

# FIRST Team 1529

The CyberCards

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## 1. This Document & Its Conventions

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The 2021-22 CARDINAL ROBOT BATTLE Game Manual is a resource for all 1529 Robotics sub teams for information specific to the 2021 CARDINAL ROBOT BATTLE game. Its audience will find the following detail:

- a general overview of the CARDINAL ROBOT BATTLE game
- detail about the CARDINAL ROBOT BATTLE playing field
- description of how to play the CARDINAL ROBOT BATTLE game
- all season rules (e.g. safety, conduct, game play, inspection, etc.)

The intent of this manual is that the text means exactly, and only, what it says. Please avoid interpreting the text based on assumptions about intent, implementation of past rules, or how a situation might be in “real life.” There are no hidden requirements or restrictions. If you’ve read everything, you know everything.

Specific methods are used throughout this section to highlight warnings, cautions, key words, and phrases. These conventions are used to alert the reader to important information and are intended help teams in constructing a robot that complies with the rules in a safe manner.

Key words that have a particular meaning within the context of the FIRST Robotics Competition and CARDINAL ROBOT BATTLE are defined in the glossary section and indicated in ALL CAPS throughout this document.

## 2. Question and Answer System

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The Q & A System for this game will be located as a channel in Slack. All questions must be submitted in writing and will be answered no later than the next practice. Questions must include examples for clarity or reference multiple rules to understand the relationships and differences between them.

The Q & A opens on August 18, 2021, 6:00 PM Eastern. The Q & A may result in revisions to the text in the official Manuals (which are communicated at the beginning of each practice).

The responses in the Q & A do not supersede the text in the manuals, although every effort will be made to eliminate inconsistencies between them. While responses provided in the Q&A may be used to aid discussion at each event, per Inspection & Eligibility Rules and REFEREE Interaction sections, REFEREES and INSPECTORS are the ultimate authority on rules. If you have concerns about enforcement trends by volunteer authorities, please notify Mr. Snodgrass.

The Q & A is not a resource for firm predictions on how a situation will play out an event. Questions about the following will not be addressed:

- rulings on vague situations,
- challenging decisions made at past events, or
- design reviews of a robot system for legality.

Weak questions are overly broad, vague, and/or omit rule references. Examples of questions that will not be answered in the Q & A include:

- Is this part/design legal?
- How should the REFEREE have ruled when this specific game play happened?
- Duplicate questions
- Nonsense questions

Good questions ask generically about features of parts or designs, gameplay scenarios, or rules, and often reference one or more relevant rules within the question. Some examples of questions that will likely be answered in the Q & A are:

- A device we are considering using on the ROBOT comes with purple AWG 40 wire, does this comply with R?? and R??
- We're not sure how to interpret how Rule G?? applies if Blue ROBOT A does X and Red ROBOT B does Y, can you please clarify?
- If a robot does this specific action, is it doing what this defined term is describing?

### 3. GAME OVERVIEW

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*(SEE GAME FIELD IMAGE AT THE END OF THE BOOK)*

In CARDINAL ROBOT BATTLE, 1 robot works to protect their HOME BASE from menacing opponents who are out to steal their POWER GEM. Each team, along with their trusty bots, race to collect, stack, and steal CONSTRUCTION BRICKS to build a wall for maximum protection. Near the end of the match, robots can steal one or both opposing teams' POWER GEMS and return to their HOME BASE. Will your team be able to protect your gem?

During the 15 second AUTONOMOUS Period, robots follow pre-programmed instructions. Teams score points by:

1. Moving CONSTRUCTION BRICKS back to their HOME BASE. (2pts.)
2. Stacking CONSTRUCTION BRICKS in their home base. (3pts per level standing at the end of autonomous)

In the final 2 minutes and 15 seconds of the match, drivers take control of the robots. Teams score points by:

1. Moving Construction Bricks back to their HOME BASE. (1pt per brick counted at the end of the match) (**NOTE:** teams may only control no more than 2 CONSTRUCTION BLOCKS at a time.)
2. Stacking CONSTRUCTION BLOCKS in their home base. (1pt per level. Making a stacked brick with 2pts)

In the final 30 seconds of the match, teams can score END GAME points by:

3. Stealing an opponent's POWER GEM and bringing it back to their HOME BASE (15pts if opponent's POWER GEM is in your base)
4. Teams whose POWER GEM is still in their HOME BASE when the match is over will receive 10pts.

At the end of the match, teams will lose points based on each MINI-MINE placed in their home base. (.5pts per mine)

The team with the highest score at the end of the match wins.

Each team will be awarded points based on each presentation, driving challenges, and the robot game. The following points will be awarded based on each winning item. The team with the most cumulative points will be labeled the winner.

Activity	First Place	Second Place	Third Place
Project Management Award:	6	4	2
Safety Award	6	4	2
Design Award	6	4	2
Strategy and Data Analysis Award	6	4	2
16.1 Driving Test	5	3	1
16.2 Construction Brick Timed Challenge	5	3	1
16.3 POWER GEM Delivery Challenge	5	3	1
Programming Award	5	3	1
Robot Game	5	3	1

## 4. ARENA

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The ARENA includes all elements of the game infrastructure that are required to play CARDINAL ROBOT BATTLE: the CONSTRUCTION BLOCKS, the FIELD, POWER GEMS, MINI-MINES, and ALLIANCE STATION.

Guardrails form the long edges of the FIELD and are a 1 ft. 7 in. (~48 cm) tall system of transparent polycarbonate supported on the top and bottom by aluminum extrusion.

## 5. Zones and Markings

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FIELD Zones and markings of consequence are described below. Unless otherwise specified, the tape used to mark lines and zones throughout the FIELD is blue painters tape.

**ALLIANCE STATION:** 3ft x 3 ft taped square on each side of the triangle that is infinitely tall volume formed by, and including the ALLIANCE WALL, the edge of the field parameter, and ALLIANCE tape.

**HOME BASE LINE:** a tape line spanning between two sides of the FIELD and located 3 ft. from the point of the triangle.

**CONSTRUCTION BRICK LOADING ZONE:** three construction blocks will be placed 6 feet from each point of the triangle on a blue tape marking. All other construction blocks will be placed randomly in the middle of the field.

## 6. PLAYER STATION

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A PLAYER STATION is one (1) of three (3) assigned positions at the corner of each of the triangle walls. This is where a DRIVE TEAM operates their ROBOT. Each PLAYER STATION is marked by a blue tape section on the ground.

Each PLAYER STATION contains the following components for teams:

- 1 CONSTRUCTION BRICK

- 2 MINI-MINES

CARDINAL ROBOT BATTLE is played with construction blocks, power gems, and MINI-MINES. A construction block is a yellow 7 in. (~18 cm) diameter plastic block. Each POWER GEM has a different size and shape. A MINI-MINE is a yellow 7 in. (~18 cm) diameter plastic block.

## 7. The FIELD Management System

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The Field Management System (FMS) during CARDINAL ROBOT BATTLE will be Vex Cortex system 2-cell phones. One with the 15 second autonomous and one with the 2:15 countdown clock. A timekeeper will start and stop autonomous, like an FTC match. Then, the timekeeper will start and stop the Teleoperated period. Teams are responsible for their own E-STOPS.

When a DRIVE TEAM is ready to begin. They will connect their player station directly to their robot.

## 8 MATCH PLAY

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Participants of CARDINAL ROBOT BATTLE will battle on September 15<sup>th</sup> during normal practice time. Presentations will be first, followed by the skills challenges, and ending with the BATTLE. Parents should come to this practice to see what their students have done while sharing in a dessert celebration. During a 2 minute 30 second match during CARDINAL ROBOT BATTLE, three teams will play MATCHES executed per the details described below.

### 10.1 CONSTRUCTION BRICKS

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236 50 CONSTRUCTION BRICKS are staged as follows:

- One (1) Construction Brick is given to each of the three (3) teams to begin the match.
- The rest of the CONSTRUCTION BRICKS will be in the center of the field in the CONSTRUCTION BRICK LOADING ZONE.

### 10.2 Mini-Mines

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2 MINI-MINES are staged as follows:

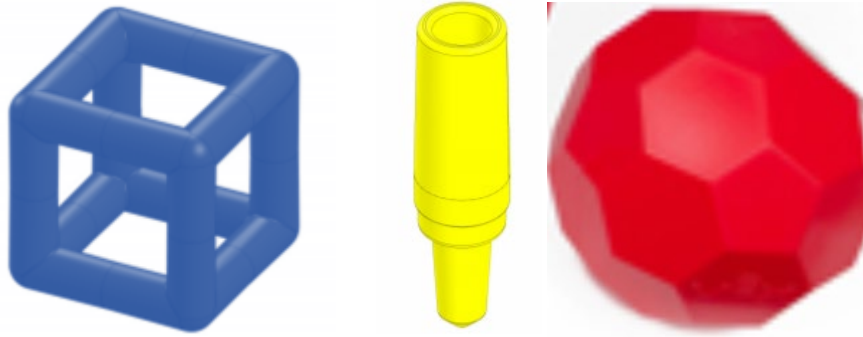
- Ten (10) MINI-MINES will be against all three walls of the field. 2 will be in each home base to begin the match.

### 10.3 POWER GEMS

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3 POWER GEMS are staged as follows:

- One (1) Random POWER GEM will be placed in one of the three home bases by the referees/volunteers.
- POWER GEMS consist of various objects the following objects:



## 9. ROBOTS

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Each team will design, prototype, construct, and program a robot that is no larger than 24 inches by 24 inches by 24 inches utilizing the parts in their totes as well as any 3D printed parts that are printed in our school. Scrap metal and wood will also be available.

Each robot will have its own drive station and wireless receiver.

Each DRIVE TEAM stages their ROBOT such that part of its bumper is intersecting the infinite vertical plane created by the corresponding HOME BASE LINE.

### *Building Constraints:*

1. You can not cut, bend, or damage any of the Vex pieces.
2. Each team is allotted 72 hours of print time. (Filament pending.)

## 10. Humans

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During this activity, it is more important to focus on process rather than simply building the robot. Each team will have "Sub-Team" leaders who will oversee each specific task on your team. Your team must include the following:

1. **Project Manager:** The project manager oversees the Gantt Chart for your teams build process. They must present the Gantt Chart, CAW, and answer questions about your team's process throughout this event.
2. **Safety Captain:** The safety captain purpose is to promote the safety culture within FIRST, as well as ensuring safety is followed throughout the entire process. The SC must document how the team is being safe, as well as participate in a judge discussion with the Safety Advisor. Judges and/or Safety Advisors will focus on team safety behaviors and safe physical conditions. The SC must be able to explain:
  - a. How their safety culture within their team environment exists so that safety is a top priority.
  - b. How they train team members on basic safety practices as well as tool & machine safety
  - c. How they integrate safety into their everyday activities including:

- i. Personal protective equipment (PPE) - wearing required and providing for others at outreach opportunities (e.g. Safety glasses, closed toed shoes, etc.)
  - ii. Safe physical conditions – workspace, condition of hand tools and power tools, power cords, safe handling of batteries and charging equipment
3. **Design Lead:** This student is responsible for making a CAD book of all the drawings from your design as well as presenting your design (possibly with the help of 2 other students) to the judges. A team spokesperson must be able to identify and describe the innovation and can trace its conception, design, manufacturing/assembly, or deployment. The spokesperson must prove that the innovation is practical; it addresses the game's challenge. It is not just a cute idea and is reliable under the stress of competition.
4. **Programming Lead:** This student is responsible for documenting all the programming and controls of the robot that provide unique machine functions. They must be able to explain how their team used:
  - a. *Creative Development:* express the importance of collaboration in developing programs and how to use an iterative process in your work. (example: Collaboration and Program design)
  - b. *Data:* explain how computers/the robot handle data and how data can be used to produce new information and solve problems. (example: how did they utilize data compression/data delivery to the robot and how did they extract data from coding mistakes)
  - c. *Algorithms and Programming:* explain how you used algorithms and abstractions to create programs that solve problems. (example: how/why did they develop algorithms, simulations, and algorithmic efficiency within their code)
  - d. *Computer Systems and Networks:* Explain how computer systems and networks relate to your robot. (example: parallel and distributed computing, Git Hub, pushing code to the robot, retrieving data from the robot)
5. **Electronics Lead:** The EL is responsible for understanding the electronics on the robot, wiring the robot, and fixing all electronics problems with the robot.
6. **Mechanical Lead:** The Mechanical lead is responsible for keeping up with the Gantt chart, confirming that all mechanical items are being completed on the robot per the design specifications. As well as communicating any design irregularities to the design lead.
7. **Scouting/Strategy Lead:** This student directs making certain that the team has a detailed game play strategy and that the design, build, and game play are focused on that strategy. They are also in charge of creating scouting sheets for in competition data collection. Finally, they will present that strategy to the judges during the final rounds.
8. **Digital Media Lead:** This person oversees making certain that the entire build season is documented via images, social media posts, videos, and the engineering notebook. Their job is to help create high quality presentation for all the presenters.

During the competition, each team will be responsible for making certain that they have a drive team that consists of a DRIVER, COACH, OPERATOR, and a TECHNICIAN. All four of these

positions *MUST BE HIGH SCHOOL STUDENTS*. Drivers are the rookie only students who will drive the robot during the competition. The OPERATORS are the students who will be operating the robots' various appendages. The COACHES oversee making certain that your team is sticking to your strategy to score the most points possible. The TECHNICIAN is a student who supervises fixing anything mechanical that goes wrong before or after the match. Teams should have a different DRIVE TEAM for each match and each of the skills challenge. This is not mandatory. The DRIVE TEAM (minus the TECHNICIAN) stage player station on their side of the triangle. TECHNICIANS stage in the event-designated area near the FIELD.

## 11. Autonomous Period

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The first phase of each MATCH is called AUTONOMOUS (AUTO) and consists of the first fifteen (0:15) seconds. During AUTO, ROBOTS operate without any human user DRIVE TEAM control or input. ROBOTS attempt to score by moving CONSTRUCTION BRICKS into their HOME BASE.

## 12. Teleoperated Period

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The second phase of each MATCH is called the TELEOPERATED Period (TELEOP) and consists of the remaining two minutes and fifteen seconds (2:15). During this phase, DRIVERS remotely operate ROBOTS to retrieve and stack Construction Blocks to protect their Power Gem. Teams may take the blocks from the center of the field or their opponent's wall.

The final thirty (0:30) seconds of TELEOP is the ENDGAME, during which ROBOTS attempt to capture their opponents POWER GEM and return to their home base.

## 13. Scoring

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Teams are rewarded for accomplishing various actions through the course of a MATCH, including Construction Brick movement during AUTO, stacking CONSTRUCTION BRICKS during TELEOP, manipulating, and placing MINI-MINES to reduce your opponent's scores, and capturing your opponent's Power Gem.

Points are counted twice during a match. First, matches will pause directly after AUTO to add points scored. Then, at the end of the match points will be counted and victory will be rewarded to the team with the highest score.

During the 15 second AUTONOMOUS Period, robots follow pre-programmed instructions. Teams score points by:

3. Moving CONSTRUCTION BRICKS back to their HOME BASE. (2pts.)
4. Stacking CONSTRUCTION BRICKS in their home base. (3pts per level standing at the end of autonomous)

In the final 2 minutes and 15 seconds of the match, drivers take control of the robots. Teams score points by:

5. Moving Construction Bricks back to their HOME BASE. (1pt per brick counted at the end of the match) (**NOTE:** teams ~~may~~ may only control no more than 2 CONSTRUCTION BLOCKS at a time.)

6. Stacking CONSTRUCTION BLOCKS in their home base. (1pt per level. Making a stacked brick with 2pts)

In the final 30 seconds of the match, teams can score END GAME points by:

7. Stealing an opponent's POWER GEM and bringing it back to their HOME BASE (15pts if opponent's POWER GEM is in your base)
8. Teams whose POWER GEM is still in their HOME BASE when the match is over will receive 10pts.

At the end of the match, teams will lose points based on each MINI-MINE placed in their home base. (.5pts per mine)

The team with the highest score at the end of the match wins.

**\*\*Gems will be located 9" from the point of the triangle and 6" from the side of the triangle in the team's home base.**

**\*\*Field size is 12 x 12 x 12 triangle.**

## 14. Skills Challenges

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Before the competition begins, teams will compete in the following skills challenges.

### 16.1 Driving Test

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The CARDINAL ROBOT BATTLE driving test entails two timed driving challenges.

1. The first challenge drivers must drive their robots touching each of their opponents' HOME BASES, returning to their own HOME BASE in between. Then, they will drive to the center of the field and return to their home base. The fastest time wins.
2. The second challenge drivers will complete the same path as before, but this time they will have to dodge the MINI-MINES that are in the way. The fastest time wins.

### 16.2 Construction Brick Timed Challenge

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1. The third challenge is designed to see how well the driver and operator can collaborate. The team will try to take as many construction blocks from around the field as possible and get them into their base. The most construction blocks win.

### 16.3 POWER GEM Delivery Challenge

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The CARDINAL ROBOT BATTLE

1. The fourth challenge is also designed to see how well the driver and operator can collaborate. The team will try to take their opponents POWER GEM from behind a 1 construction brick high wall. Your time will stop when both opponents POWER GEMS are in your home base.

**\*\*NOTE:** Each Skill Challenge should **MUST** have a different Rookie Driver.

## 15. Team Presentations

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Each team will be participating in a series of presentations. These presentations are designed to replicate what would happen at an actual FIRST Robotics Competition. The presentations are as follows:

a. ***Project Management Award:***

Winners of this award must present their teams Gantt Chart, explain the strategies used to adhere to the timeline, and explain where they overcame a problem within the timeline. They must also present their teams CAW, and answer questions about your team's processes throughout this event.

b. ***Safety Award:***

The winners of this award must be able to explain:

- a. How their safety culture within their team environment exists so that safety is a top priority.
- b. How they train team members on basic safety practices as well as tool & machine safety
- c. How they document their teams training efforts
- d. How they integrate safety into their everyday activities including:
  - i. Personal protective equipment (PPE) - wearing required and providing for others at outreach opportunities (e.g. Safety glasses, closed toed shoes, etc.)
  - ii. Safe physical conditions – workspace, condition of hand tools and power tools, power cords, safe handling of batteries and charging equipment

c. ***Design Award***

A team spokesperson must be able to identify and describe at least one of their robots innovations and trace its conception, design, manufacturing/assembly, and deployment. The spokesperson must prove that the innovation is practical; it addresses the game's challenge. It is not just a cute idea and is reliable under the stress of competition.

9. ***Programming Award***

The winners of this award must be able to explain how and provide evidence that their team used the following while programming their robot:

- a. ***Creative Development:*** express the importance of collaboration in developing programs and how to use an iterative process in your work. (example: Collaboration and Program design)
- b. ***Data:*** explain how computers/the robot handle data and how data can be used to produce new information and solve problems. (example: how did they utilize data compression/data delivery to the robot and how did they extract data from coding mistakes)
- c. ***Algorithms and Programming:*** explain how you used algorithms and abstractions to create programs that solve problems. (example: how/why did they develop algorithms, simulations, and algorithmic efficiency within their code)

- d. *Computer Systems and Networks*: Explain how computer systems and networks relate to your robot. (example: parallel and distributed computing, Git Hub, pushing code to the robot, retrieving data from the robot)

#### 10. **Strategy and Data Analysis Award**

The winners of this award have proven that their team has a detailed game play strategy and that the design, build, and game play are focused on that strategy. They have provided their scouting sheets for in competition data collection. As well as explained in detail how they utilized other data to make decisions during this activity.

### 16. Other Important Information:

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- During game play proper gracious professionalism is required. Students who insult, hurt, or otherwise denigrate other students will be asked to leave. We are a team, and we are expected to act like one.
- During game play, drive teams MUST stay in their designated areas. Leaving their area will result in disqualification.
- During game play, you may NOT intentionally hurt another team's robot.
- Unintentional damage to other robots will a penalty with possibility of disqualification.
- If your robot does not pass inspection, you will not be able to compete.
- If any part of your robot leaves the playing field, you will be eliminated.
- No VEX parts can be modified in any way. (Cut, bent, etc.)
- Each time is allotted 72 hours of print time on the available 3D printers. (Depending on the availability of filament) (**Clarification:** 72 hours of print time on school printers. Any item printed on outside printer should match game dimensions.)

### 17. Glossary

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REFEREE: an official who watches a game or match closely to ensure that the rules are adhered to and (in some sports) to arbitrate on matters arising from the play.

CONSTRUCTION BRICKS: are yellow stackable bricks used to create a wall to protect your gem.

POWER GEM: There are three different POWER GEM's in this game. Each one is drastically different.

INSPECTORS: are the volunteers who make certain your robot is safe.

HOME BASE: is the area where your POWER GEM is housed.

AUTONOMOUS: is the 15 seconds at the beginning of each match where your robot will move independently.

TELEOPERATED(TELEOP): is the period when humans control the robots during a match.

END GAME: The last 30 seconds of a match where you can steal your opponent's POWER GEM

MINI-MINE: are small yellow blocks that are used to remove scores from your opponent's overall score.

**ALLIANCE STATION:** is a place on a typical FIRST field where all three alliance partners come together and play during a match. During our game, it is a desk on the side of the station.

**CONSTRUCTION BRICK LOADING AREA:** is the area in the middle of the field where all the CONSTRUCTION BRICKS begin.

**ALLIANCE WALL:** is a wall at the end of the standard rectangle FIRST field that houses the drive teams.

**FIELD:** is where the robot game is played.

**DRIVERS:** students who operate the drive train of the robot.

**COACHES:** students who make sure that your team is following your decided team strategy.

**HUMAN PLAYERS:** are players who are allowed to interact with the field elements in a FIRST game.

**DRIVE TEAM:** is the combination of DRIVERS, OPERATORS, COACHES, and TECHNICIANS.

**E-STOPS:** are electronic stops to stop a robot from moving.

**MATCHES:** timed periods of robot play.

