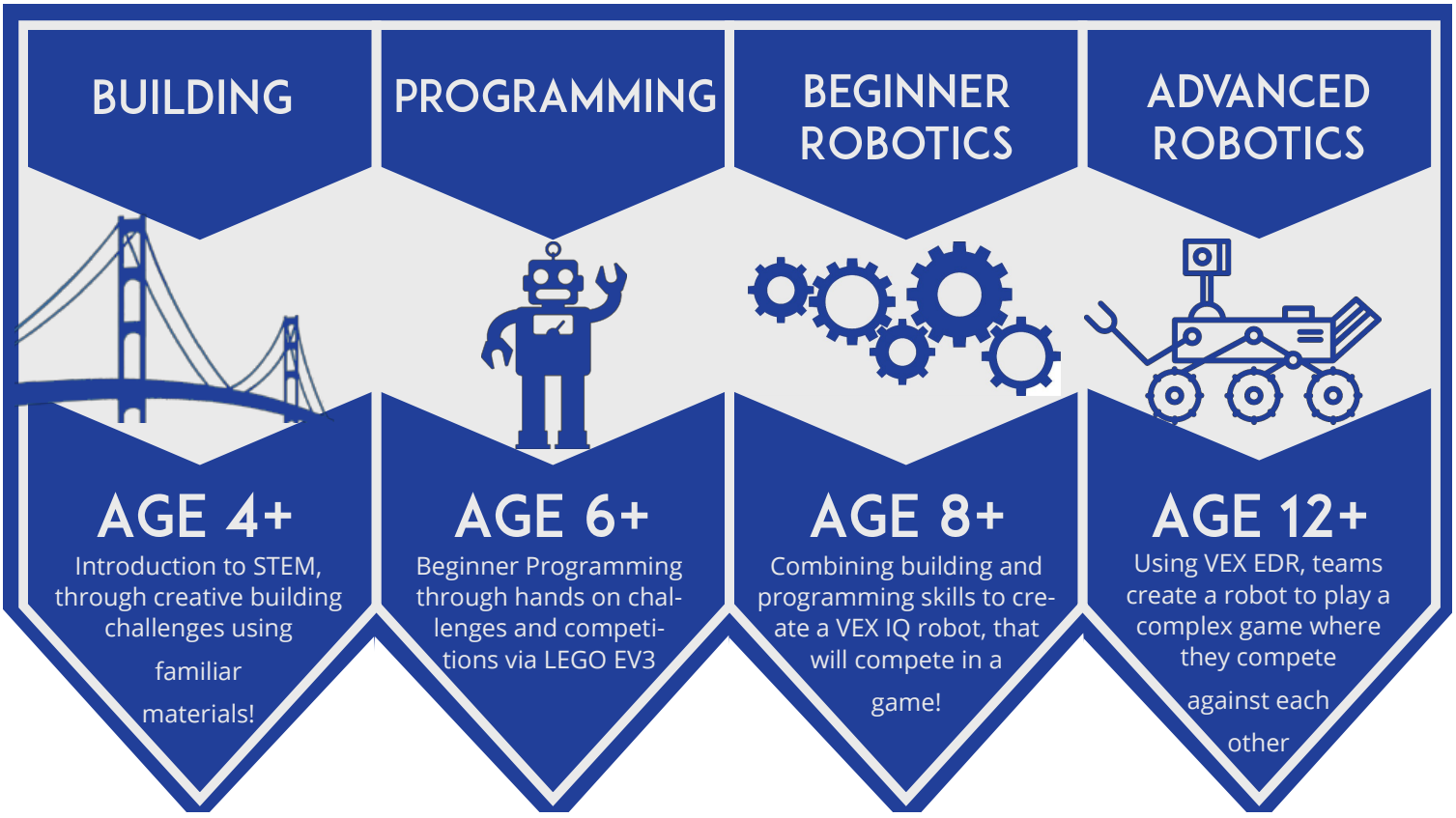
CURRICULUM

Various Program Levels

In order to **adapt the various age groups** and **levels of expertise** of our camp participants our team has organized our activities into **four separate levels.**

Each of the programs has a sample itinerary for the activities, however it can be easily adapted to **accommodate different timelines and budgets**. We have also published this resources on our website for other FRC teams to use.

By formally documentation our curriculum this year, it has allowed for our camps to become more standardized and easy to transfer knowledge to others. With a quick read of instructions any member of our team can take the initiative to host a workshop. Our team has devoted **120 hours** to creating this program.



BUILDING

Overview

This workshop is to be used with children aged 8+. It is based on 2 hours a day, for 5 days. Its purpose is to teach the fundamentals of physics and engineering. It requires a variety of household materials and marbles.

Challenge Level (Beginner)

These workshops are broken up into two different challenges. The first is a bridge building challenge. Every team is given 2 chairs that are placed exactly 1 meter apart. Their bridge must rest on the chairs, and some tape may be added to stop the bridge from moving around, but can't hold the bridge up. Teams are permitted to attach stuff to the top of the chairs but nothing on the bottom. The bridges may not touch the floor. At competition day weights will be added to the bridges and the team's bridge that supports the most weight will win. For the best experience teams should only be allowed to use toothpicks, popsicle sticks, hot glue and string. This encourages teams to use physics and clever designs rather than just a lot of material.

The second challenge is to create a Rube Goldberg machine for transporting a series of marbles to a cup. The cup will be placed on the floor, taped 1 meter to the right of the desk. The cup cannot be moved. Teams can use any household recyclable materials (no sharp edges) to create their machine. A Rube Goldberg machine is not to create the fastest or most effective way of transporting the marble but rather the most creative. Teams will be judged based on creativity, quality of construction and use of materials.

Day One

Start by introducing the kids to each other by playing a game of 2 truths and a lie, instructors included. This is done by a person saying their name then 2 truths and a lie and everyone will vote on which they think is the lie. For instructors, they will also add their school, grade and how many years they have done competitive robotics. At the end of the week the lie will be revealed.

After which they will be broken up into their predetermined groups (It is important that we have a copy of each kid's names, grade, learning disabilities and allergies. Having names and grade makes it easier to create groups that will work well together. Every 2 groups should be allocated one dedicated instructor to those groups for the week.

After all the groups have been created, walk the kids through the tasks of the day which is to build a bridge that will span a "river". There is a river monster present in the river and a lot of people will be taking pictures of it so the bridge needs to support all their weight.

The rules of challenge are given to the teams and as well they are told of any material restrictions they are given. Also, this would be when the instructors will explain the design process to the kids. The design process FRC 1325 will be using for this workshop are as follows:

Define: For the teams to write what they would like there bridge to do and what the goals are. (Just the objective of the challenge)

Brainstorm: At this stage they may use computers or tablets to look at prominent bridges and determine how they work. They also are to draw their idea of what they want their bridges to look like and how they want to construct them

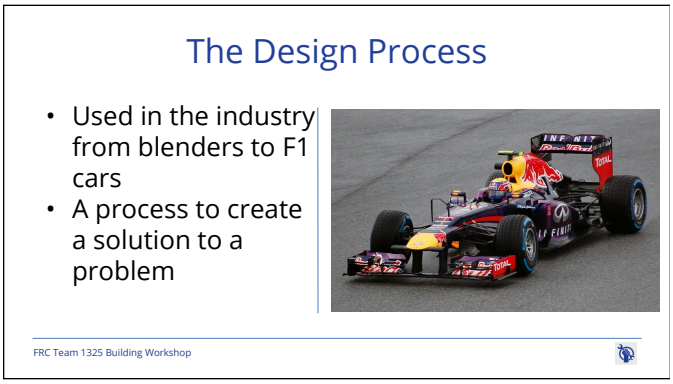
Develop/Construct: This is where they use their drawings and research to create the first versions of their bridges.

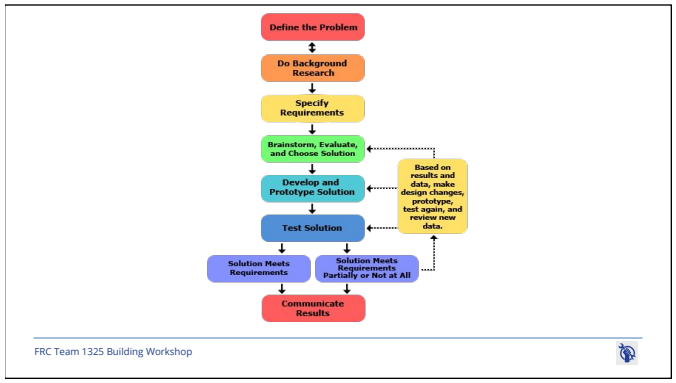
Test: Here they will add weight to their bridges while watching for potential weak spots. It is important they collect data such as using a table or Excel to calculate the weight they hold in each test and what went wrong.

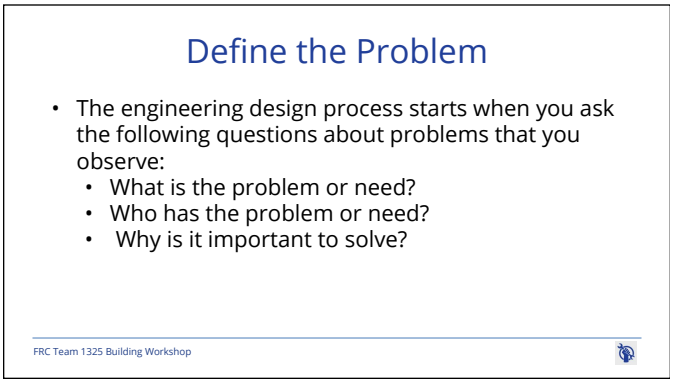
Iteration: At this stage, they will have already tested their bridges and will work to patch any weak spots they have found. They will repeat test and iteration steps until they have a bridge they are happy with.

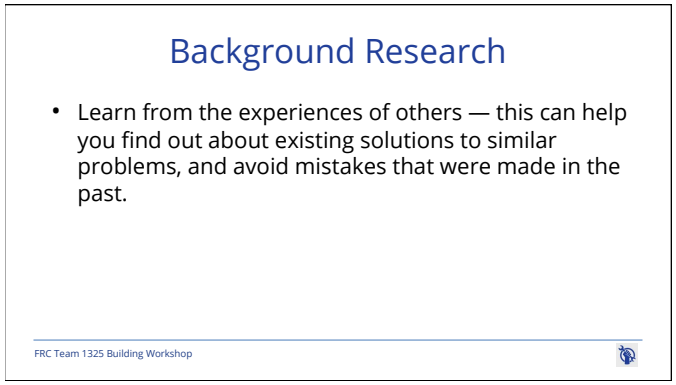
Most of Day 1 should be Defining, brainstorming and the beginning of construction. They must finish defining and brainstorming and have their instructor approve it before moving on to construction.

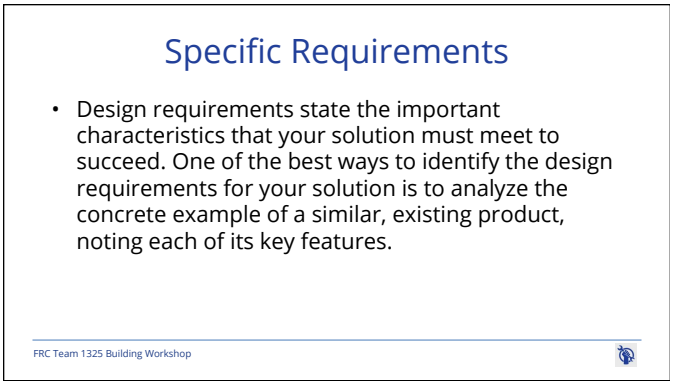
Slideshow











Brainstorm a Solution

- There are always many good possibilities for solving design problems. If you focus on just one before looking at the alternatives, it is almost certain that you are overlooking a better solution. Good designers try to generate as many possible solutions as they can.

Choose the Best Solution

- Look at whether each possible solution meets your design requirements. Some solutions probably meet more requirements than others.
- Reject solutions that do not meet the requirements.

Develop the Solution

- Development involves the refinement and improvement of a solution, and it continues throughout the design process, often even after a product ships to customers.

Build a Prototype

- A prototype is an operating version of a solution. Often it is made with different materials than the final version, and generally it is not as polished. Prototypes are a key step in the development of a final solution, allowing the designer to test how the solution will work.

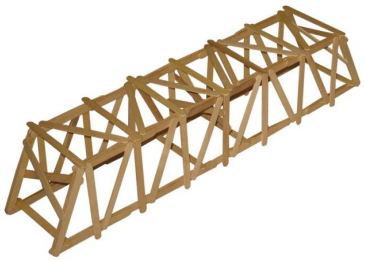
Test and Redesign

- The design process involves multiple iterations and redesigns of your final solution. You will likely test your solution, find new problems, make changes, and test new solutions before settling on a final design.

Day Two

This day should be used for them to build their bridges. As this workshop is for them to learn by doing there is no formal presentation. It is important that weight is only added to the bridges by instructors. Weights are just various pieces of aluminum and steel that had been previously weighed in Team 1325's shop and their masses are known. DO NOT BREAK THE BRIDGE, just add weight until the bridge shows visible stress.

The best bridge for this challenge is a truss bridge with string running to the tops of the chairs from about 1/3 into the bridge on both sides. The trusses should be like the one below:



Instructors should do their best to lead students towards this design, but let them experiment first as most teams will determine themselves this is the best approach.

Teams should be continually reminded that this is their last day to work on their bridges and that the next day will be the competition.

Day Three

The day should begin with recapping the rules of what and where their bridges can be attached too. If the group as a whole is behind allot 30 minutes for teams to get there bridges ready.

After an instructor, different to the one they always work with will ask them about their bridge and how they got to their current design. After which weight will slowly be added at the center of mass of the bridge until it can't support the weight anymore. DO NOT BREAK THE BRIDGE, add until there is visible stress that the bridge can't take more weight. Then record the number. After announcing the team that won and inform them at the end of the week they will get an award.

Now ask all teams to clean up their area's but not to take apart their bridges. As the teams are cleaning up their desks an instructor must go around and take pictures of each bridge.

After which instructors should begin to introduce the next challenge, the marble roller coaster or Rube Goldberg Machine. Explain what it must do and what they will be judged and scored on.

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Now ask all teams to clean up their area's but not to take apart their bridges. As the teams are cleaning up their desks an instructor must go around and take pictures of each bridge.

After which instructors should begin to introduce the next challenge, the marble roller coaster or Rube Goldberg Machine. Explain what it must do and what they will be judged and scored on.

At this point they are to use the same design process outlined on Day One. They will have time to research roller coasters and talk about things they want their roller coaster to have. ie) a loop, a 90 degree turn.

Day Four

This day is to be used to construct their roller coasters. Make sure the teams know build quality is something they will be judged on. Be sure that every team shares their design with their instructor before building and its approved.

It is important that teams stay within their own limits and aren't too ambitious with their designs. Instructors must remind teams to stay within their own means.

Teams should be testing each part of their roller coaster as they add on to it and they must make sure that in the end the marbles end in the cup.

Day Five

This is the competition day. The students will be given 45-1 hour to work on their roller coasters. They should be doing the final touches and finishing them. At this point they should be most concerned with getting the marble in the cup rather than creating loops etc.

Judging is like last time, this time they will present to the entire group talking about how they came to their given design. Afterwards they will demo and judges will allocate them a score.

Lastly, do the award ceremony (Further Outlined in Awards). Awards will be read, then the kids will walk up, high-five all the instructors then take a picture of their robot with their instructor. After which their parents can take pictures with their parents if they are present. If there is time, reveal the truth and lies from day 1.

After all kids have left instructors need to take pictures of all roller coasters then recycle them if the kids choose not to take them home.

PROGRAMMING

Overview

This workshop is to be used with children aged 6-14. It is based on 2 hours a day, for 5 days. Its purpose is to teach the fundamentals of competitive robotics while teaching fundamental programming and strategic skills. It required 1 EV3 kit per a group of 2-4 kids. Also required is a sheet of paper with a very large black circle drawn on it.

Challenge (Level Intermediate)

Objective is to make a robot that drives within the circle autonomously. When it detects the black line, the robot is to back away from it using a color sensor. If time permits an ultrasonic sensor can be used so when another robot is detected within 10 cm the robot “attacks”. Last robot to remain in the white circle wins. The game is a round robin tournament where it is 1vs. 1.

Each team must have a 5 second delay before there program begins to that way everyone’s hands are off the robot before the robots “battle”. If two robots are entangled in each other the have 10 seconds to untangle themselves before they will be removed and the match will start again. Team’s may add modifications to their robots to make them better for battle, but may not add mechanisms that will damage other robots.

Trapping robots and preventing their robots from moving is legal but must be autonomous. If an instructor asks a “weapon” to be removed it must be. To be out all the robots WHEELS must be out of the circle.

Teams are not allowed to modify the original placement of their wheels unless it is an advanced team and an instructor allows it. But if they do be sure to mark where the old wheels were, as if that part of the robot goes out the team is out.

Day One

Start by introducing the kids to each other by playing a game of 2 truths and a lie, instructors included. This is done by a person saying their name then 2 truths and a lie and everyone will vote on which they think is the lie. For instructors, they will also add their school, grade and how many years they have done competitive robotics. At the end of the week the lie will be revealed.

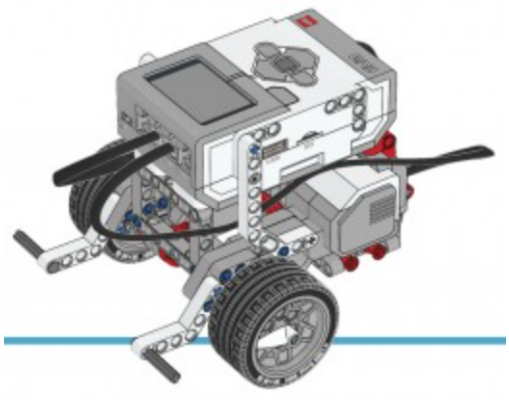
After which they will be broken up into their predetermined groups (It is important that we have a copy of each kid's names, grade, learning disabilities and allergies. Having names and grade makes it easier to create groups that will work well together.) Every 2 groups should be allocated one dedicated instructor to those groups for the week.

After all the groups have been created, walk the kids through the tasks of the day which is to build the robot.

On the first day teams are to build the robots they will be competing with.

They will be creating the Educator Vehicle (#4554)

http://robotsquare.com/2013/10/01/education-ev3-45544-instruction/

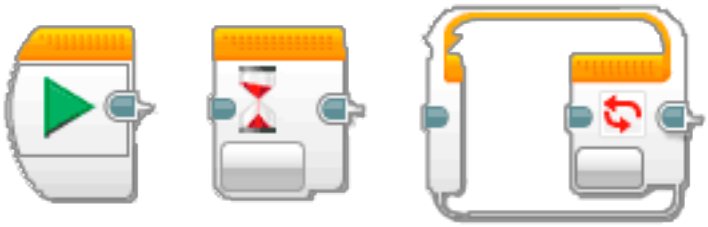


Each team will be given a box with all the materials they need and an instruction booklet. Teams will work together to construct their robots. This is a good way for the kids to get to know each other as it's a simple task of just following instructions. This is also a good chance for instructors to change up the groups for kids that seem to be having personality differences. Estimated times to be completed is 1.5 hours. Anyone done early can begin to program their robots to drive in a straight line so they can ensure their robots move.

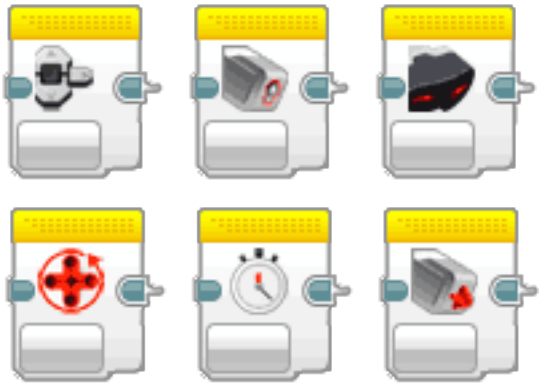
Day Two

On the second day, most teams should be completed their robots and be working on programming their machines. At the beginning of the class one instructor will walk the kids through the how-to program using the drag and drop Lego EV3 language. This should take around 30 min. Below is how that lesson is taught:

First: They will need to drag a flow block, as they will want this program to initialize and run multiple times. So, they will drag the start block and then connect the timer block as per the rules their must be a 5 seconds delay present in the program. After which the loop block will be connected and the rest of the program will be placed in that loop.



Second: They need the robot to be searching for the color that is present. So they need to take go into the sensor blocks and drag the COMPARE color sensor (second block in the set below). Set it too look for white. Below is the sensor tab's:



After which drag the action block for driving forward. This will be the forth block in the ones below. This will make the robot drive forward if the color sensor see's white.

Now drag another color sensor block in after and set it to black. Then drag the action block and set the robot to drive backwards. This time if the robot see's black the robot will drive backwards and stay in the arena.

After this presentation the kids can work on programming and testing there robots themselves.

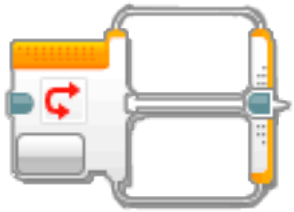
Now the kids can add the robot to drive in other ways such as it drives back and turns when it see's black which usually is the most effective strategy. Also making the robot when it see's white to make random turns and switches in direction which can be accomplished by dragging the randomizer in the data operations tab. Also adding a color sensor on both sides and a gyro is advisable but the kids must decide to that on their own. The simple program just outlined is the only one instructors can force upon their teams. Doing this will take almost all of day two and three. Instructors must ensure all the kids are taking turns programming and continually test their robots.

It's important that they understand the blocks and their functionality. Also at the practice area's an instructor must always be present and ensure that only one team practices at a time. Each team must wait in line and are only allowed one test of their program at a time. It's advisable to set up two practice fields.

Day Three

Most of day three will still be modifying their programs to stay in the lines of the arena. Any teams that are done and happy with their ability to stay in the lines, they may add an ultrasonic range finder to their robot. This sensor will detect an object in its way.

If it see's something it will "attack", which is just drive into the opponent and push it out of the arena. The best places for the sensor is on the back of the robot. To program the sensor in the current loop that is being used needs to be replaced with a double one like below.



Now the same program as before goes in the top bracket and the new program goes in the bottom. A simple program is needed, just drag in the sensor block for the range finder and set it to less than or equal to 10 cm. That is usually a good distance but can be extended to whatever the team needs. If a team works well and is already finished they may start modifying their machine with enhancements so they will be better in competition. Make sure they are aware that they may not create a system that damages other robots. Trapping robots though is fully legal. Size isn't a rule but if an instructor notices team(s) is making something very large, ask them to reduce it. Remind teams that once the tires go out the ring they are out.

Day Four

This day is essentially a catchup day. This is a day that team's will get ready for the competition the following day. Teams can now modify their staying in arena code, "attack" code or modify their robots for the competition. It is very important that the teams talk to their instructor about the changes they want to make before making them. This prevents teams from ripping there robots apart the day before a competition.

Day Five

This is the competition day. This starts with re-explaining the rules which are as follows:

1) Ensure there is a 5 second delay from the beginning of the program. Failure to do so is an automatic forfeit.

2) An instructor will call 3,2,1 GO and that is only when kids may start the program.

3) Robots start facing each other on opposite sides of the circle.

4) There are no humans on the Mat during a match.

5) If two robots are entangled (stuck together) for more than 10 second's they will be removed apart and reset to opposite sides of the circle.

6) All Ref (Instructor) calls are final and can't be argued.

7) If a match goes on for longer than 8 minutes it will be called a tie.

8) Each round is best 2 out of 3.

After explaining the competition model which is 4 quarter finals, 2 semifinals and 1 final. This may need to be modified depending on number of groups.

Second option for an odd number of groups is to have every team face each team once. Team's with the most wins face each other in the final. If teams are tied for number of wins pick the team that won the fastest to move on to the final.

After the competition have all kids return there robots back to their desks. After they have settled down, explain Jr.FLL, FLL and FRC to the kids and show what FRC Team 1325 does.

Lastly, do the award ceremony (Further Outlined in Awards). Awards will be read, then the kids will walk up, high-five all the instructors then take a picture of their robot with their instructor. After which their parents can take pictures with their parents if they are present. If there is time, reveal the truth and lies from Day 1.

After all kids have left instructors need to take pictures of all robots then take them apart and have the kits ready for the next week.

BEGINNER ROBOTICS

Overview

This workshop is to be used with children aged 8+. It is based on 2 hours a day, for 5 days. Its purpose is to teach the fundamentals of competitive robotics, strategic design, the design process, robotic linkages and mechanisms and programming. It requires 1 VEX IQ kit per a group of 2-4 kids. Also required is standard VEX IQ blocks and electrical tape.

Challenge (Level Intermediate)

Teams will be playing the 2014-2015 official VEX IQ game; high rise. Game manual is available on VEX Education's website and game animation is available here https://www.youtube.com/watch?v=iMQAYdLGOMQ.

FRC Team 1325 changes the game in a few ways. Firstly, there will be no autonomous mode in this game it will be 2-minute driver control periods, where drivers will switch after 1 minute. For teams of 4, pairs of two will alternate matches for driving, when an instructor call's switch.

During matches a timer is to be projected on a screen. Game rules are the same as outlined in the game manual. Lastly for ease of component transportation 1325 will use electrical tape to outline the game arena. The preset blocks used to build high-rises will be double sided taped in place on a flat floor.

As well teams will work together in 1vs.1 teams to achieve the highest score. After a round robin matchup teams will be given their average score. Then Alliances will be created as follows: 1 with 8, 2 with 7, 3 with 6, 4 with 5 to ensure an even playoff matchup.

Day One

Start by introducing the kids to each other by playing a game of 2 truths and a lie, instructors included. This is done by a person saying there name then 2 truths and a lie and everyone will vote on which they think is the lie. For instructors, they will also add their school, grade and how many years they have done competitive robotics. At the end of the week the lie will be revealed.

After which they will be broken up into their predetermined groups (It is important that we have a copy of each kid's names, grade, learning disabilities and allergies. Having names and grade makes it easier to create groups that will work well together. Every 2 groups should be allocated one dedicated instructor to those groups for the week.

After all the groups have been created, walk the kids through the tasks of the day which is to build the robot from the instruction booklet. Every team must first build the drive base outlined in the booklet. After which they can either continue with the what is outlined in the instruction booklet or create something new such as a 4-bar or elevator or pivoting arm. Usually the instruction robot is not very competitive, but will play the game. The most effective robots are bottom stackers using wheels but that is very complex for most kids so often a 4-bar linkage is the way to go. Be sure to push teams to try new things rather than making the instruction bot.

Instruction's to the instructional bot are found at https://www.vexrobotics.com/vexiq/animated-build/clawbot-iq#1 or https://www.vexrobotics.com/vexiq/education/iq-curriculum/your-first-robot/build- instructions if you don't want the animations.

Each team will be given a box with all the materials they need and an instruction booklet or laptop. Teams will work together to construct their robots. This is a good way for the kids to get to know each other as it's a simple task of just following instructions. This is also a good chance for instructors to change up the groups for kids that seem to be having personality differences. All teams should be able to finish a drive base in this time. No team should have a completed robot until Day Three at the earliest.

Day Two

At the beginning of day two have all the kids sit as the instructors do a small presentation. It is a series of video's that will outline some very important robotics concepts that will allow them to do well at the competition such as gear ratio's. The playlist is available at https://www.youtube.com/watch?v=ELo481zsbTI&list=PLvvcc7S26YEgp60fNJwh64aj 9ywiZ79Ta. The videos that should be shown are "Key Concepts – Speed, Torque and Mechanical Advantage", "VEX IQ Mechanisms- Gear Ratio's" and "VEX IQ Tip- Keeping Shafts Supported and In Position. Apart from these show other videos to teams that need specific help or if the group is struggling with something in particular as a whole.

After which the kids will continue to work on building their robots for the challenge with their instructors. It is important that instructors ask the teams to constantly test their idea before fully implementing them just to ensure they work out. Only two teams can be on a practice field at a time and an instructor must be present at fields always. Each team gets 3 minutes on the field at a time. Every group is allowed a block to test with at their desk.

Day Three

On Day 3 start with a short breakdown of how games are scored. Explain to all the students how to achieve points in the game and what fouls are.

After teams continue working on their robots. At this point they should be finishing up there robot's and be working on programming them in MOD KIT. If a student would really like to use robot C and had done so in the past its permissible. Make sure an instructor fluent in robot C is present to help them along. MOD KIT should be used for the rest. MOD KIT instructions are found at https://www.vexrobotics.com/iq-modkit-for-vex-g.html. Ensure controls are agreed upon by everyone on the team as they will all be driving. There is a variety of sensors available to use such as color sensors and gyro's. Note for instructors is some sensors such as the IR Sensor has different colors and students often want them just to make their robots "look cool". Ensure all sensors and mechanisms present on a robot serve a function.

At this point if a team's robot isn't working and doesn't seem like it works, now would be the time to try and create the instruction bot to ensure the team has something to compete with.

Day Four

At the beginning of the day talk with all teams about how driving robots work with switching drivers at the one minute mark. Also beginning procedures such as controllers on the floor before a match begins, and only to pick up the controller once the match begins.

Controllers must be placed on the floor at the end of a match, and can only be picked up after the field has been reset, program disabled. At the end of a match it is the kid's responsibility to reset the field so it is important for them to know how to. Fields are to be reset only when an instructor has said to and has calculated the score and told it to the lead instructor to record.

Day Four should be used as a driver practice day where practice matches will be set up. Most robots should be completed. It is important to stress to the kids that communication during a match is vital to doing well and if you are silent your score will not be good. Show this with 2 "practice matches".

Have one instructor vs. another instructor and over dramatize not talking and having robot's get in each other's way and show visible frustration during the match with each other. Then reset the field and play another match with talking where they are going and communicating what each robot is doing. Hopefully the score for the second match will be much higher than the first and will demonstrate to them how important communication is.

After kids can be left to finish their robots and practice and make sure to stress that this is their last day to work on their robots. If a team is still struggling to get their robot done, this would be the time for an instructor to start building with them to get it done.

Day Five

This is the competition day. This starts with re-explaining the rules which are as follows:

1) Teams must place their controllers on the floor before placing their robot in the designated starting position and enabling there program. Their robot MAY NOT move before the match begins or they will be given a 10-point penalty.
2) An instructor will call 3,2,1 GO and that is when the teams may pick up their robots. Note for instructors is the timer must be up and usually music makes students get more into the match.
3) There are no humans on the field during a match.
4) At the one minute mark, the lead instructor will yell switch, at that point the controller will be passed off to the other driver.
5) All Ref (Instructor) calls are final and can't be argued.
6) At the buzzer, all controllers must be PLACED on the floor or it is an automatic loss for that team (not their partners)
7) At the end of a match an instructor will calculate the score. Once calculated an instructor will call reset and the field is to be reset by the kids
8) Finals will be best 2 out of 3

The matches start as a round robin where if possible everyone plays with everyone but if that is not possible at least every team must play once. Each teams score will be calculated and at the end of the round robin every teams average score will be calculated and alliances will be made as follows:

1) 1 with 8
2) 2 with 7
3) 3 with 6
4) 4 with 5

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Day Four should be used as a driver practice day where practice matches will be set up. Most robots should be completed. It is important to stress to the kids that communication during a match is vital to doing well and if you are silent your score will not be good. Show this with 2 "practice matches".

Have one instructor vs. another instructor and over dramatize not talking and having robot's get in each other's way and show visible frustration during the match with each other. Then reset the field and play another match with talking where they are going and communicating what each robot is doing. Hopefully the score for the second match will be much higher than the first and will demonstrate to them how important communication is.

After kids can be left to finish their robots and practice and make sure to stress that this is their last day to work on their robots. If a team is still struggling to get their robot done, this would be the time for an instructor to start building with them to get it done.

ADVANCED ROBOTICS

Overview

This workshop is to be used with children aged 12+. It is based on 2 hours a day, for 5 days. Its purpose is to teach the fundamentals of competitive robotics, strategic design, the design process, robotic linkages and mechanisms and programming. It requires 1 VEX EDR kit per a group of 2-4 kids. Also required is standard VEX EDR balls, footballs, field perimeter and electrical tape.

Challenge (Level Expert)

Teams will be playing a game created by Team 1325; Score It. Firstly, there will be no autonomous mode in this game it will be 2-minute driver control periods, where drivers will switch after 1 minute. For teams of 4, pairs of two will alternate matches for driving. During matches a timer is to be projected on a screen. In VEX EDR Competition teams will play against each other, playing for the win. On Competition day, every team will play against each other, to gain the largest number of wins. After each team will be ranked of wins. If teams are tied for wins it then goes to average score. If still tied it will be a coin toss. Alliances will be preset, 1 with 6, 2 with 5, and 3 with 4. This can be adjusted for any even number of teams. With an odd number of teams, alliance 1 will have both bottom 2 teams and will alternate with each other when playing.

The same consists of two open towers along with two “shelfs”. There will be a divide between the two teams so no contact what so ever is allowed. Teams will race to score points by pushing balls onto the other teams playing area, 1 point for balls and 3 points for footballs. If teams place balls in there towers they count for 3 points each and footballs on a shelf are 5 points each.

**Note for advanced students place balls and footballs wherever the team would like along the front wall and have a 15-sec autonomous period. Points are doubled.

Day One

Start by introducing the kids to each other by playing a game of 2 truths and a lie, instructors included. This is done by a person saying their name then 2 truths and a lie and everyone will vote on which they think is the lie. For instructors, they will also add their school, grade and how many years they have done competitive robotics. At the end of the week the lie will be revealed.

After which they will be broken up into their predetermined groups (It is important that we have a copy of each kid's names, grade, learning disabilities and allergies. Having names and grade makes it easier to create groups that will work well together.) Every 2 groups should be allocated one dedicated instructor to those groups for the week.

After all the groups have been created, walk the kids through the tasks of the day which is to build the robot from the instruction booklet and explain the game. Every team must first build the drive base outlined in the booklet. After which they can either continue with the what is outlined in the instruction booklet or create something new such as a 4-bar or elevator or pivoting arm. Usually the instruction robot is competitive and will be very effective at playing the game. If teams would like to build their own machines they MUST have tell their instructor their plan of what they would like to build. Also in the building of the drive-base the instructor needs to do their best to gauge skill level. Often the best way to play the game is with the instruction robot with a modified claw.

Instruction's to the instructional bot are found at:

https://content.vexrobotics.com/docs/ClawBotGuide-0512.pdf

Each team will be given a box with all the materials they need and an instruction booklet or laptop. Teams will work together to construct their robots. This is a good way for the kids to get to know each other as it's a simple task of just following instructions. This is also a good chance for instructors to change up the groups for kids that seem to be having personality differences. All teams should be able to finish a drive base in this time. Most teams will complete the robot in this time.

Day Two

At the beginning of day two have all the kids sit as the instructors do a small presentation. It is a series of video's that will outline some very important robotics concepts that will allow them to do well at the competition such as gear ratio's. The playlist is available at

https://www.youtube.com/watchv=ELo481zsbTI&list=PLvvcc7S26YEgp60fNJwh64aj9ywiZ79Ta. The videos that should be shown are "Key Concepts – Speed, Torque and Mechanical Advantage", "VEX IQ Mechanisms- Gear Ratio's" and "VEX IQ Tip- Keeping Shafts Supported and In Position. Although these videos were made for the VEX IQ Platform the same principals apply to VEX EDR.

If the group as a whole seems to be more advanced the instructors can run the much more detailed mechanical advantage PowerPoint found here: https://docs.google.com/presentation/d/1CoPpM_SwxGslQrgLSublil8KNHYaMd0Nznwenq4MlPg/edit?usp=sharing

As well if the entire group or most is designing their own new machines instructors should run the design processes PowerPoint found here:

https://docs.google.com/presentation/d/14kjtrYwHr5c9HtQqYOY28J7pHC7-Du9dMHcAA1BzHm0/edit?usp=sharing

If a team is completed and think they are done building they should begin programming (more about that can be found on Day Three). If a team claims they are fully done and are fooling around push them to change their robot. Usually getting them to change the claw to better accomplish the football is wise.

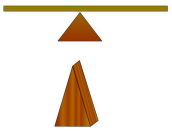
INVERSE PARADOX
Design Workshops
1325

6 Simple Machines

Pulley

Inclined Plane

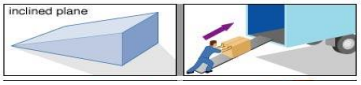
Lever



Wheel & Axle

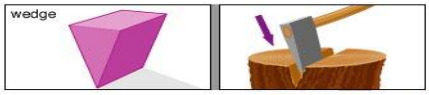
The Inclined Plane

Often referred to as a 'ramp' the inclined plane allows you to multiply your force over a longer distance. You do the same amount of work, it just seems easier because you spread it over time.



The Wedge

A wedge works in a similar way to the inclined plane, only it is forced into an object to prevent it from moving or to split it into pieces. An axe is a common use of the wedge.

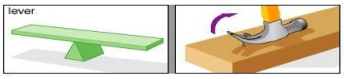


The Screw

The screw is really just an inclined plane wrapped around a rod. It too can be used to move a load (like a corkscrew) or to 'split' and object (like a carpenter's screw).

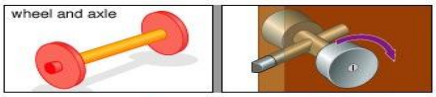
The Lever

The lever is simply a bar supported at a single point called the fulcrum. The positioning of the fulcrum changes the mechanical advantage of the lever. With the fulcrum positioned closer to the load, you can exert less force over a longer distance.



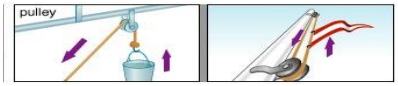
The Wheel and Axle

Any large disk (wheel) attached to a small diameter shaft or rod (axle) can give you mechanical advantage. Turning a screw with a screwdriver is a simple example of a wheel and axle.



The Pulley

A pulley is any rope or cable looped around a support. A very simple pulley system would be a rope thrown over a branch to hoist something into the air. Often, pulleys incorporate a wheel and axle system to reduce the friction on the rope and the support.



Mechanical Advantage (MA)

- Simple machines are used to reduce the force or torque needed to accomplish a given task. (When output force is gained, distance is lost)
- MA is a factor of how much the input force/ torque is amplified in the output of the machine.

$$Mechanical\ Advantage = \frac{output\ force}{input\ force} = \frac{(distance\ over\ which\ effort\ is\ applied)}{(distance\ over\ which\ the\ load\ is\ moved)}$$

Ideal Mechanical Advantage (IMA)

- This is a theoretical number.
- It assumes that power in = power out
- In other words, efficiency = 100%
- When you calculate MA, you will actually be finding IMA

Actual Mechanical Advantage (AMA)

- This is a real world number.
- In the real world, frictional losses prevent 100% efficiency as some of the input energy is lost in the form of heat.
- To find AMA, measure power in and measure power out. Then calculate MA.

IMA example

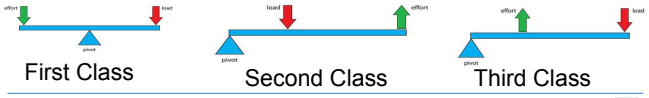
- The top surface of a ramp is 10 ft long.
- The highest point of the ramp is 5 ft off the ground.
- What is the IMA of the ramp

$$Mechanical\ Advantage = \frac{(distance\ over\ which\ effort\ is\ applied)}{(distance\ over\ which\ the\ load\ is\ moved)}$$

Levers

- Levers are classified by the location of their pivot, load, and force
- MA of levers is calculated by finding the distance from the load to the pivot, and the distance from the force to the pivot

$$Mechanical\ Advantage = \frac{Distance\ from\ force}{Distance\ from\ load}$$



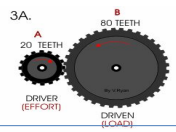
First Class Second Class Third Class

Calculating MA of Pulley systems

- A single pulley attached to a ceiling has a MA of 1 (only useful to change direction of pull)
- If that pulley is attached to the load (you are pulling up) the MA becomes 2 (1/2 as much force but twice the distance input).
- Each additional pulley you add increases the MA.
- The quickest way to calculate MA is to count the number of ropes (except for the last one if you are pulling it down).

Gears

- A gear is like a lever attached to an axle.
- Each tooth acts like a lever, so when a tooth of one gear contacts a tooth of a different gear, it either increases or decreases the input force.



Gearing

Small gear drives large gear:

- Output speed decreases
- Output force increases
- Example: Wench, Starter, or Car Differential

Large gear drives small gear:

- Output speed increases
- Output force decreases
- Example: Bicycle

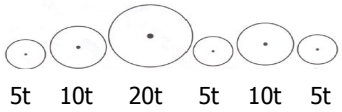
- Gearing can be used to control speed and torque
- Use a tooth # of 1 for any worm gears.

Calculating the MA of Gears

- Example:
- 10 tooth Input gear
- 30 Tooth output gear
- MA = output/ input
- MA = 30/10
- MA = 3:1
- MA = 3 X the torque, 1/3 the speed output

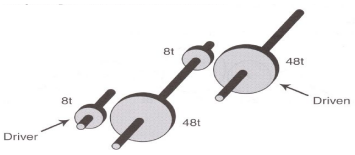
Calculating the MA of Gears

- To calculate the total MA of gears in series, simply use the input and output (first & last) gears in you MA equation.



Calculating the MA of Gears

- When compound gear sets (or cluster gears) are used; find the MA of the first set, then find the MA of the next set, and multiply them together.
- First set:48/8
- Ma = 6:1
- Second set:48/8
- MA = 6:1
- 6:1 x 6:1 =
- Total MA = 36:1



Using gears to change speed

- The number of teeth on a gear, and its rotational speed are directly related
- Formula:
  - #of teeth in gear 1 X speed of gear 1 = #of teeth in gear 2 X speed of gear 2
- Example:
  - What output gear would be needed to reduce the speed of a 25 tooth drive gear spinning at 1000 RPM to an output speed of 500 RPM?
  - 25x1000 = ?x500
  - 25000/500 =50 teeth

Day Three

To begin day three start with a short breakdown of how games are scored. Explain to all the students how to achieve points in the game and what fouls are as outlined in Day Four etc.

After teams continue working on their robots. At this point they should be finishing up there robot's and be working on programming them in ROBOT MESH. If a student would really like to use robot C and had done so in the past its permissible.

Make sure an instructor fluent in robot C is present to help them along. Robot Mesh should be used for the rest.

Robot Mesh can be found at https://www.robotmesh.com/studio/

This programming language is very basic and easy to follow. Teams should have no problem using it. Be sure to click on the generated code tab and ensure that the kids understand what it all means. Ensure controls are agreed upon by everyone on the team as they will all be driving. There is a variety of sensors available to use such as color sensors and gyro's.

At this point if a team's robot idea isn't working and doesn't seem like it works, now would be the time to try and create the instruction bot to ensure the team has something to compete with.

Day Four

At the beginning of the day talk with all teams about how driving robots work with switching drivers at the one minute mark. Also beginning procedures such as controllers on the floor before a match begins, and only to pick up the controller once the match begins. Controllers must be placed on the floor at the end of a match, and can only be picked up after the field has been reset, program disabled. At the end of a match it is the kid's responsibility to reset the field so it is important for them to know how to. Fields are to be reset only when an instructor has said to and has calculated the score and told it to the lead instructor to record.

Day Four should be used as a driver practice day where practice matches will be set up. Most robots should be completed, make sure to stress that this is their last day to work on their robots. If a team is still struggling to get their robot done, this would be the time for an instructor to start building with them to get it done.

Day Five

This is the competition day. This starts with re-explaining the rules which are as follows:

1) Teams must place their controllers on the floor before placing their robot in the designated starting position and enabling their program. Their robot MAY NOT move before the match begins or they will be given a 10-point penalty.
2) An instructor will call 3, 2, 1 GO and that is when the teams may pick up their robots. Note for instructors is the timer must be up and usually music makes students get more into the match.
3) There are no humans on the field during a match
4) At the one minute mark, the lead instructor will yell switch,at that point the controller will be passed off to the other driver
5) All Ref (Instructor) calls are final and can't be argued.
6) At the buzzer,all controllers must be PLACED on the floor or it is an automatic loss for that team (not their partners).
7) At the end of a match an instructor will calculate the score. Once calculated an instructor will call reset and the field is to be reset by the kids.
8) Finals will be best 2 out of 3.

The matches start as a round robin where if possible everyone plays with everyone but if that is not possible at least every team must play once. Each teams score will be calculated and at the end of the round robin every teams average score will be calculated and alliances will be made as follows:

1) 1 with 6
2) 2 with 5
3) 3 with 4

After the round robin, its elimination matches. Every team will play each other again and the team top two teams advance to final. As per usual break ties with highest score. This may need to be modified depending on number of groups. If even number of alliances is present do top seed versus lowest seed and create a bracket.

The final will be best two out of three. After the competition have all kids return there robots back to their desks. After they have settled down, explain Jr.FLL, FLL and FRC to the kids and show what FRC Team 1325 does.

Lastly, do the award ceremony (Further Outlined in Awards). Awards will be read, then the kids will walk up, high-five all the instructors then take a picture of their robot with their instructor. After which their parents can take pictures with their parents if they are present. If there is time, reveal the truth and lies from day 1.

After all kids have left instructors need to take pictures of all robots then take them apart and have the kits ready for the next week.

AWARDS

Overview

Every kid will receive an award at the end of the week, regardless of their performance throughout the week. The awards list will be same as the FRC Awards. Awards available are as follows:

- Industrial Design (A very robust well thought our machine, paired with very strong code base)
- Innovation in Control (Interesting use of sensors to accomplish the challenge. Unique code is also a reason to award a team this award)
- Engineering Inspiration (An inspiring effort to accomplish the challenges. Although it may not have panned put this is awarded to a team who tried, even though their machine may not have met expectation)
- Judges Award (If instructors feel they deserve an award but can't think of something. Can be used if they did something extraordinary outside the competition such as helping another team)
- Quality Award (For a machine that functioned well and reliably)
- Creativity (For an interesting and functional machine feature)
- Event Winner
- Event Finalist
- Highest Seeded Team

Instructors must nominate the students for the awards the night before and let the Lead Instructor know so they can print the certificates. Short Speeches should be written and announced for when the kids receive their award like in FRC. That falls on the lead instructor.

INSTRUCTOR RESPONSIBILTIES

An instructor is responsible for setting up the desks and kits for the kids. Each instructor is responsible for working with their teams and making sure they stay focused and keep working at the task. An instructor needs to make sure they work together and take turns, such that one person is not doing all the work.

Usually not needed but if a needed babysit a group and make them set up a “schedule” to take turns. Instructors also need to work to stop arguments, which usually start by a kid not feeling their voice is heard. Ensure they understand no idea is a bad idea and that all ideas are met objectively.

With VEX Robotics often the kids just want to build the instruction bot. It is important that instructors propose new ideas to get kids to think for themselves and try something new. Like a 4-bar. Instruction bot is a last resort. If a team makes instruction bot ensure they improve on it once it is complete. Usually redoing the claw makes a team competitive with instruction bot.

In VEX, instructors should be more hands on working with their teams on their robots. In some cases, kids will think they know better. In these cases, let them work on their own because more often than not their idea will not pan out and they will then ask for help again.

It’s important that instructors make sure the kids know that an instructor is a teacher and they treat you that way. Don’t be afraid to tell a kid that if they are misbehaving or being rude that they will not succeed at the challenge unless they get their act together. Time outs are also an option. Kids who will cry due to you giving them a time out or letting them know they are being rude should be left to cry it out for 5-6 minutes and come back after and ask what is wrong. If not sure what to do talk to lead instructor.

If the whole group is not listening to instructors, turn out the lights and give them 5-10 minutes of everyone must stay at the desks not work on the robots and sit in silence. If any kids are still making trouble lead instructor will talk with them.

Instructors are responsible for making sure no pieces are on the floor, and that if a team's station gets very messy that they must clean it up before continuing to build.

At the end of the day they must reset the desks and pack up all the kits.

At the end of a week they must ALL take apart the robots built that week and return the kits to original condition.

Dependent on the organization FRC 1325 is working with, when kids are being sent home at the end of a day kids MUST sign out with lead instructor before leaving. They must either leave with their parent, or have a signed note. A phone call to their parent is also acceptable.