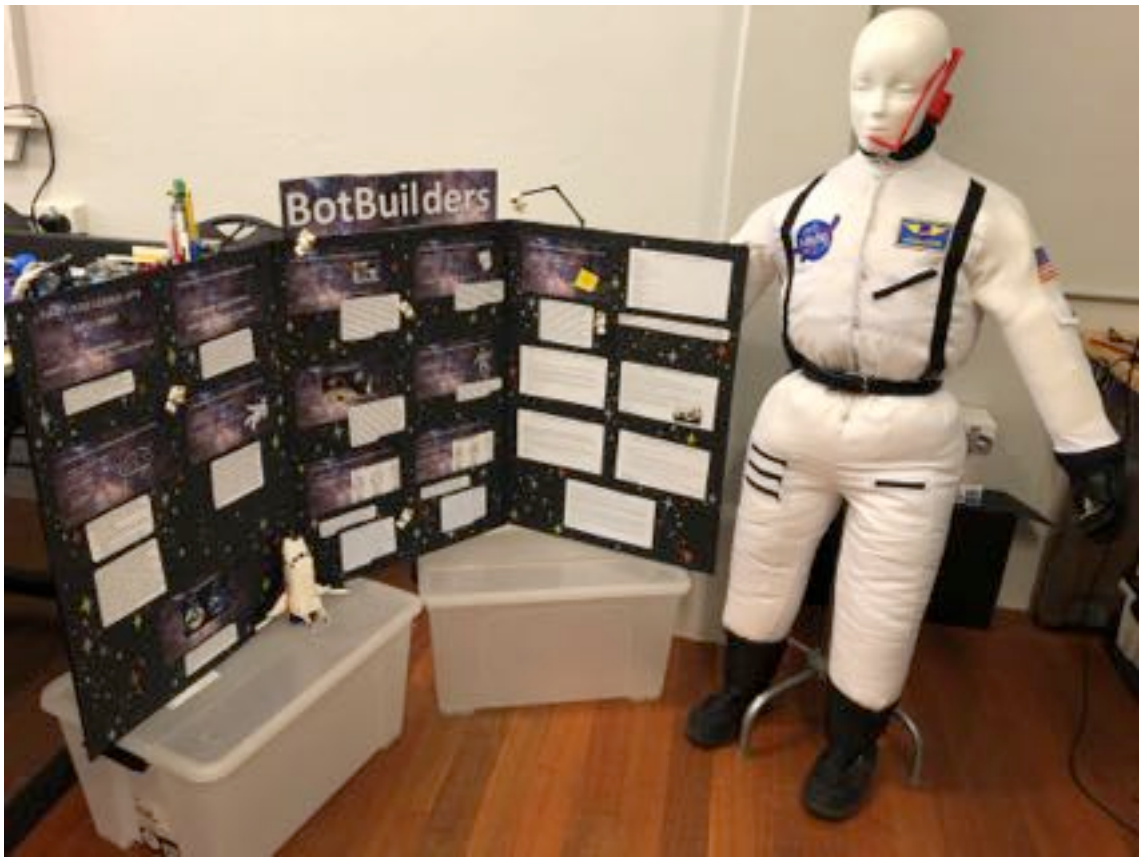


4/12/18
Andrew completed all the 3D digital design models so that if something breaks we can easily put it back together and so we can show the judges in our robot executive summary. After that he continued working on building and attaching the arm that would hit the second meteor ball after inserting the tube module. It was difficult to do this because the gear kept slipping, he is still trying to find a good place for the axel so the gear can change angle of rotation. Jackson tried to code the whacking of the second meteor with the arm that Andrew made but because the gears keep slipping it would only occasionally come back which meant we would get a penalty. They had many attempts. When Katelyn arrived she completely finished the research presentation posters and put the BotBuilders name at the top. It looks SO GOOD! The team practised all the mission runs. Our average is 200 points. The spacesuit we ordered on Monday came today and we discussed how we can incorporate it into our presentation.

5/12/18
Andrew discovered a better position for the axle that could turn the arm that whacks the meteor on the field near the habitation hub. When the arm moves forward towards the ball the gears don't slip however they still slip if the arm is programmed to return back to the side of the robot. So, what we have decided is to keep the arm pointing forward after it hits the meteor. This way, it saves time because we don't have to wait for the arm to return and the arm is always completely in base when the robot returns after completing the mission. Providing the robot drives straight, this mission should successfully insert the tube module, remove and capture the dock module and push the meteor into place. Jackson refined this code for the tube module and made it more reliable however this mission was only 40% successful because the robot veers a lot when driving forward. We tried giving one motor more power than the other but it just wasn't consistent so that robot just kept veering. We felt this was an important problem to solve that we spent at least an how trying to fix the problem. We even tried using a gyro but it made the robot lurch forward and didn't help the problem. Then, we realised that the arms and other parts used to guide the robot into the habitation hub and to catch the dock module were touching the surface of the table which would be causing friction. So, we added to small wheels to each arm guide and it worked perfectly! The robot now drives straight and ejects the dock module EVERY time. After solving the dock module problem Andrew and Jackson decided to put Lego spaceman mini figures on the research project poster using blu-tac to make it look even better. In the afternoon the team recorded several voice messages so that they can be played back though the space suit when the 'hug' is simulated. The team also practised the mission runs many times so they can get an average of 240 points. Jackson and Andrew scored 280 points on video which was shared to YouTube while Katelyn and Ayzlin got an average of 220 points and Joe and William got an average of 190 points.

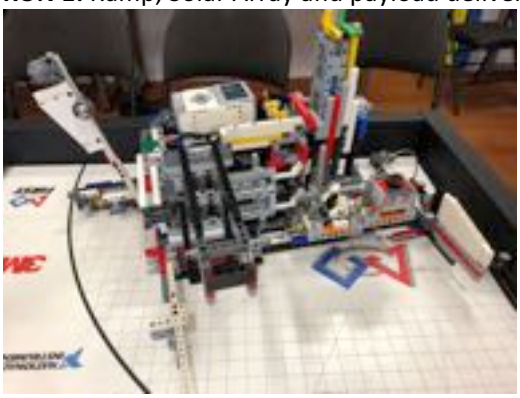
Today Ayzlin also bought in the spacesuit that is now stuffed with pillows and uses a coat stand with a coat hanger to stay upright. The team helped each other to put the LED lights into the suit to show where the simulated hug would be.

6/12/18
Jackson practised with both Andrew and William on the mission runs because Joe could not make it today. Andrew fixed the audio files for Barbra Gertrudette (the space suit) using Audacity to get rid of some of the background noise then Jackson coded an EV3 brick and a light sensor to so that the audio files would play when the lights turned on in the suit. For the rest of the training session the team practiced on the mission table.

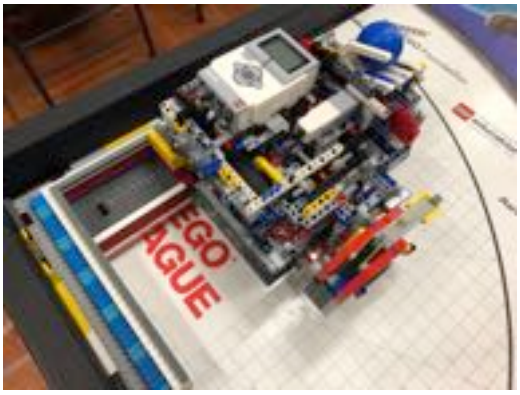


ROBOT SLEEVE FRAMES- NATIONAL CHAMPIONSHIP, 8th and 9th DECEMBER 2018

RUN 1: Ramp, Solar Array and payload delivery



RUN 2: Collect all 4 core samples,
deliver agent craft to crater crossing and throw meteor



RUN 3: Insert tube module, eject and capture
dock module and hit meteor towards the belt.

RUN 4: Food Production, Observatory, water, satellites,
aerobic exercise and escape velocity

ORDER OF MISSIONS:

National Competition, 8-9/12/2018

Robot Game 1:
Katelyn (robot operator)
Ayzlin (helper)

Robot Game 2:
Andrew (Robot Operator)
Jackson (helper)

Robot Game 3:
Joe (Robot Operator)
William (helper)

OPEN and RUN the MASTER PROGRAM

Run 1:
PROGRAM NAME: Ramp
TIME TAKEN: 20 seconds
TOTAL POINTS: 64

Lift Space travel ramp
Push Solar Array
Deliver Supply Payload
Deliver Crew Payload
Lower crater crossing gate

NEED TO:

- Make sure the wheels are NOT touching the inside walls
- Carefully place the push frame in front of the robot
- Ensure that the frame is as far left as it can be with a slight angle
- Use the ladder sleeve
- Ensure the ladder is as low as it can go
- Place the supply payload on the highest axles that stick out on the ladder (left side)
- Place the crew payload on the lowest axles that stick out on the ladder (right side)
- Press the middle button

Run 2:
PROGRAM NAME: Core Sample
TIME TAKEN: 17 seconds
TOTAL POINTS: 16 (plus extra when samples are delivered)
Collect and capture all 4 core samples
Throw meteor ball to the meteoroid belt
Deliver agent craft to crater crossing

NEED TO:

- Use starting corner frame
- Make sure to use the two thin bars on both sides of the starting frame
- Use the sleeve with the side cage
- Carefully place the robot on the table in the starting frame without dragging the wheels
- Load the agent craft onto the shooter
- Place the blue ball onto the attachment above the core samples cage
- Press middle button
- Be careful with the core samples when the robot returns to base

Run 3:
PROGRAM NAME: Tube Module
TIME TAKEN: 20 seconds
TOTAL POINTS: 28 points
Deliver and insert tube module
Eject and capture the Dock Module
Hit the meteor out in the field towards the belt

NEED TO:

- Be sure to restart master program
- Use the frame with the guiding arms
- Carefully place the robot without dragging the wheels
- Angle the robot towards the habitation hub
- Press middle button

Run 4:
PROGRAM NAME: Food Production
TIME TAKEN: 45 seconds
TOTAL POINTS: 132 points
Turn Observatory to **white**
Eject rocket upwards on Escape Velocity
Push food production to green
Whack aerobic exercise to grey
Deliver blue water sample to food production
Push other team's solar array forward
Move Blue satellite to outer orbit lines
Deliver two satellites to outer orbit lines
STOP ROBOT

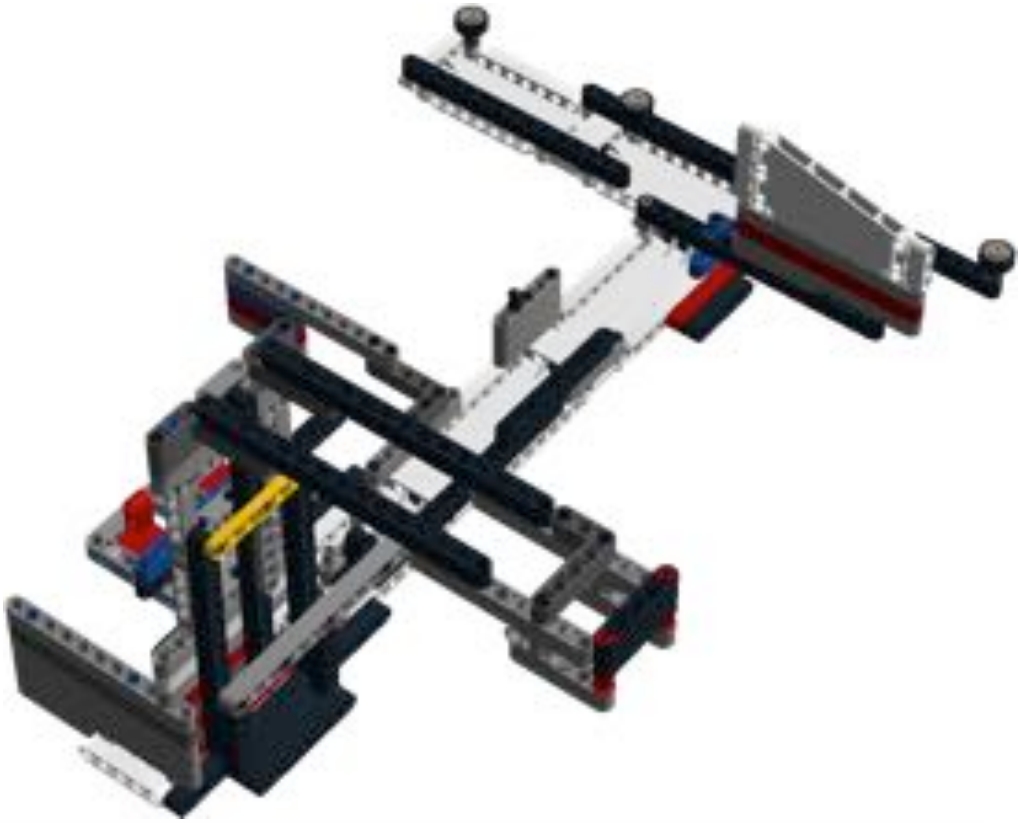
NEED TO:

- Be sure to restart master program
- Carefully place the long pushing frame in front of robot
- Carefully position the arm the flips the long bar downwards to the table
- Place the blue water sample in the front of the robot
- Carefully place the two satellites in the top cage (make sure the antenna stick out towards the front)
- Press middle button

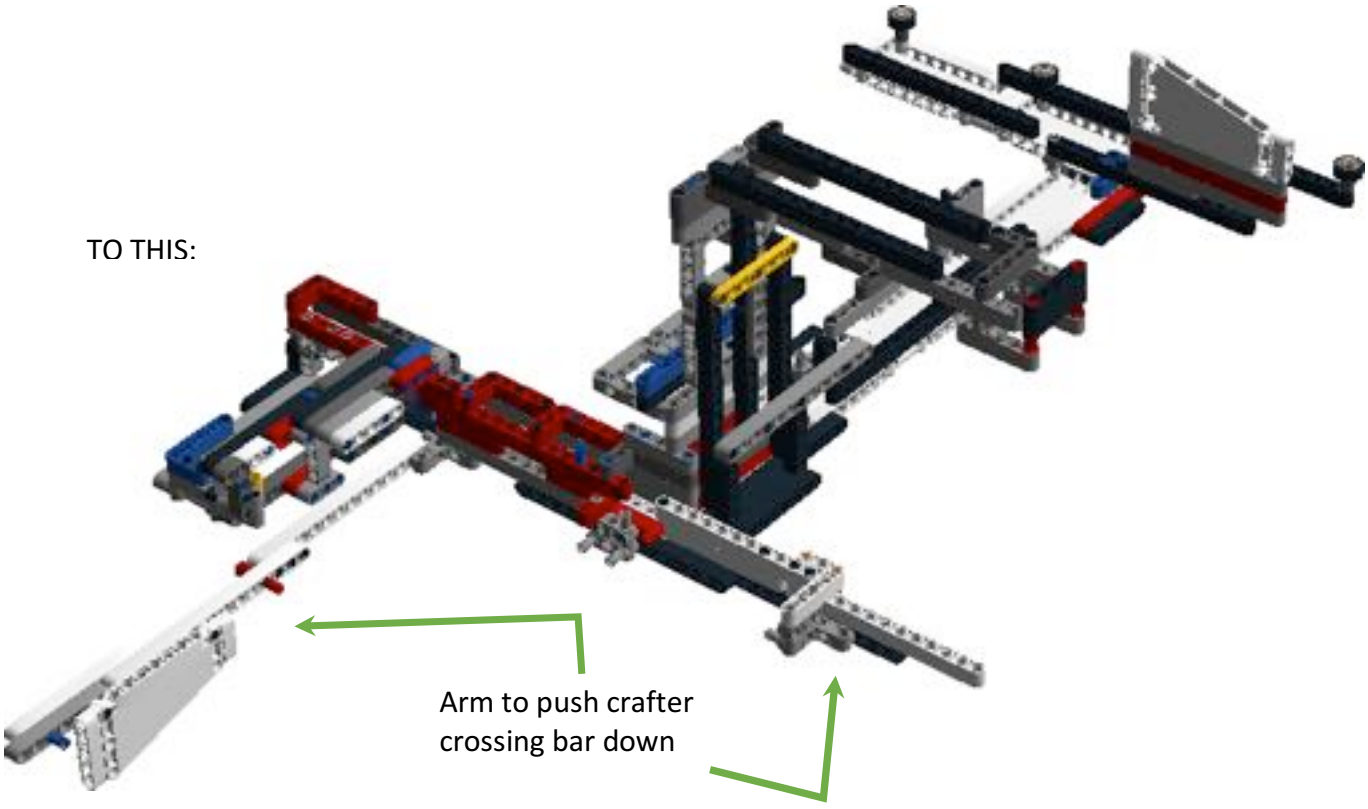
ROBOT DESIGN and ACCESSORY CHANGES FOR NATIONAL COMP

Push Frame for Run 1:
Ramp mission.

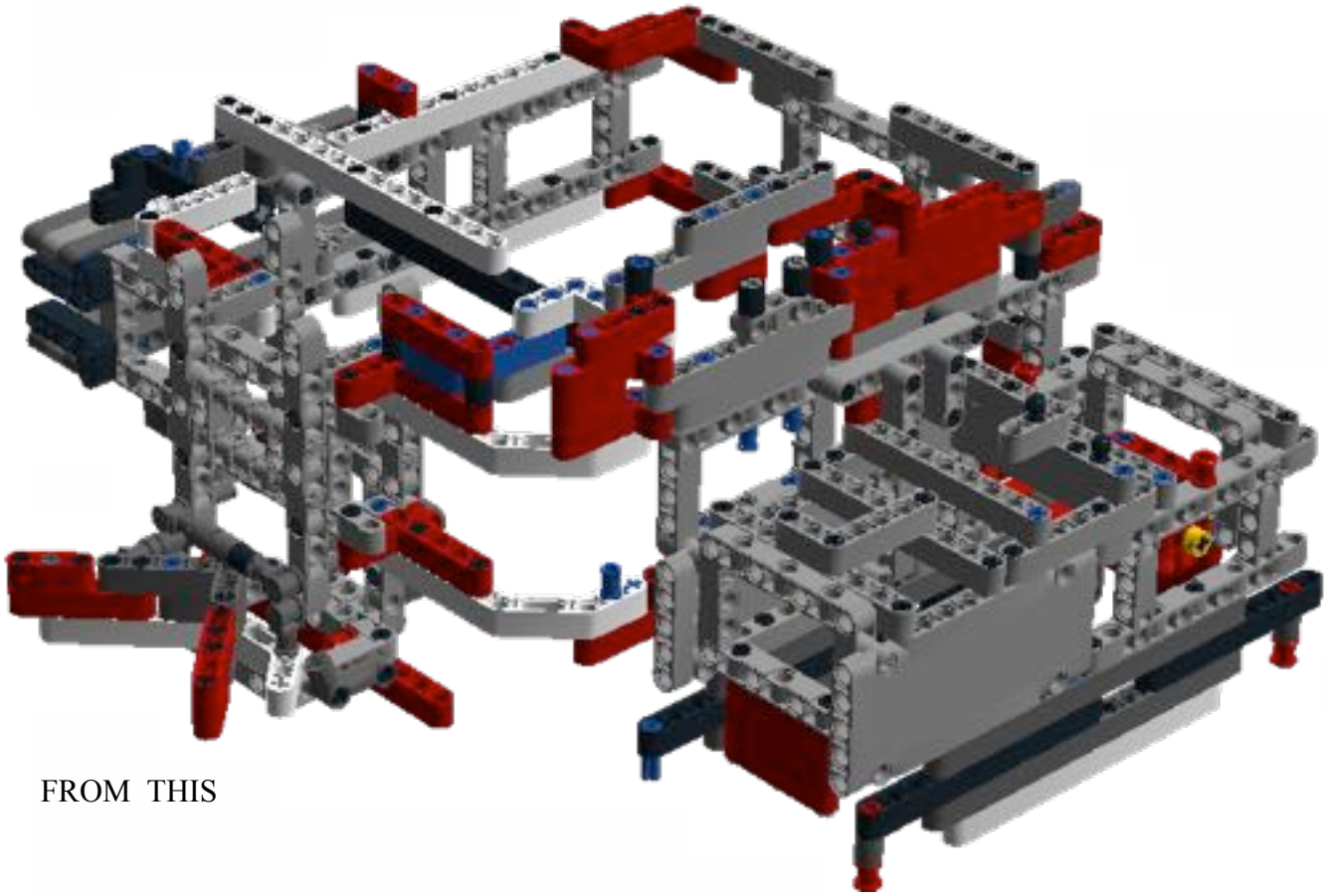
FROM THIS:



TO THIS:

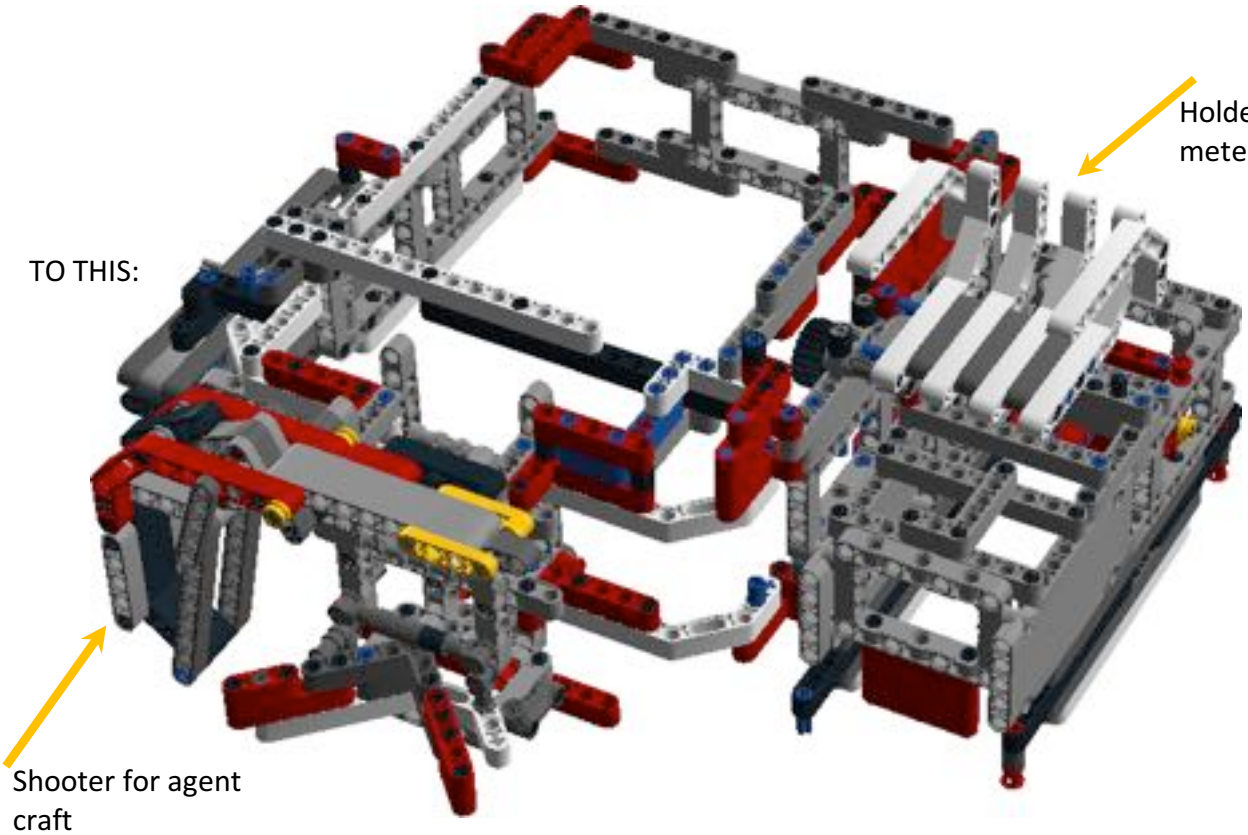


Sleeve for Run 2: Core sample collection.



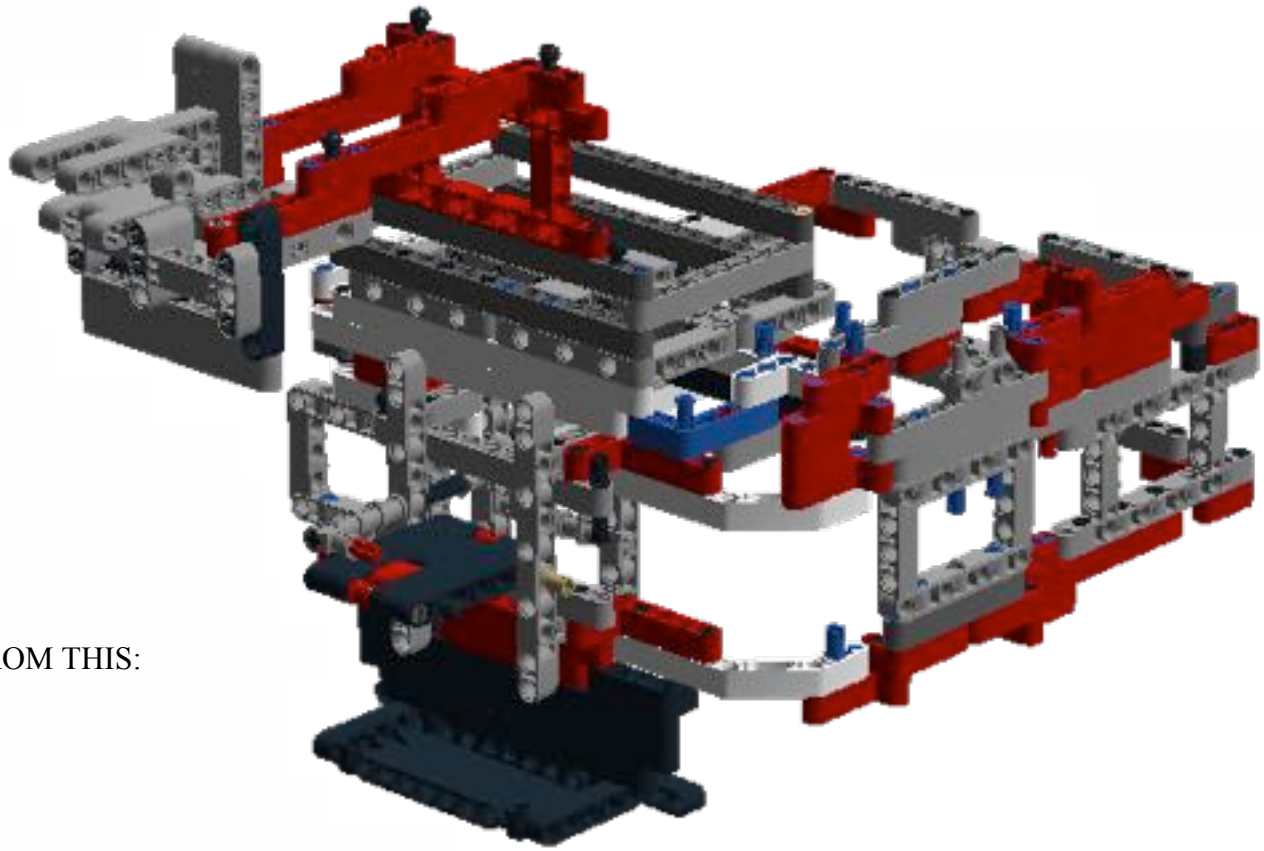
FROM THIS

TO THIS:

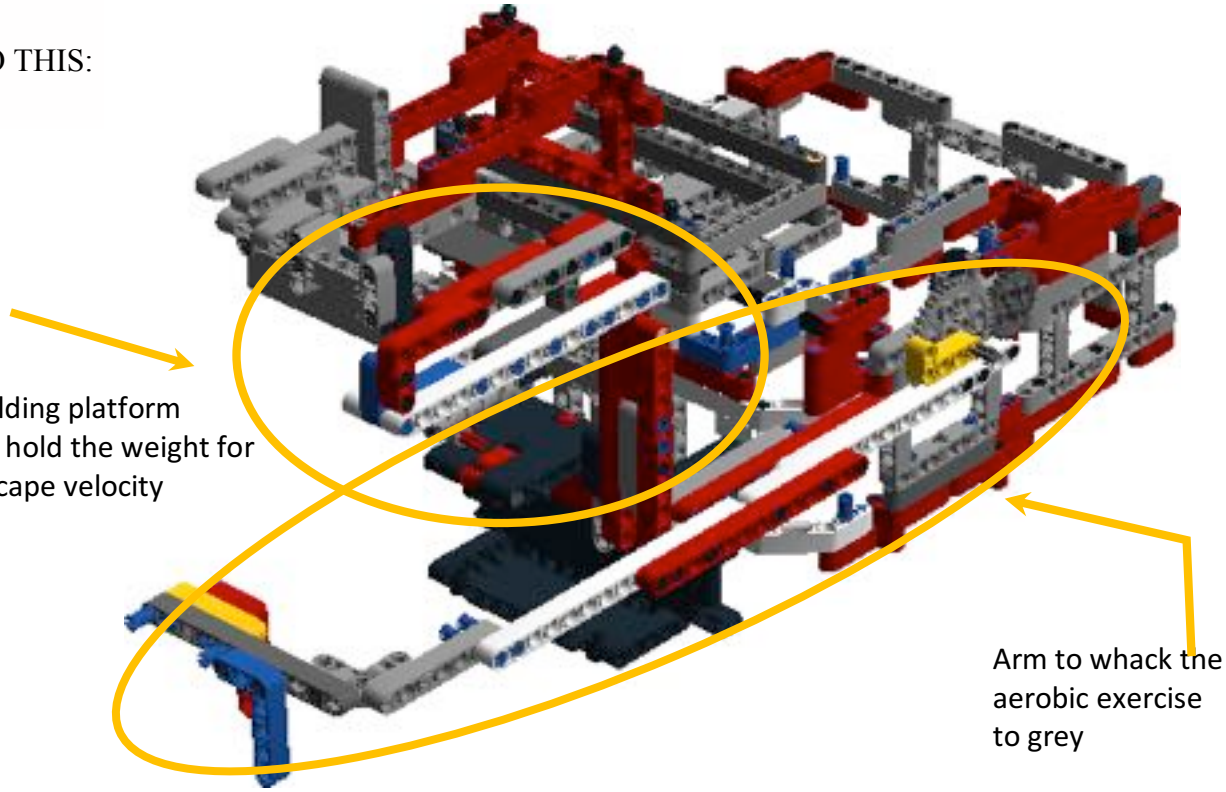


Sleeve for Run 4: Food Production (BigBoi)

FROM THIS:

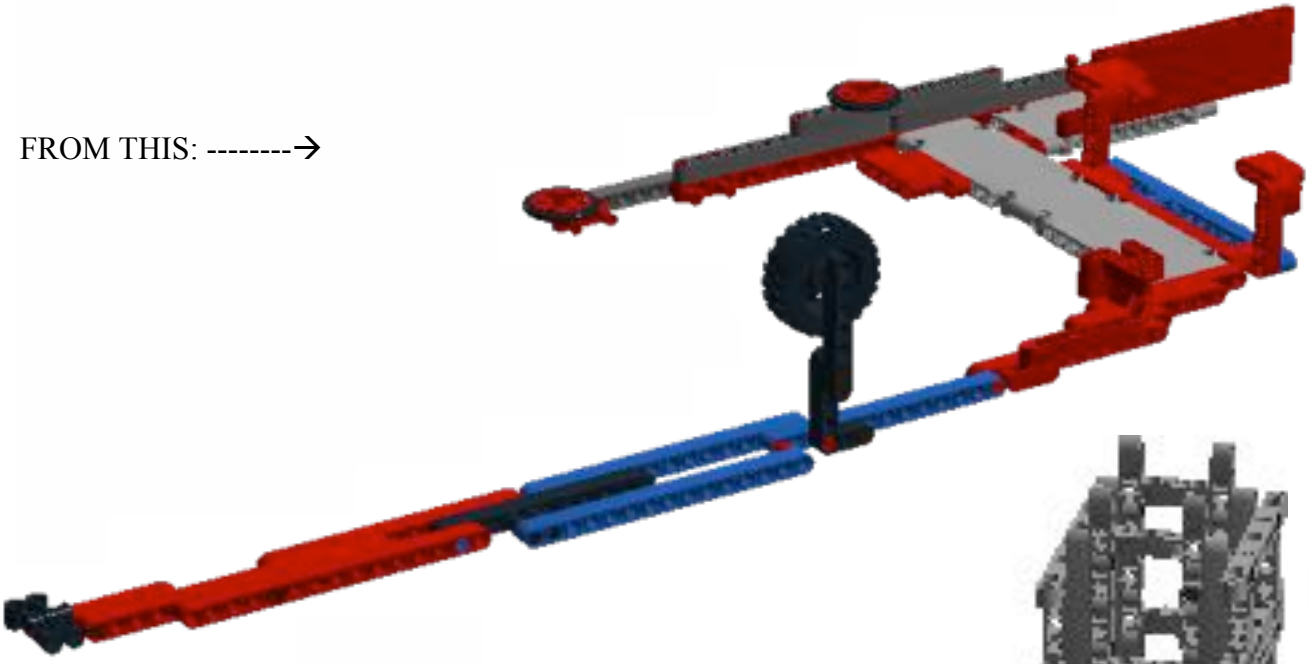


TO THIS:

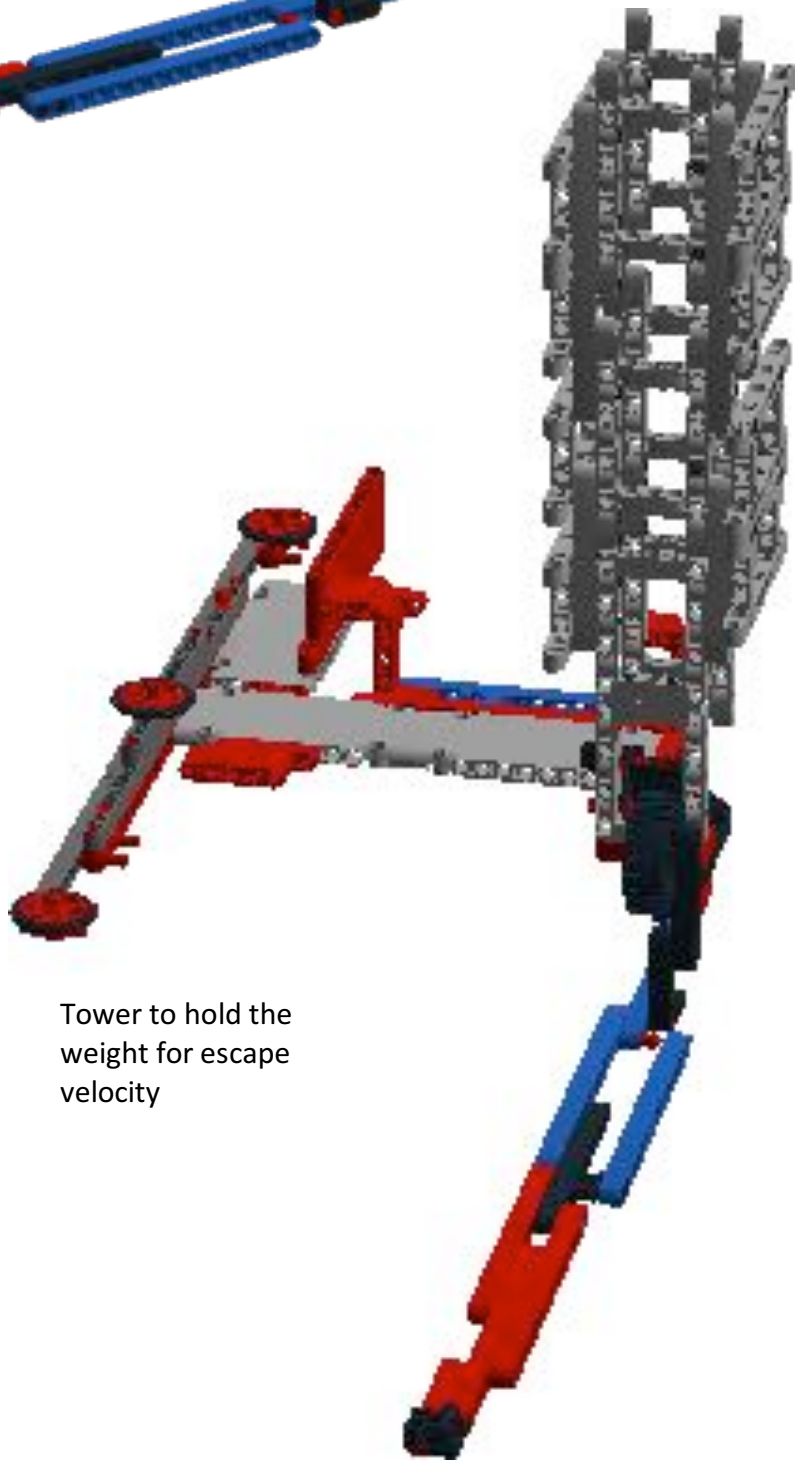


Pushing frame for Run 4: Food production:

FROM THIS: --------→



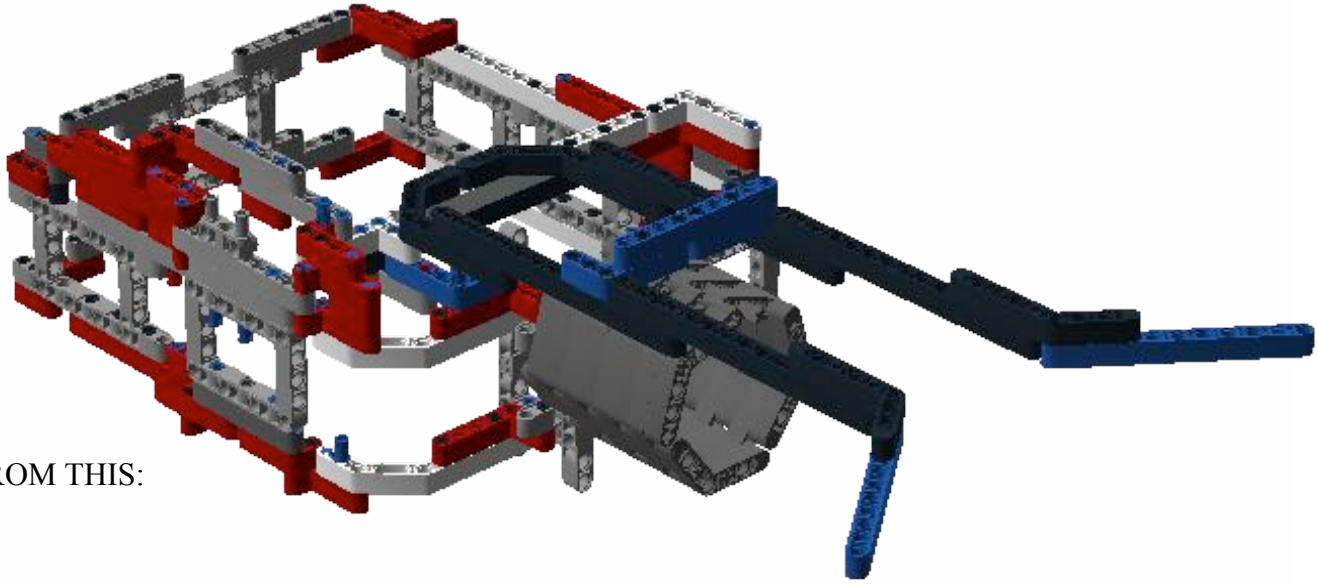
TO THIS: --------- >



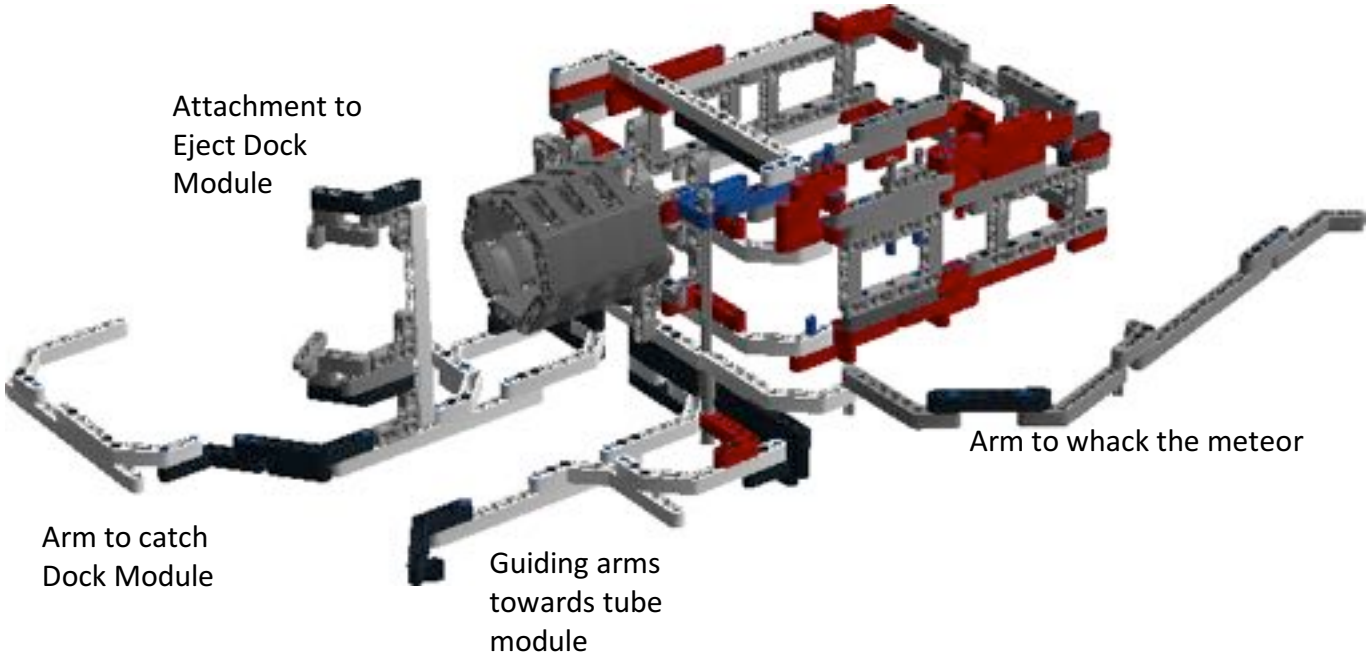
Tower to hold the weight for escape velocity

Sleeve for Run 3: Tube Module

FROM THIS:



TO THIS:



8/12/2018

Today was the Australian national championship. We set up the research project poster and the core values poster in the pits. We gave out lollies, cards and flyers to the other teams in the different pit areas and we spoke to other teams about their solutions and about their robots. It was so great to see so many different robots. We had the research project first and we brought Barbara Gertrudette [B.G] inside to show our solution in action. The project went extremely well and the team answered the questions that the judges asked. We were all happy that our families were allowed to come in and watch us present and thankfully we finished the speech just as the time ran out. We gave chocolate hugs to the judges because it supports our solution. It was funny when William accidentally poured the entire tub of hugs on the judges table due to his excitement.

We had the core values judging next and no one spoke at the same time. Our two captains: Katelyn and Jackson gave everyone a chance to speak. We think the judges were impressed on how we worked as a team. We had to choose one thing out of 10 things that we would take to space if we were deep space astronauts and then justify our decision. We also had to answer several questions about our team and how we progressed through the season.

Joe and William did the first Robot Game and scored 189 points. They couldn't get the dock module out even though it worked during training.

We did the robot judging next and this is where we think we shined the most. We showed the 3D digitals designs of every model Andrew made, we explained we did this because it was easy to repair if something was accidentally broken. We showed how our robot turns into modules. This is because it can be easily fixed and so we know how to put it back together. We also showed our unsuccessful ideas and how we improved on them during the season. Katelyn and Ayzlin went next for the robot game 2, and they scored 195 points.

9/12/2018

Today was the second day of the Australian national championship. We only had one more thing to do and that was the last robot game. Both Jackson and Andrew practised on the practise tables to get more consistency. When they got to the actual table the left-hand motor thought it was a medium motor but it was a large motor. They fixed it by pulling out the cord but it was too late they got 28 points. Jackson and Andrew were very upset. We waited for the closing ceremony. During the closing ceremony, most teams were dancing to music while waiting for the results. After that every student got a LEGO medal for getting this far. We got an invite to A.P.I and got a champion 3rd place award. Unfortunately, the InteliBots didn't make it through.


Champion's Award
Third Place
Botbuilders

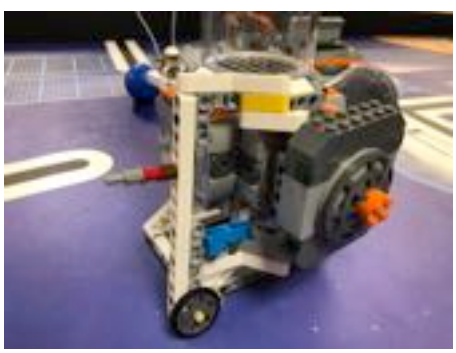
JOURNAL – AFTER NATIONALS

10/6/19

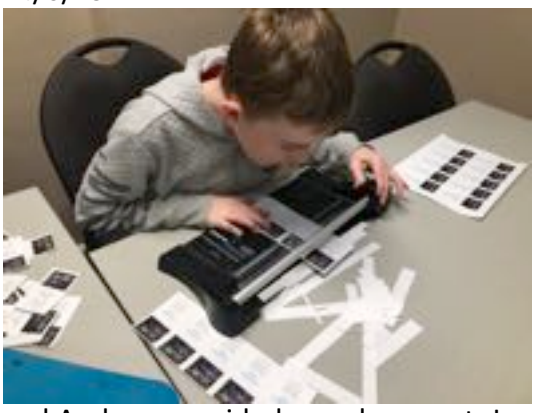
Today was the first day back for FLL after a 6-month break. We discussed what went wrong at the nationals and how we could fix it for the International competition. Sadly Ayzlin and Joe aren't going to the internationals due to other commitments but they are still part of the team. Joe is our emotional support while he codes up the maze robot for Robocup.Jr. Joe kept seeing what we were doing though out the training session. We discovered that the tube model sleeve needed adjustment to take out the dock module because this was a problem at the nationals. At the start of the training session all the motors thought that it was medium motors we still don't know why it did this but if the cords are unplugged and then plugged back in it works again. William reread the journal to see what problems happened during previous training sessions. One thing we forgot when we were practicing was putting the waits on the push frame for the space travel mission. We quickly realised we forgot when the frame started veering right (towards crater crossing). This was bad due to missing the drop off zone for the space travel mission, we won't forget to do this on competition day.

17 & 18/6/19

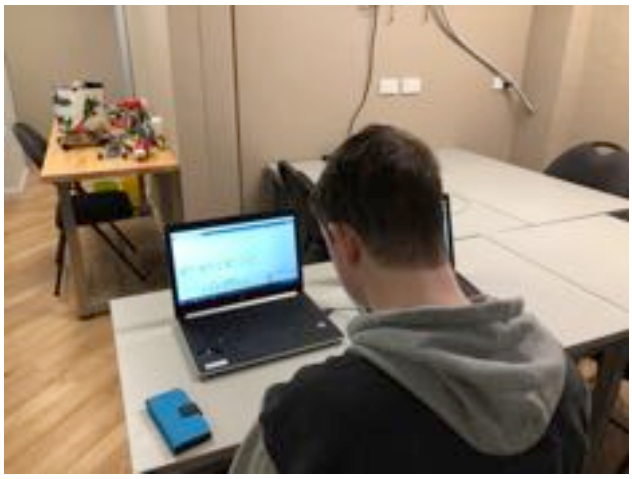
At training, we had a lot of trouble trying to get the dock module out consistently. We tried changing pieces on the attachment which slid above and below where the dock was inserted however this caused the guide arms to get stuck most of the time. We spent quite a bit of time trying slightly different positions of the pieces that were meant to push the dock out. It would only work IF the robot went exactly straight while it was inserting the tube module and this did not happen very frequently. This means that the robot would likely get stuck while trying to navigate through the gap between escape velocity and the space station. So, Jackson and Andrew decided it would be better to code up a different part of the BigBoi which would change the path of the robot to go reverse past the space station and go around it. It would travel forward to the North wall, turn and then reverse between anerobic exercise and the space station right up to where we drop off our escape velocity tower. This was a much better and far more consistent approach. Because of this we also changed the tube module mission to not eject and collect the dock module by removing the small attachment from the side of the tube module holder. We were happy that this increased accuracy of inserting the tube module. William spent an afternoon of experimenting with the ball whacking arm to see if the robot could collect the cone module. And while it worked most of the time, the time it took to eject the cone module by whacking it with the arm several times, we decided that it wasn't worth loosing 10 seconds for something that didn't work 100%. We removed these pieces of the ball whacker.



24/6/19



William made some more flyers and cards to give out at the internationals while Andrew and Jackson practised the mission runs at the robot table. Jackson slightly tweaked some code as they practiced (like the approach to velocity tower, the angle the robot turns after pushing the opponent's solar arrays forward and a left small turn after capturing the core samples). They were doing really well and consistently got around 230points. They were even able to get ALL the missions except for one ball, three times! Katelyn and William practised the mission runs for nearly 1.5 hours while Jackson and Andrew provided moral support. Joe was also there watching and cheering us on. After Katelyn left at 5:40pm, William fixed the speeches to divide the parts equally between the four people who are going to the internationals. Jackson and Andrew were able to practice three more time before Jackson left at 6:05pm.



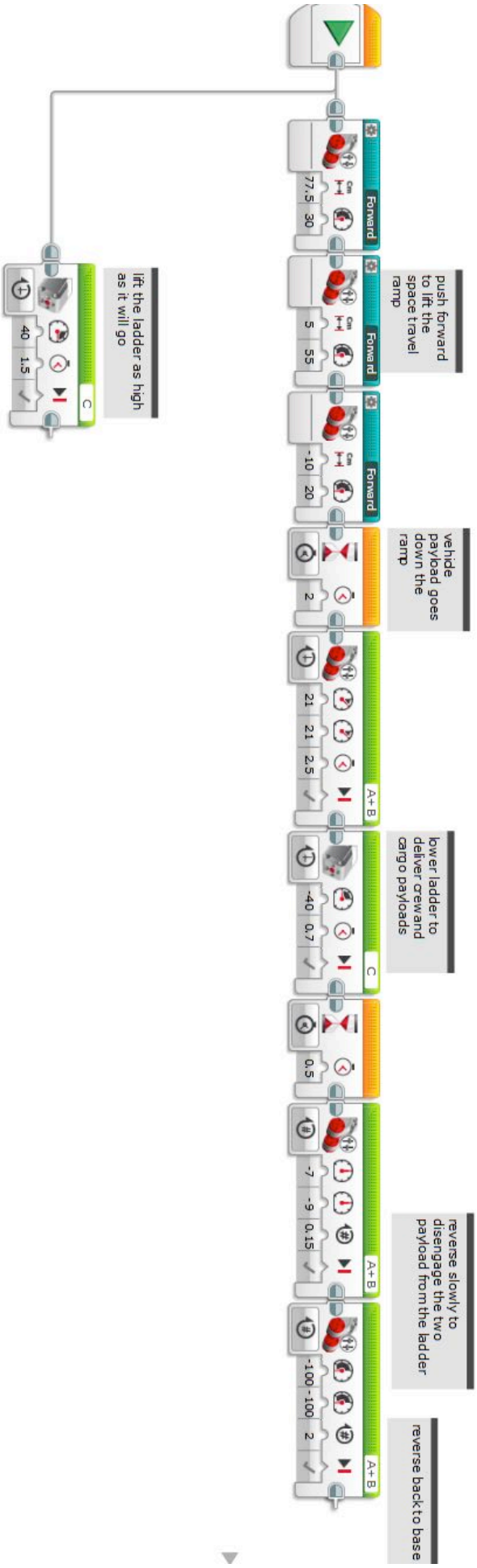
25/6/19

This might be the last day of training in the studio before the competition. William spent the afternoon practicing the mission runs on the table. Making sure to remember how the robot is positioned when starting each run. When Jackson arrived, he and Andrew spent a couple of hours practicing again until 6pm.

CODE CHANGES FOR API INTERNATIONALS

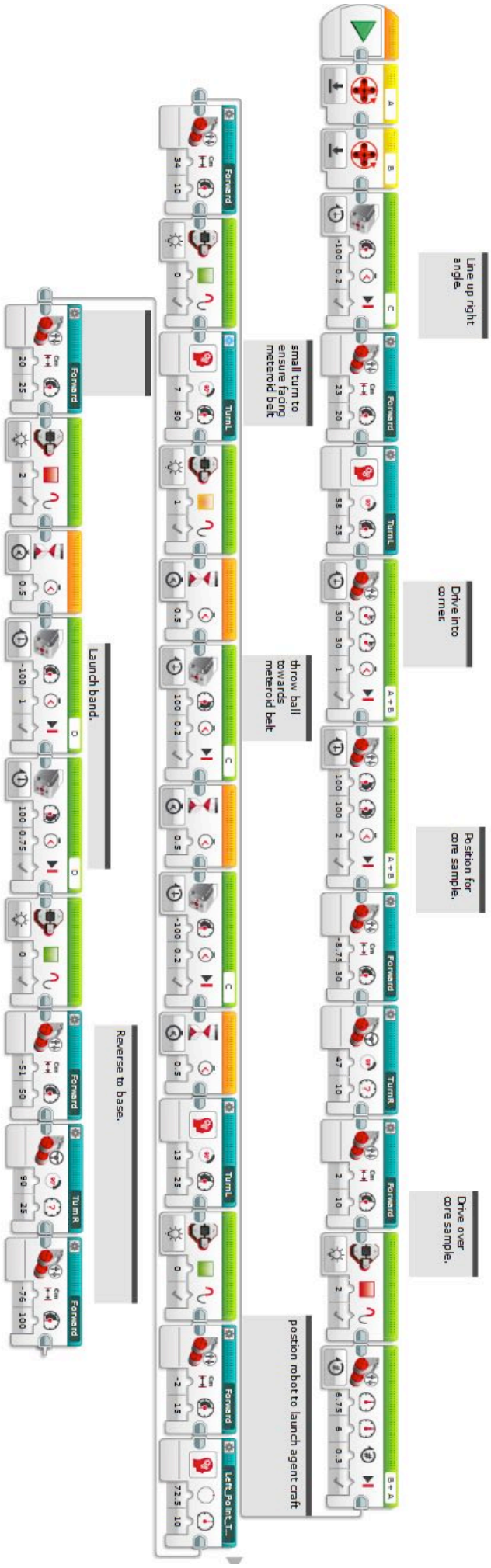
Run 1: Space Ramp

- Lift space ramp to vehicle down ramp
- Push solar array forward
- Lower crater crossing gate
- Deliver payload to ramp



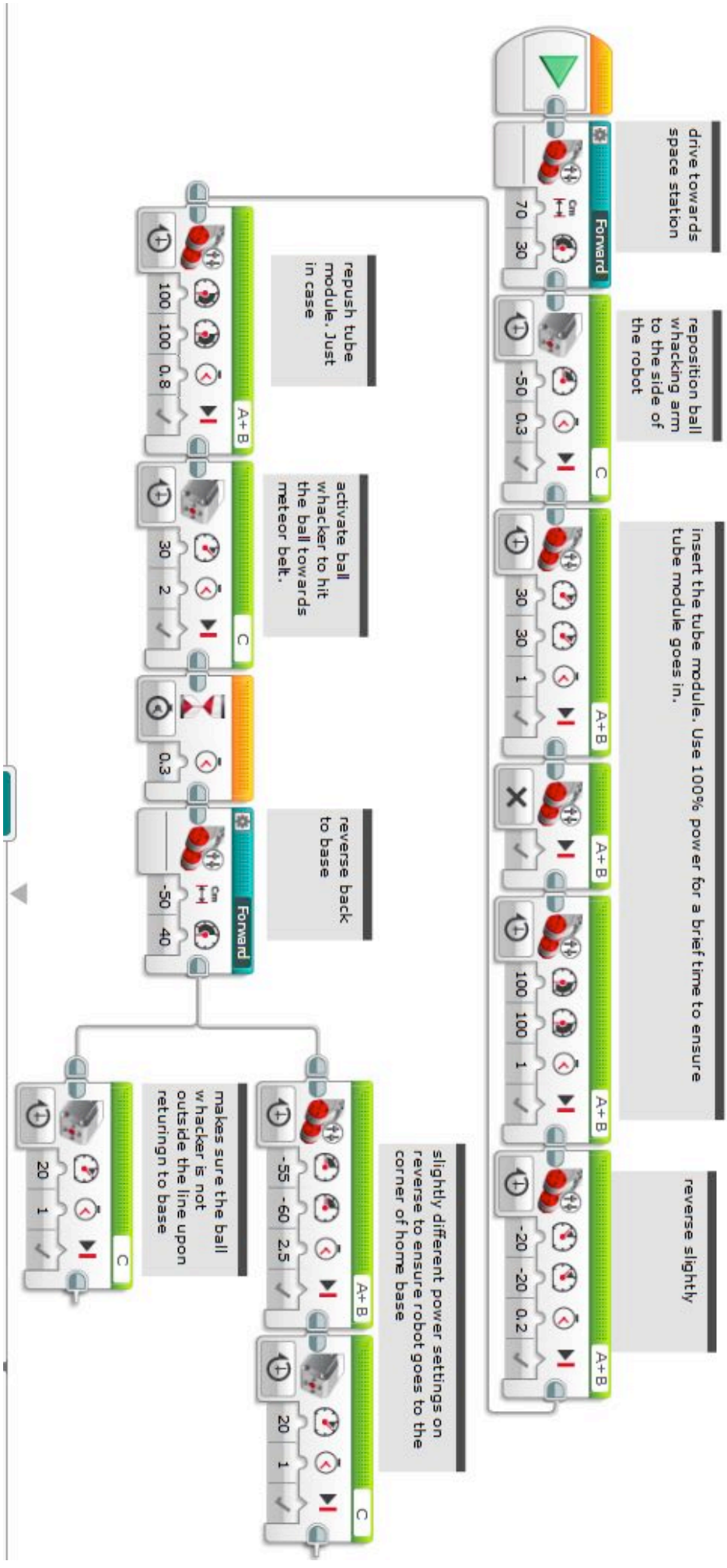
Run 2: Core Samples

- Collect all core samples
- Deliver 1 meteor to meteoroid belt
- Deliver agent craft across crater crossing



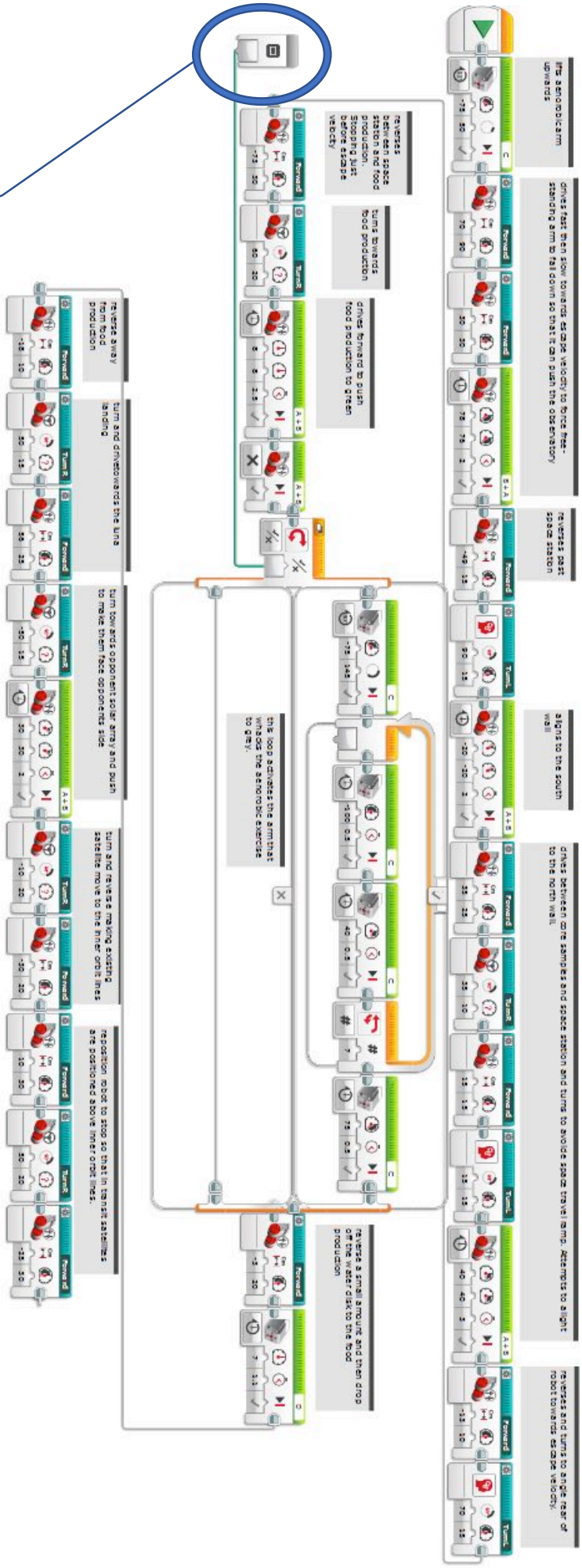
Run 3: Tube Module

- Insert tube module
- Push 2nd meteor towards meteoroid belt



Run 4: BigBoi

- Push observatory to white
- Launch space velocity rocket
- Adjust anaerobic exercise to grey
- Deliver water to food production
- Push opponent solar array
- Deliver all three satellite to inner orbit lines



This ensures that there are two options available when running this mission. IF the clock is at 1:25 or LESS than the code can be chosen as **true**, this will mean that the robot will do the whacking of the Anaerobic exercise as part of the run.

Otherwise, the code will be chosen as FALSE, which means that the robot **will not** do the whacking of the anaerobic exercise as this adds about 10 seconds to the mission.

ASIA Pacific Open Championship – Thursday 4th July, 2019

Today was the first day of the international competition. It was all about registering the teams and setting up the pit area's. We were SO excited when we walked into the room where the pits were because there were already a LOT of teams there setting up and we were so surprised that many of the teams were setting up small gazebo's for their pit area! We found out pit towards the back of the room and we were near another Australian team. We set up our area as best as we could but we started to feel like we didn't have enough items to represent Australia and that we didn't have a small gift item to give each of the international teams so the awesome parents of the team quickly rushed off to Macquarie shopping centre to buy some small Australiana things. They also got some balloons and some lollies as well. Oh, and a cool pair of Australian thongs! We went around handing out our team brochures that had our solution as well as our 'hug a friend' card. We really liked looking at the other teams area's.

At 5:45pm the team walked down to the Macquarie theatre for the opening ceremony which started late at 6:10pm. We sat right at the back with our coaches, Rebecca and Daniel. The opening ceremony only went for about 15 minutes and then the Friendship event started. It was all about watching other teams do a performance or presentation about their country. We chose to only watch as we didn't feel comfortable performing in front of so many people.

After that, we all sprinted back to the pit area because it was raining quite heavily so that we could quickly grab some things from underneath our table and also so that we could quietly practice our speech. The first time we practiced, the speech went for 6 minutes and 5 seconds; more than 1 minute over the limit! So, as a team, we went through each person's section and removed unnecessary lines. Then we practiced it again and were happy that the time was reduced to 5 minutes and 5 seconds. Now, all we need to do is practice tomorrow, after the first robot game.

5/7/2019

Day #2 of the Internationals. The first thing we did was to add more decorations to our pit area and created koala's with BotBuilders cards attached to their ears. We wanted to look more 'Australian'. It was so great that our parents went out yesterday and got some things from Macquarie Shopping Centre. And it turned out really good. The team also handed out little koalas to other teams in the pit areas. It felt great being able to swap something from our team to an international team.

Katelyn and William watched Andrew and Jackson practise at the robot practise tables for 20 minutes until 9:20 which ended about 15 minutes before the first robot game. We all walked down together and waited to be called in to the red table. Andrew and Jackson were nervous and this was made worse when the tube module accidentally fell off the table and broke, seconds before the game started and it affected their confidence because they couldn't fix it properly. But they scored 125 points which was quite good for the first game.

The robot design was next. Jackson, Andrew and William discussed about the robot and the robot's attachments. We discussed about the old designs and how we improved on them. While Katelyn discussed about the coding aspects; such as the MyBlocks and especially the code for the observatory. We weren't sure how this was perceived because we noticed the level of enthusiasm among the two judges was very low to the point that we felt they weren't interested. This was the case from as soon as we walked into the room.

After that we practised our speech for a about 20 minutes in an area close to the practice table. We had to cut a little bit more off the presentation because it went for just over 6 minutes. Our presentation was at 11:30am and we timed it perfectly. The judges asked questions such as; how much would it cost to implement and what kind of feedback we got. We were happy with how we presented. After that we posed for a team photo at 11:50am in front of the A.P.I sign.

For lunch, we all had $15 vouchers that we could spend it at the university cafeteria. Daniel, Rebecca and William had small pizzas, hot chips and a drink, Andrew bought a donut and a drink, Katelyn had satay rice and Jackson had a burger and chips. It was good to just relax. After that we played 2 games of pool in the Campus Commons area which cost $2 per game. Then the team built with some white Lego bricks for about 45 minutes near the pit area. Andrew made a colosseum, William made a house with a garage, and Jackson and Katelyn both made different towers.

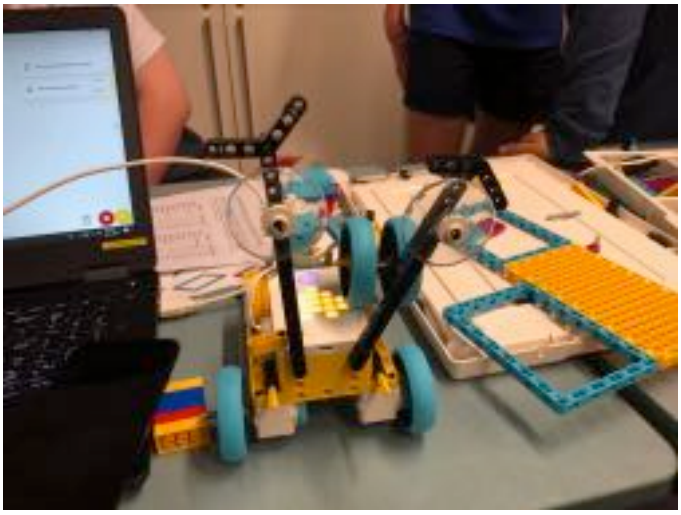
The core values judging was at 1:50pm. We each had a turn of speaking equally and we showed the judges the core values poster and we think they really liked it. We also talked about how we shared videos to YouTube and how we got inspiration from other YouTube videos. We also spoke about how we shared resources with three other teams throughout the season and we gave examples of how we progressed through the season.

Katelyn and William practised at the practise robot tables for about 25 minutes but we accidentally chose the 1 bad table. It wasn't painted on the inside which caused a large amount of friction while the robot frame went along the side during the Big Boi observatory run. The robot kept messing up but we didn't change any code because the table was different to all other tables. After that we all played pool again until about 5:30pm and then we then waited in line for over an hour for a sausage sizzle until 6:45pm. While in line Jackson balanced a half-filled water bottle on his head for 1 hour; Katelyn tried lightly tickling him a couple of times. William high fived lots of judges and teams throughout the whole day and we think other teams had fun with this. The team did not want to go the Australia night instead we played 4 more games of pool until about 9:30pm while Daniel watched Rocket league. We were all a bit cold but we were also having a great time.

6/7/2019

Today is William 14th Birthday. William And Andrew's grandparents as well as Aunty and cousins arrived to watch the 2nd robot game at 10:35am. Jack the head robot game ref got the crowd to sing happy birthday to William. We scored 195 points for the second round. Andrew went around asking other AU teams to sign his birthday card. We posed for another team photo at 11:15 because our eyes weren't completely open in the first one. Andrew and Jackson practised at the practice tables for 10 mins for the 3rd robot run. Andrew and Jackson did the 3rd and final mission at 1:50pm and scored 219 points. We are so happy that we came 12th overall on the points for the robot game and we were the top scoring Australian team in the robot game!

The team had a boxed dinner at the campus commons then played pool again for about an hour. After that we went to sit at the Glass Atrium because it was quiet. Andrew, William and Jackson played balloon volleyball until about 4:50pm; it was really fun. The BotBuilders then did a team building activity with another AU team (the Krakens) in the same building we did the core values judging. It went from 6pm to 9pm. We had to build and code the new LEGO robot called 'Spike Prime'. We had to code it to do alternate challenges on the robot table. Katelyn and a member from the Krakens did the coding while the rest of us worked together to build the robot and the attachments. We decided to call the alliance 'The BotKrakens'. The activity finished at 9pm and then the team all went to Maccas at about 9:20pm.



7/7/2019
We arrived at the pits at 8:25am and Andrew and Jackson carried the Spike prime robot to the Macquarie Theatre. All teams did the beyond orbit challenges from 9am to 10:40am. The BotKrakens did two runs which we completed the first mission in the first 17 seconds and ran the robot wherever. For the second run Katelyn coded up some extra movements for the robot by the big tire whacker. After that we danced while waiting for the closing ceremony. Each team got a medal in the closing ceremony. Sadly the BotBuilders didn't get a trophy but we are still proud of getting to API / APOC. Next year, some of us will be moving up to do FTC while some of use will also do both FLL and FTC. After we packed up after the closing ceremony we were lucky enough to change the sizes of our APOC shirts because they were a bit too big. Everyone had left by lunch time.

By the end of this season we had all turned another year older; Katelyn, Jackson and Andrew are now 16, Joe and William are 14 and Ayzlin is 12. We are now looking forward to next season: City Shaper.