vexrobotics.com

VEX IQ CHALLENGE

SQUARED AWAY

2019-2020
Game Manual

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The Game

Game Description

Matches are played on a field set up as illustrated in the figures throughout. The *Robot Skills Challenge* and the *Teamwork Challenge* use the exact same field and setup.

In the *Teamwork Challenge*, an *Alliance* of two (2) *Robots*, operating under driver control, work together in each *Match*.

In the *Robot Skills Challenge*, one (1) *Robot* attempts to score as many points as possible. These matches consist of *Driving Skills Matches*, which will be entirely driver controlled, and *Programming Skills Matches*, which will be autonomous with limited human interaction.

The object of the game is to attain the highest score by *Scoring Balls* in or on *Cubes*, and *Scoring Cubes* in *Corner Goals* or on *Platforms*.

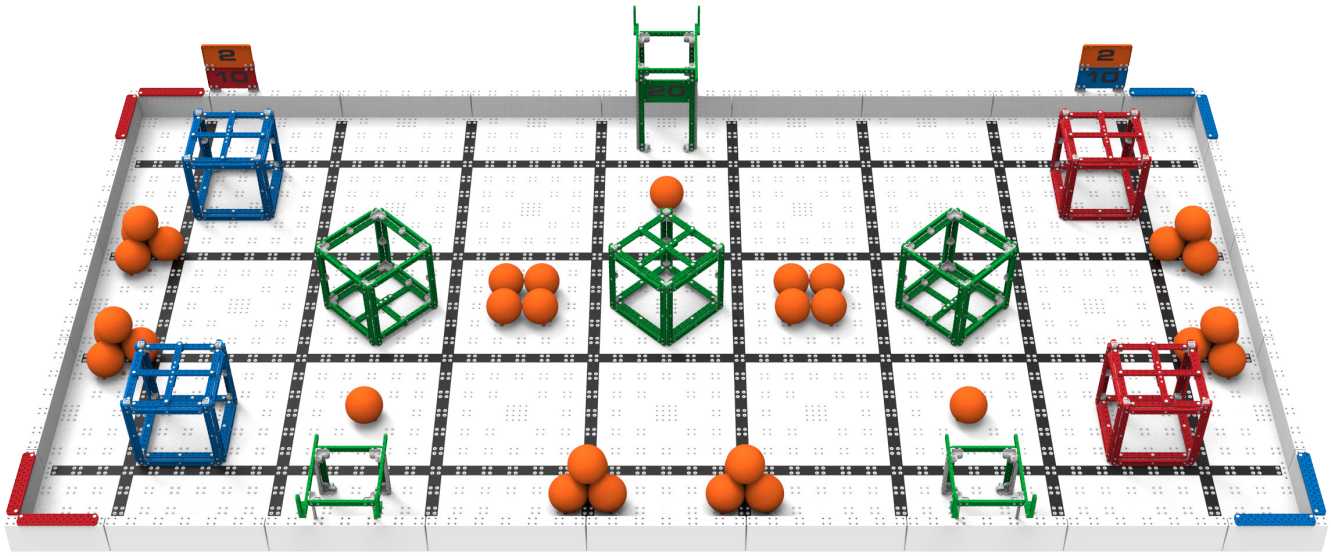

Figure 1: *Starting configuration of the field for a VEX IQ Challenge Squared Away Match.*

Each VEX IQ Challenge Squared Away *Match* includes the following:

- Thirty-five (35) *Balls*
- Seven (7) *Cubes*
  - Two (2) red *Cubes*
  - Two (2) blue *Cubes*
  - Three (3) green *Cubes*
- Four (4) *Corner Goals*
  - Two (2) red *Corner Goals*
  - Two (2) blue *Corner Goals*
- Three (3) green *Platforms*

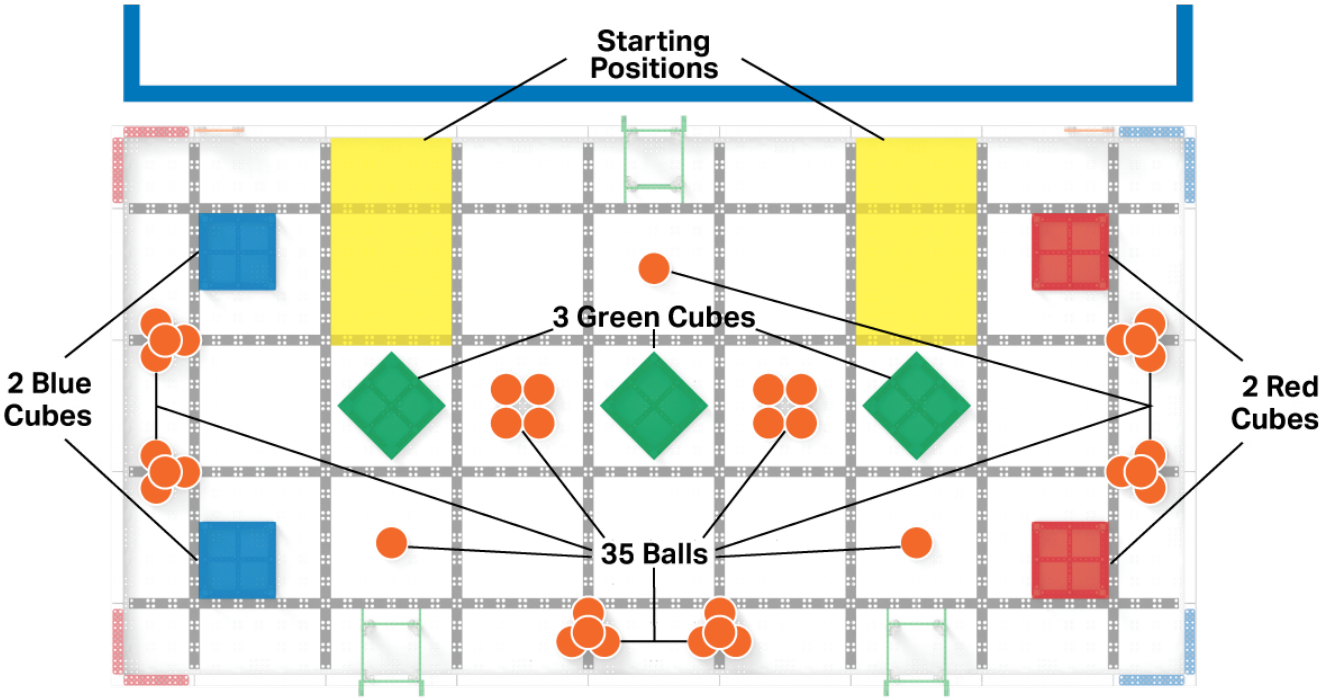

Figure 2: *Overhead view of the Field. The* ***Starting Positions****,* ***Cubes****, and* ***Balls*** *are all highlighted.*

Game Definitions

Alliance - A pre-assigned grouping of two (2) *Teams* that are paired together during a given *Teamwork Match*.

Alliance Score - Points scored in a *Teamwork Match* awarded to both *Teams*.

Autonomous - A *Robot* that is operating and reacting only to sensor inputs and to commands pre-programmed by the *Students* into the *Robot* control system. The *Robot* is operating without input from a VEX IQ Controller.

Ball – An orange spherical shaped plastic object with diameter of approximately 3" (76.2mm).

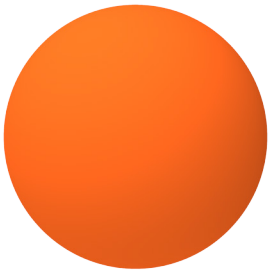

***Figure 3**: A Squared Away Ball.*

Corner Goal – One of the four 6" square goals located in the corners of the *Floor* that are used to *Score Cubes*. The inside edges of the black lines surrounding the *Corner Goal* mark the outer edges of the goal. The *Corner Goal* is defined as this portion of the *Floor*, not the 3-dimensional volume above it. The field perimeter and black lines are not considered part of the *Corner Goal*.

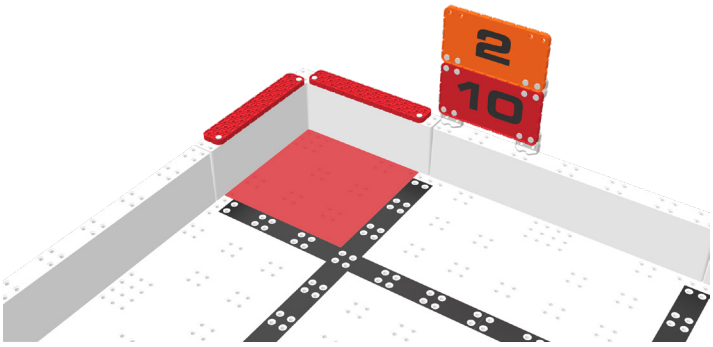

***Figure 4**: A red Corner Goal.*

Cube – A red, green, or blue cube-shaped object built out of VEX IQ parts with dimensions of approximately 7" (177.8mm).

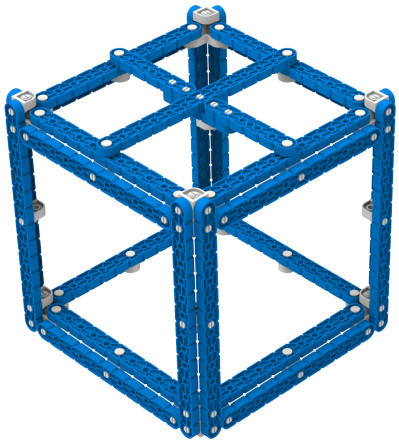

***Figure 5**: A blue Cube.*

Disablement - A penalty applied to a *Team* for a rule violation. During *Disablement*, a *Team* is no longer allowed to operate their *Robot*, and the *Drivers* will be asked to place their VEX IQ Controller on the ground. A *Disablement* is not the same as a *Disqualification*.

Disqualification - A penalty applied to a *Team* for a rule violation (see <T9> for more details). If a *Team* is *Disqualified* in a *Match*, the *Head Referee* should notify the *Team* of their violation at the end of the *Match*. At the *Head Referee*'s discretion, repeated violations and *Disqualifications* for a single *Team* may lead to its *Disqualification* for the entire event.

Driver - A *Student Team* member who stands in the *Driver Station* and is responsible for operating and controlling that *Team*'s *Robot*. Up to two *Team* members may fulfill this role in a given *Match* (see <G6>).

Driver Controlled - A *Robot* operating under the control of a *Driver*.

Driver Station - The region behind the *Field*, where the *Drivers* must remain during the *Match* unless legally interacting with their *Robot*.

Field - The entire playing field, including the field perimeter and field tiles.

Field Element - The field perimeter, *Floors*, *Platforms*, and any other supporting structures or VEX IQ elements attached to the *Field*.

Floor – The interior part of the playing field that is within the field perimeter.

Game Object - A *Cube* or a *Ball*.

Match - A *Driving Skills Match*, *Programming Skills Match*, or *Teamwork Match*.

Driving Skills Match - A *Driver Controlled* period that is sixty seconds (1:00) long with only one (1) *Robot* on the *Field*.

Programming Skills Match - An *Autonomous* period that is sixty seconds (1:00) long with only one (1) *Robot* on the *Field*.

Skills Match - A *Driving Skills Match* or *Programming Skills Match*.

Teamwork Match - A *Driver Controlled* period that is sixty seconds (1:00) long with one (1) *Alliance* on the *Field*.

Platform - One of three (3) green and white structures built out of VEX IQ parts, approximately 5" (127.0mm) or 9.5" (241.3mm) tall, that are used for *Scoring Cubes*.

Robot - Anything that has passed inspection that a *Team* places on the *Field* prior to the start of a *Match*.

Scored - A *Game Object* is *Scored* if it satisfies one of the following conditions, and is not touching a *Robot*.

a. **A Ball is Scored inside of a Cube** if it meets the following criteria:
   i. The *Ball* is at least partially within the three-dimensional volume defined by the outer edges of the *Cube*'s structure.
   ii. The *Ball* is not contacting the *Floor* "outside" of the *Cube*. The portion of the *Floor* which is "outside" of the *Cube* is roughly defined as a vertical projection of the *Cube* onto the *Floor* beneath the *Cube*, regardless of the *Cube*'s orientation.

Teams may encounter other *Ball*/*Cube* states than the examples depicted in the figures below. In these cases, as long as *Ball* satisfies criteria "a" and does not clearly violate criteria "b", then the *Ball* should generally be considered *Scored* inside of a *Cube*. *Teams* will be given the "benefit of the doubt" in these judgment calls, as *Head Referees* will not be expected or required to define a perfectly rigid imaginary vertical projection or check minute measurements.

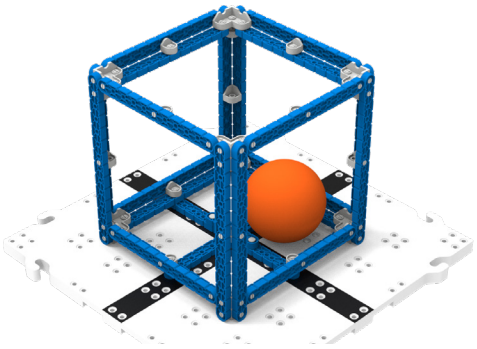

Figure 6: *A Ball Scored inside of a Cube.*

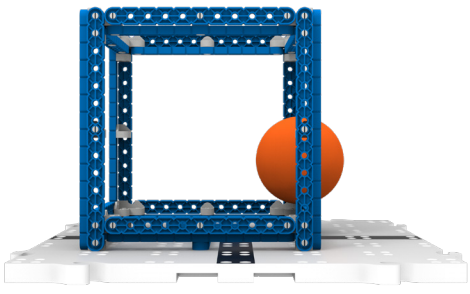

Figure 7*: A Ball Scored inside a Cube.*

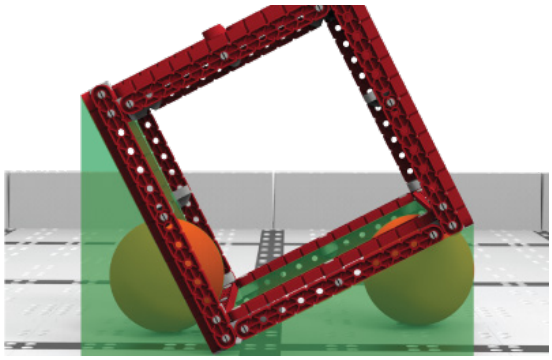

***Figure 8**: Two Balls Scored inside a Cube.*

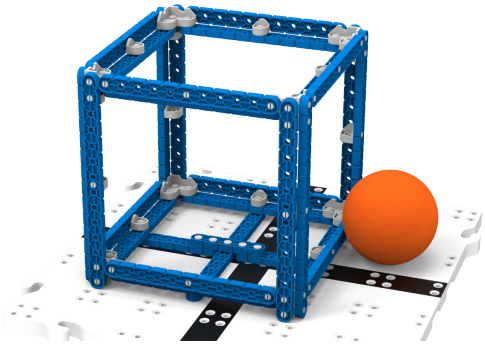

***Figure 9**: A Ball that is touching the Floor outside a Cube and is therefore not Scored.*

b. **A Ball is Scored on top of a Cube** if it meets the following criteria:
   i. The *Ball* is at least partially above the side of the *Cube* with cross-beams.
      1. The side of the *Cube* with cross-beams is the side which is furthest away from (and roughly parallel to) the *Floor*.
   ii. The *Ball* is not contacting the *Floor*.
   iii. The *Ball* is at least partially within the three-dimensional area defined by the infinite vertical projection of a *Cube* when it is placed normal to the *Floor*.

Note: If a *Ball* meets the criteria for both "inside" and "on top of" a *Cube* (i.e. criteria a and b), then it counts as being on top of a *Cube* (i.e. criteria b).

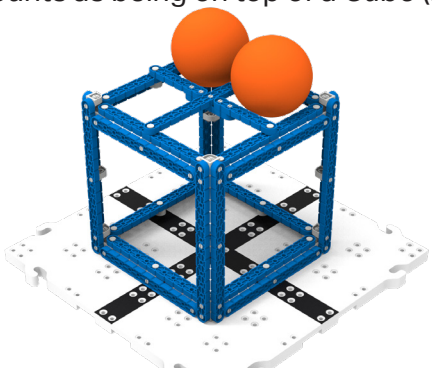

***Figure 10**: Two Balls Scored on top of a Cube.*

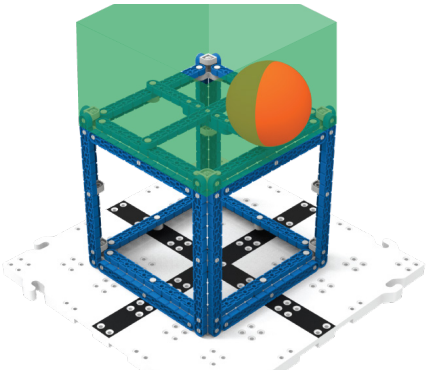

***Figure 11**: One Ball partially within the infinite vertical projection of a Cube.*

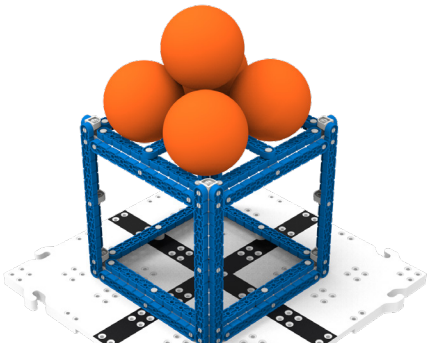

***Figure 12**: Five Balls Scored on top of a Cube.*

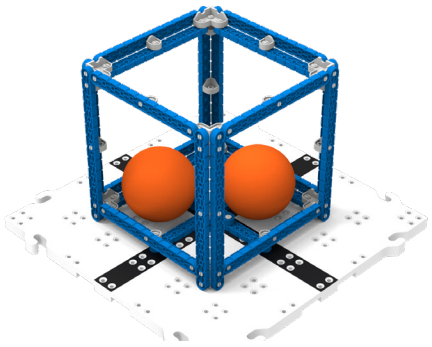

***Figure 13**: These two Balls are above the cross-beams of the Cube, but the cross-beams are not furthest away from the Floor. These two Balls are therefore Scored, but only inside a Cube.*

c. **A Cube is Scored in a Corner Goal** if any part of it is contacting a *Corner Goal* of the same color as the *Cube*. See the definition of *Corner Goal* for specific details.

Note: A maximum of one (1) *Cube* may count for points per *Corner Goal*.

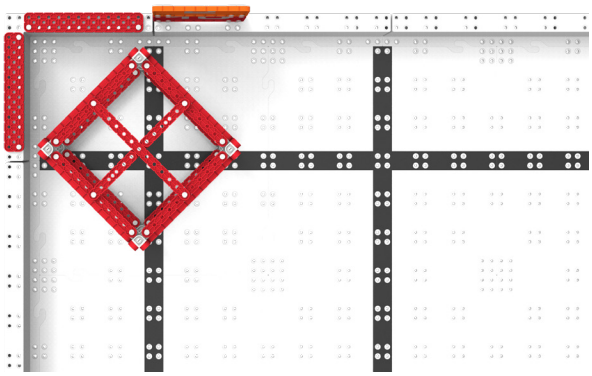

***Figure 14**: A red Cube Scored in a Corner Goal.*

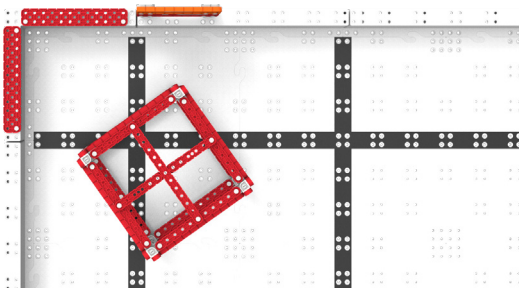

***Figure 15**: A Cube Scored in a Corner Goal.*

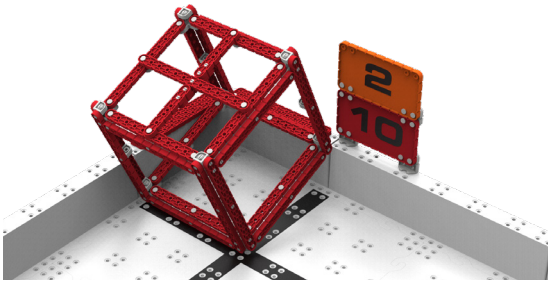

***Figure 16**: A Cube that is not touching a Corner Goal and is therefore not Scored.*

d. **A Cube is Scored on a Platform** if it meets the following criteria:
   i. The *Cube* is contacting the *Platform* (including its supporting structures).
   ii. The *Cube* is not contacting the *Floor*.
   iii. The *Cube* is not contacting the Field Perimeter.
   iv. The *Cube* matches the color of the *Platform* (i.e. is a green *Cube*).

Note: A maximum of one (1) *Cube* may count for points per *Platform*.

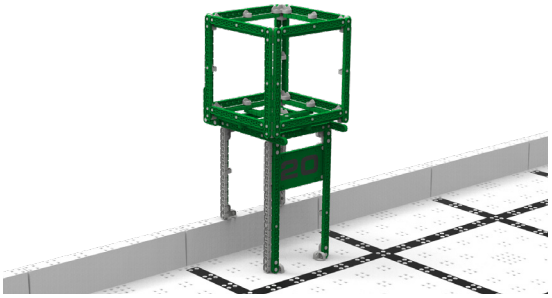

***Figure 17**: A Cube Scored on a Platform.*

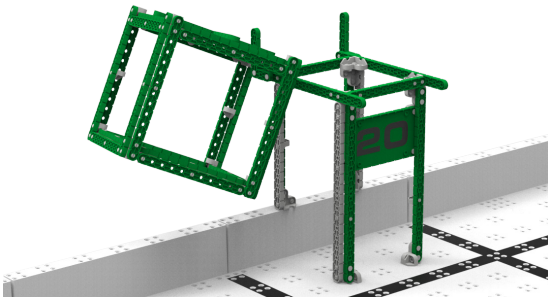

***Figure 18**: A green Cube contacting a Platform and not contacting the Floor or the Field Perimeter; therefore, it is Scored.*

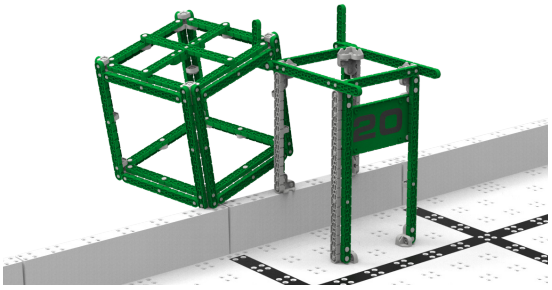

***Figure 19**: A green Cube contacting the Field Perimeter, therefore it is not Scored..*

Starting Position - The two (2) designated 11" x 19" (279mm x 482.6mm) spots on the field where *Robots* must start the *Match*. *Starting Positions* are bounded by the inner edges of the long black lines, outer edge of the short black line, and the inner edge of the field perimeter. See Figure 2 for more details.

Student - Anyone born after May 1, 2004 (i.e. who will be 15 or younger at VEX Worlds 2020). Eligibility may also be granted based on a disability that has delayed education by at least one year. *Students* are the individuals who design, build, repair, and program the *Robot* with minimal adult assistance.

- **Elementary School Student** - Any *Student* born after May 1, 2007 (i.e. who will be 12 or younger at VEX Worlds 2020). *Elementary School Students* may "play up" and compete as a *Middle School Student*.
- **Middle School Student** - Any eligible *Student* that is not an *Elementary School Student*.

Team - Two or more *Students* make up a *Team*. A *Team* is classified as an **Elementary School Team** if all members are *Elementary School Students*. A *Team* is classified as a **Middle School Team** if any members are *Middle School Students*, or made up of *Elementary School Students* who declare themselves "playing up" as *Middle School Students* by registering their team as a **Middle School Team**. Once declared and playing as a **Middle School Team**, that team may not change back to an **Elementary School Team** for the remainder of the season. *Teams* may be associated with schools, community/youth organizations, or a group of neighborhood *Students*.

Scoring

- A *Ball* that is *Scored* in a *Cube* is worth one (1) point.

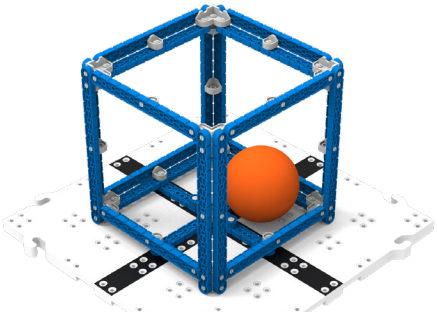

***Figure 20**: A Ball Scored in a Cube*

- A *Ball* that is *Scored* on a *Cube* is worth two (2) points.

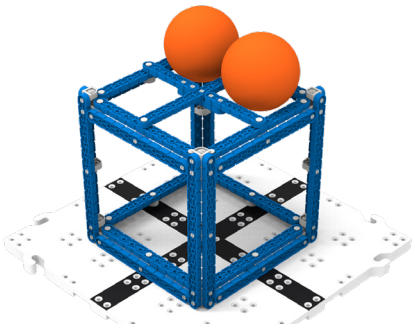

***Figure 21**: A Ball Scored on a Cube*

- A *Cube* that is *Scored* in a *Corner Goal* is worth ten (10) points.

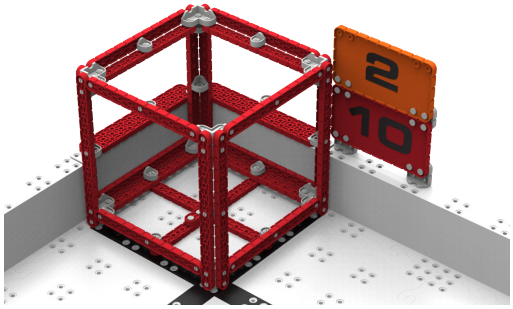

***Figure 22**: A Cube Scored in a Corner Goal*

- A *Cube* that is *Scored* on a *Platform* is worth twenty (20) points.

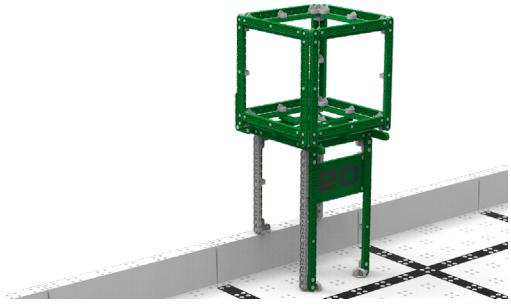

***Figure 23**: A Cube Scored on a Platform*

Safety Rules

<S1> Stay safe, don't damage the Field. If, at any time, the Robot operation or Team actions are deemed unsafe or have damaged any Field Elements or Scoring Objects, the offending team may be *Disabled* and/or *Disqualified* at the *Head Referee*'s discretion. The *Robot* will require re-inspection before it may again take the *Field*, per <R2e>.

Game Rules

<G1> Treat everyone with respect. All *Students* and adults associated with a *Team* are expected to conduct themselves in a respectful and positive manner while participating in the VEX IQ Challenge. If *Team* members are disrespectful or uncivil to staff, volunteers, or fellow *Teams* at an event, the *Team* may be *Disqualified* from their current or upcoming *Match*. Judges may also consider team conduct and ethics when determining awards.

In all aspects of the VEX IQ Challenge program, the *Students* make the decisions and do the work with adult mentorship. The VEX community prides itself on being a positive learning environment where no one is bullied, harassed, or berated. *Teams* avoid placing unnecessary stress upon *Students* and/or event volunteers; instead, challenging situations are viewed as teachable moments to model positive behaviors and good sportsmanship.

This rule exists alongside the REC Foundation Code of Conduct. Violation of the Code of Conduct can be considered a violation of *<G1>* and can result in *Disqualification* from a current *Match*, an upcoming *Match*, an entire event, or (in extreme cases) an entire competition season. The Code of Conduct can be found at http://link.roboticseducation.org/recf_codeofconduct.

<G2> VEX IQ is a student-centered program. Adults may assist *Students* in urgent situations, but adults should never work on or program a *Robot* without *Students* on that *Team* being present and actively participating. *Students* should be prepared to demonstrate an active understanding of their *Robot*'s construction and programming to judges or event staff.

Some amount of adult mentorship, teaching, and/or guidance is an expected and encouraged facet of the VEX IQ Challenge. No one is born an expert in robotics! However, obstacles should always be viewed as teaching opportunities, not tasks for an adult to solve without *Students* present and actively participating. Violation of this rule could be considered a violation of <G1> and/or the REC Foundation Code of Conduct.

When a mechanism falls off, it is…
…okay for an adult to help a *Student* investigate why it failed, so it can be improved.
…not okay for an adult to put the *Robot* back together.

When a *Team* encounters a complex programming concept, it is…
…okay for an adult to guide a *Student* through a flowchart to understand its logic.
…not okay for an adult to write a pre-made command for that *Student* to copy/paste.

During *Match* play, it is…
…okay for an adult to provide cheerful, positive encouragement as a spectator.
…not okay for an adult to explicitly shout step-by-step commands from the audience.

<G3> Use common sense. When reading and applying the various rules in this document, please remember that common sense always applies in the VEX IQ Challenge.

<G4> Pre-match setup. At the beginning of a *Match*, each *Robot* must meet the following criteria:

a. Only be contacting the *Floor* and/or *Field Perimeter*.
b. Fit within an 11" x 19" (279.4mm x 482.6mm) area, bounded by the *Starting Position*.
c. Be no taller than 15" from the *Floor*.

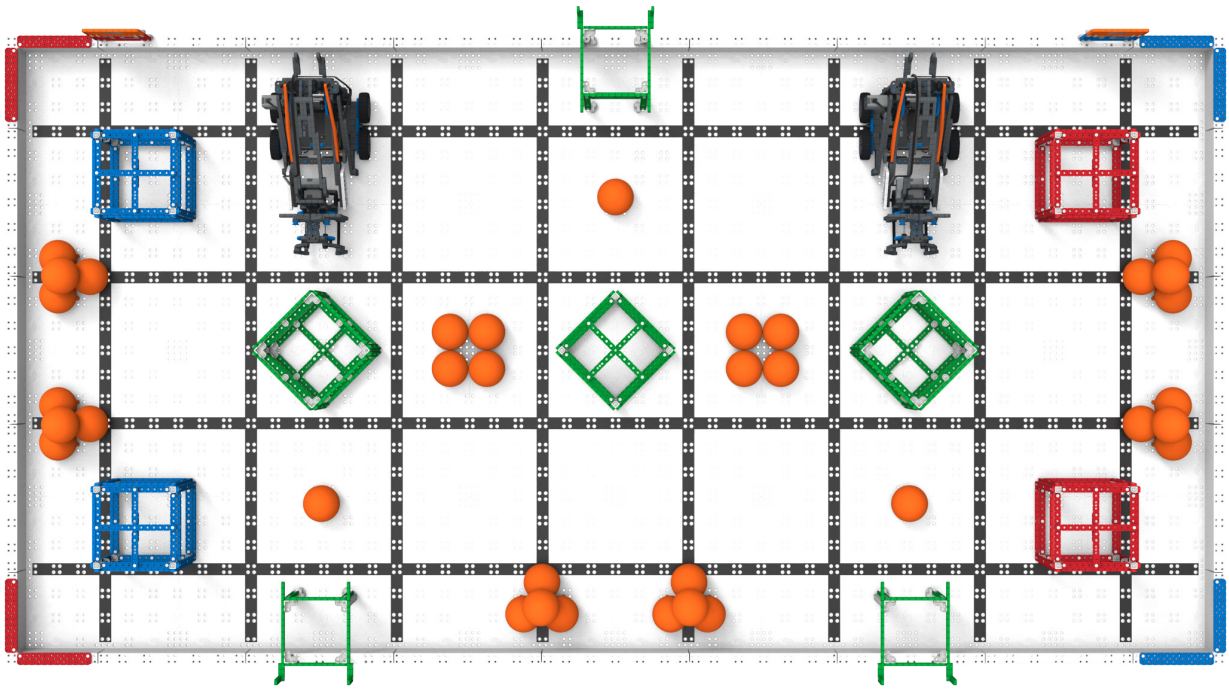

***Figure 24**: Two Robots in a legal Match starting configuration.*

An offending *Robot* will be removed from the *Match* at the *Head Referee*'s discretion. They will not receive a *Disqualification*, but they will not be permitted to play in the *Match*.

Note: *Robots* must be placed on the *Field* promptly. Repeated failure to do so could result in a violation of <G1>.

The exact definition of the term "promptly" is at the discretion of the *Head Referee* and the *Event Partner*, who will consider event schedule, previous warnings or delays, etc.

<G5> Expansion is limited during a Match. During the *Match*, *Robots* may not expand beyond the following restrictions:

a. Horizontally, beyond an 11" x 19" (279.4mm x 482.6mm) area.
b. Vertically, beyond the 15" (381mm) high starting requirement.

This expansion limit does not require that the *Robot* stay in the same configuration as it was when it began the *Match*. It simply means that, at any given moment during the *Match*, it should be able to fit within an 11" x 19" x 15" (279.4mm x 482.6mm x 381mm) rectangle. See <R5> for more details.

Violations of this rule will result in a warning for minor offenses that do not affect the *Match*. Major and/or *score* affecting offenses will result in a *Disqualification*. *Teams* who receive multiple warnings, or who are unable to easily remedy the violation, may also receive a *Disqualification* at the *Head Referee*'s discretion. <R2e> would then apply, and Robots may need to be re-inspected for compliance with <R5>.

<G6> Two Drivers per Team. Each Team shall include two Drivers. No Driver may fulfill this role for more than one Team at any given event, or in a given season. Teams with only one Student in attendance at an event are granted an allowance to use another qualified Driver from the event. That Driver may now only drive for the team the Driver is subsuming in for, for the duration of the event.

When a team qualifies for a Championship event (e.g., States, Nationals, Worlds, etc.) the Students on the team attending the Championship event are expected to be the Students on the Team that were awarded the spot. Students can be added as support to the team but should not be added as drive-team members or programmers for the team.

An exception is allowed if one (1) Student on the drive team or a programmer on the Team cannot attend the event. The team can make a single substitution of a drive team member or programmer for the Championship event with another Student, even if that Student has competed on a different team. This Student will now be on this new team and may not substitute back to the original team.

Violations of this rule will be reviewed by the REC Foundation and may result in one or both teams being disqualified for the event or the remainder of the season with all trophies and awards won that season being nullified.

<G7> Drivers switch Controllers midway through the Match. In a given *Match*, no *Driver* shall operate a *Robot* for more than thirty-five (0:35) seconds. The two *Drivers* must switch their controller between twenty-five (0:25) seconds and thirty-five (0:35) seconds remaining in the *Match*. The second *Driver* may not touch his/her *Team*'s controls until the controller is passed to him/her. Once the controller is passed, the first *Driver* may no longer touch his/her *Team*'s controls.

> Note: If only one *Driver* is present (i.e. the *Team* has not exercised the allowance in <G6>), this rule still applies, and they must cease *Robot* operation after thirty-five (0:35) seconds.

Violations of this rule will result in a warning for minor offenses that do not affect the *Match*. Score affecting offenses will result in a *Disqualification*. *Teams* who receive multiple warnings may also receive a *Disqualification* at the *Head Referee*'s discretion.

<G8> Drivers drive your Robot, and stay in the Driver Station. During a *Match*, *Robots* may only be operated by that *Team*'s *Drivers*. *Drivers* must remain in their *Driver Station*, except when legally interacting with their *Robot* as per <G17>. *Drivers* are not allowed to use any communication devices during their *Match*. Devices with communication features turned off (e.g. a phone in airplane mode) are allowed.

<G9> Hands out of the Field. *Drivers* are prohibited from making intentional contact with any *Field Element*, *Game Object*, or *Robot* during a *Match*, except for the allowances in <G17>.

Violations of this rule will result in a warning for minor offenses that do not affect the *Match*. Score affecting offenses will result in a *Disqualification*. *Teams* who receive multiple warnings may also receive a *Disqualification* at the *Head Referee*'s discretion.

Note: Accidental contact may result in a warning, *Disqualification*, or *Disablement* at the *Head Referee*'s discretion.

<G10> Keep Game Objects in the Field. *Game Objects* that leave the *Field* during a *Match* will not be returned. "Leaving the Field" means that a *Game Object* is outside of the vertical projection of the Field Perimeter and no longer in contact with the *Field*, *Field Elements*, other *Game Objects*, or *Robots*.

If a *Game Object* is on its way out of the *Field* (as determined by the *Head Referee*), but is deflected back into the field by a *Driver*, field monitor, ceiling/wall, or other external factor, <G9> would apply. This *Game Object* should be considered "out of the field" and removed by the *Head Referee*.

If the redirection occurred due to contact with a *Driver*, it will be at the *Head Referee*'s discretion whether <G9> or <G10> should apply.

<G11> When it's over, it's over. Scores will be calculated for all *Matches* immediately after the *Match* is complete, and once all *Robots* and *Game Objects* on the *Field* come to rest.

a. *Head Referees* or other event staff are not allowed to review any videos or pictures from the *Match*, per <T1>.
b. If there is a concern regarding the score of a *Match*, only the *Drivers* from that *Match*, not an adult, may share their questions with the *Head Referee*.
c. This rule's intent is for *Driver* inputs and *Robot* motion to cease at the end of the *Match*. A pre-programmed routine which causes *Robot* motion to continue after the end of the *Match* would violate the spirit of this rule. Any scoring which takes place after the *Match* due to *Robots* continuing to move will not count.

<G12> Keep your Robot together. *Robots* may not intentionally detach parts or leave mechanisms on the *Field* during any *Match*. If an intentionally detached component or mechanism affects gameplay, the *Team* may be *Disqualified* at the *Head Referee*'s discretion.

Note: Parts that become unintentionally detached from the *Robot* are no longer considered to be part of the *Robot* and can be either left on the *Field*, or collected by a *Driver* (utilizing <G17>).

<G13> Don't damage the Field or Game Objects. *Robots* may not grasp, grapple, or attach to any *Field Elements*, including the *Platforms*. Strategies with mechanisms that react against multiple sides of a *Field Element* in an effort to latch or clamp onto said *Field Element* are prohibited.

While *Robots* are permitted to grasp, grapple, or attach to *Game Objects*, *Robots* which cause damage to *Game Objects* would be considered in violation of this rule and/or <S1>.

The intent of this rule is to prevent *Robots* from unintentionally damaging the *Field* or *Game Objects*. Minor violations of this *rule* that do not affect the *Match* will result in a warning. Score affecting offenses will result in a *Disqualification*. *Teams* that receive multiple warnings may also receive a *Disqualification* at the *Head Referee*'s discretion.

The key words in this rule are "clamping" or "anchoring". Bumping into a *Platform* while *Scoring*, or using *Field Elements* for alignment, are both fine.

<G14> Let go of Game Objects after the Match is over. *Robots* must be designed to permit easy removal of *Cubes* and *Balls* from their *Robot* without requiring that the *Robot* have power or remote control after the *Match* is over.

<G15> Be prepared for minor field variance. *Field* tolerances may vary by as much as ±1" unless otherwise specified. *Teams* must design *Robots* accordingly.

<G16> Replays are allowed, but rare. *Match* replays are at the discretion of the *Event Partner* and *Head Referee*, and will only be issued in the most extreme circumstances.

<G17> Handling the Robot mid-match is allowed under certain circumstances. If a *Robot* goes completely outside the playing *Field*, gets stuck, tips over, or otherwise requires assistance, the *Team*'s *Drivers* may retrieve & reset the *Robot*. To do so, they must:

a. Signal the *Head Referee* by placing their VEX IQ Controller on the ground.
b. Move the *Robot* to any legal *Starting Position*.
c. Any *Game Object* being controlled by the *Robot* while being handled must be removed from the *Robot* and gently placed in a non-*Scored* position by the *Team*.
d. Any *Game Objects* in the *Starting Position* may be moved out of the *Starting Position* and gently placed into a non-*Scored* position by the *Team*.

This rule is intended so *Teams* can fix damaged *Robots* or help get their *Robots* "out of trouble." It is not intended for *Teams* to use as part of a strategy to gain an advantage during a *Match*, including via moving *Game Objects* per parts c and d above. If a *Head Referee* sees *Teams* strategically exploiting this rule, they may be *Disqualified* from said *Match*.

<G18> This manual will have three scheduled updates. All rules in this manual are subject to changes, and not considered official until August 16th, 2019. There will also be scheduled manual updates on June 14th, 2019 and April 10th, 2020. While we do not expect there to be major changes outside of these scheduled updates, *Teams* are strongly encouraged to review the Q&A system for rule updates and clarifications.

The Game Design Committee reserves the right to make changes to this manual in the April 10th, 2020 release specifically for the VEX Robotics World Championship. One specific item that will be considered for changes is the number of *Game Objects* on the *Field*.

<G19> The Q&A system is an extension of this Game Manual. All *Teams* must adhere to all VEX IQ Challenge Rules as they are written and must abide by the stated intent of the rules. Every *Team* has the opportunity to ask for official rules interpretations in the VEX IQ Challenge Question & Answer System.

All responses in this Q&A system should be treated as official rulings from the VEX IQ Challenge Game Design Committee, and they represent the correct and official interpretation of the VEX IQ Challenge Rules. The Q&A system is the only source for official rulings and clarifications.

Previous Definitions, Rules and Rulings found in documents and Q&A's from previous seasons do not apply to the current game. If clarification is needed, the question should be asked on the current Q&A.

The VEX IQ Challenge Question & Answer System can be found at https://www.robotevents.com/VIQC/2019-2020/QA.

Section 2
The Robot

Description

Every *Robot* will be required to pass a full inspection before being cleared to participate in the VEX IQ Challenge. This inspection will ensure that all *Robot* rules and regulations are met. Initial inspections will typically take place during team registration/practice time. Every *Team* should use the rules below as a guide to pre-inspect their *Robot* and ensure that it meets all requirements.

Robot Rules

<R1> Robots must pass inspection. The *Team*'s *Robot* must pass inspection before being allowed to participate in any *Matches*. Noncompliance with any *Robot* design or construction rule may result in Disqualification of the *Robot* at an event.

a. If significant changes are made to a *Robot*, it must be re-inspected before it will be allowed to participate in a *Match*.
b. If a *Robot* has multiple functional configurations, all possible configurations must be inspected before being used in competition.
c. *Teams* may be requested to submit to random inspections by event personnel during the event. Refusal to submit will result in *Disqualification*.
d. Referees or inspectors may decide that a *Robot* is in violation of the rules. In this case, the *Team* in violation will be *Disqualified* and the *Robot* will be barred from the *Field* until it passes re-inspection.

<R2> One Robot per Team. Only one (1) *Robot* will be allowed to participate per *Team* in the VEX IQ Challenge. Though it is expected that *Teams* will make changes to their *Robot* at the event, a *Team* is limited to only one (1) *Robot*, and a given *Robot* may only be used by (1) *Team*. The VEX IQ system is intended to be a mobile robotics design platform. As such, a VEX IQ Challenge *Robot*, for the purposes of the VEX IQ Challenge, has the following subsystems:

Subsystem 1: Mobile robotic base including wheels, tracks, or any other mechanism that allows the *Robot* to navigate the majority of the flat playing *Field* surface. For a stationary *Robot*, the robotic base without wheels would be considered Subsystem 1.
Subsystem 2: Power and control system that includes a VEX IQ legal battery, a VEX IQ control system, and associated Smart Motors for the mobile robotic base.
Subsystem 3: Additional mechanisms (and associated Smart Motors) that allow manipulation of *Game Objects* or navigation of *Field* obstacles.

Given the above definitions, a minimum *Robot* for use in any VEX IQ Challenge event (including *Robot Skills Challenges*) must consist of subsystem 1 and 2 above. Thus, if you are swapping out an entire subsystem of either item 1 or 2, you have now created a second *Robot* and are no longer legal.

a. Teams may not participate with one *Robot* while a second is being modified or assembled.
b. Teams may not switch between multiple *Robots*. This includes using different *Robots* for *Robot Skills Challenge Matches*, *Qualifying Matches*, and/or *Finals Matches*.
c. Multiple *Teams* may not use the same *Robot* during a competition or season. Once a *Robot* has competed under a given *Team* number at an event, it is "their" *Robot* - no other *Teams* may compete with it for the duration of the competition season.

d. *Robots* which have not passed inspection (i.e. who are in violation of one or more *Robot* rules) will not be permitted to play in any *Matches* until they have done so. <T8> will apply to any *Matches* that occur until the *Robot* has passed inspection.
e. If a *Robot* has passed inspection, but is later found to be in violation of a *Robot* rule during a *Match*, then they will be *Disqualified* from that *Match* and <R2d> will apply until the violation is remedied and the *Team* is re-inspected.

The intent of <R2a>, <R2b>, and <R2c> are to ensure an unambiguous level playing field for all *Teams*. *Teams* are welcome (and encouraged) to improve or modify their *Robots* between events, or to collaborate with other *Teams* to develop the best possible game solution.

However, a *Team* who brings and/or competes with two separate *Robots* at the same tournament has diminished the efforts of a *Team* who spent extra design time making sure that their one *Robot* can accomplish all of the game's tasks. A multi-*Team* organization that shares a single *Robot* has diminished the efforts of a multi-*Team* organization who puts in the time, effort, and resources to undergo separate individual design processes and develop their own *Robots*.

To help determine if a *Robot* is a "separate robot" or not, use the Subsystem definitions found in <R2>. Above that, use common sense as referenced in <G2>. If you can place two complete and legal *Robots* on a table next to each other, then they are two separate *Robots*. Trying to decide if changing a pin, a wheel, or a motor constitutes a separate *Robot* is missing the intent and spirit of this rule.

<R3> Only registered Teams may compete in the VEX IQ Challenge. To participate in an official VEX IQ Challenge Event, a *Team* must first register on robotevents.com. Upon registering they will receive their VEX IQ Challenge *Team* Number and two (2) VEX IQ Challenge License Plates. Every *Robot* should have their VEX IQ Challenge License Plates displayed on two opposing sides with their VEX IQ Challenge Team Number clearly written or printed upon it.

a. License Plates must fulfill all *Robot* rules.
b. License Plates must be clearly visible at all times. For example, License Plates must not be in a position that would be easily obstructed by a *Robot* mechanism during standard *Match* play.

Figure 25: *A VEX IQ Challenge License Plate with a VEX IQ Challenge Team Number written upon it.*

<R4> Robots must fit in the sizing box. At the start of each *Match*, the *Robot* must be able to satisfy the following constraints:

a. Only be contacting the *Floor* and/or the *Field* Perimeter.
b. Fit within an 11" x 19" (279.4mm x 482.6mm) area, bounded by the *Starting Position*.
c. Be no taller than 15" from the *Floor*.

This rule works in conjunction with <G4>. <R4> is an "inspection rule", meaning that a *Robot* may not

pass inspection if it cannot satisfy these constraints. However, <G4> is a "game rule", meaning that even if a *Robot* passed <R4> in inspection (i.e. it is theoretically capable of satisfying the constraints), *Head Referees* will still be watching for it before each *Match*.

<R5> Max Robot size is 11" x 19". *Robots* must be demonstrably able to comply with the expansion rules set forth by <G5>.

a. A *Robot* may not expand beyond an 11" x 19" horizontal area any at any point during the *Match*. This limit includes the full range of motion by any appendages. For example, an arm that extends out of these constraints while operating during the *Match* would make the *Robot* illegal.

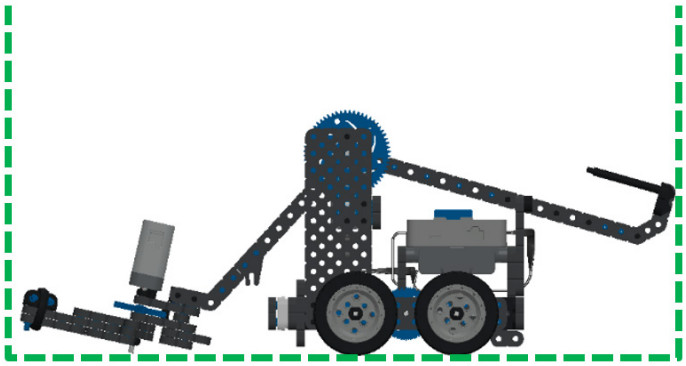

Figure 26: *A Robot which starts the Match with the legal size constraints.*

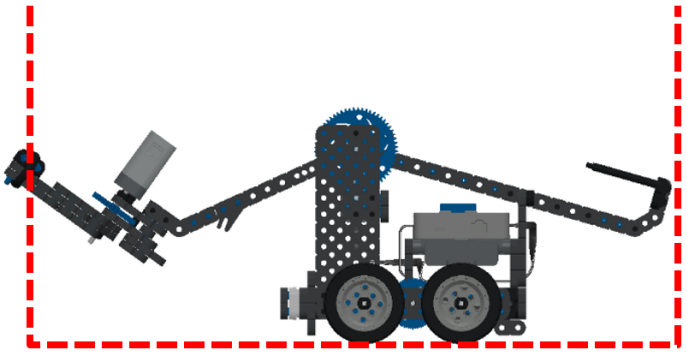

Figure 27: *The Robot from Figure 26 which has expanded outside of the legal size constraints.*

Note: The 11" x 19" horizontal limit is not restricted to the same configuration or relative position to the *Robot* as it was at the beginning of the *Match*, in its 11" x 19" *Starting Position*. For example, a *Robot* with mechanisms that can extend out of opposite sides of the *Robot* would be legal, so long as the *Robot* never exceeds 11" x 19" at any point during the *Match*. Teams who have the potential to violate this rule should be prepared to demonstrate how they will limit this motion during a *Match*.

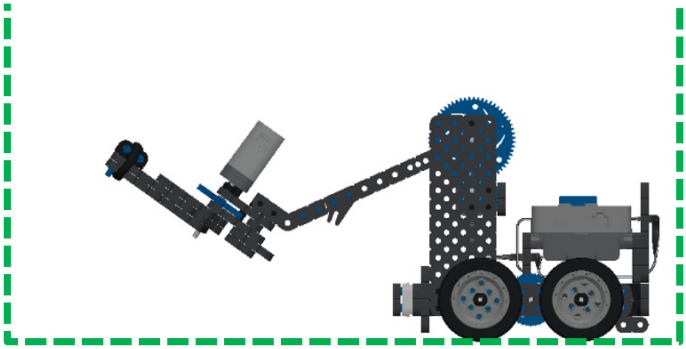

Figure 28: *A Robot with a mechanism that can extend in multiple directions.*

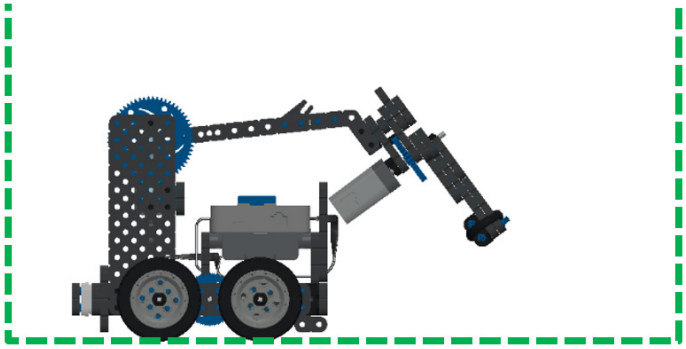

Figure 29: *The Robot from Figure 28 which never exceeds the maximum size constraint as the mechanism moves.*

b. A *Robot* may not expand beyond a 15" (381mm) vertical limit at any point during the *Match*.

Teams are advised to bear these constraints in mind and develop solutions which eliminate any mechanical risk of a violation. However, using sensors and/or programming to keep a Robot within these constraints would also be within the spirit of this rule.

<R6> Robot starting configuration is the same as inspection configuration. The starting configuration of a *Robot* at the beginning of a *Match* must be the same as the *Robot* configuration that was inspected for compliance, and within the maximum allowed size.

a. *Teams* using more than one *Robot* configuration at the beginning of *Matches* must tell the inspector(s) and have the *Robot* inspected in its largest configuration(s).
b. A *Team* may NOT have its *Robot* inspected in one configuration and then place it in an uninspected configuration at the start of a *Match*.

<R7> VEX IQ parts only. *Robots* may be built ONLY from official robotic components from the VEX IQ product line, unless otherwise specifically noted within these rules.

a. Official VEX IQ products are ONLY available from VEX Robotics & official VEX Resellers. To determine whether a product is "official" or not, consult www.vexiq.com.
b. If an inspector or other event official questions whether something is an official VEX IQ component, the *Team* will be required to provide documentation to an Inspector that proves the component's source. Such types of documentation could include receipts, part numbers, or other printed documentation.
c. Only the VEX IQ components specifically designed for use in *Robot* construction are allowed. Using additional components outside their typical purpose is against the intent of the rule (i.e. please don't try using VEX IQ apparel, team or event support materials, packaging, *Field Elements*, that are not listed in the Legal Parts Appendix or other non-robot products on a VEX IQ Challenge *Robot*).
d. Products from the VEX EDR or VEXpro product line cannot be used for *Robot* construction. Products from the VEX EDR product line that are also cross-listed as part of the VEX IQ product line are legal. A "cross-listed" product is one which can be found in both the VEX IQ and VEX EDR sections of the VEX Robotics website.
e. Mechanical/structural components from the VEX Robotics by HEXBUG product line are legal for *Robot* construction. However, electrical components from the VEX Robotics by HEXBUG product line are illegal for *Robot* construction.
f. Official components from the VEX IQ product line that have been discontinued are still legal for *Robot* use. If using a discontinued part, *Teams* must be cognizant of <R7a>.
g. 3D printed components, such as replicas of legal VEX IQ parts or custom designs, are not legal for *Robot* use.

Note: A comprehensive list of legal parts can be found in the VEX IQ Challenge Legal Parts Appendix, which will be released alongside the June 14th Game Manual Update (as noted in <G18>.

<R8> Some non-VEX items are permitted. *Robots* are allowed to use the following additional "non-VEX IQ" components:

a. Appropriate non-functional decorations, provided that these do not affect the *Robot* performance in any significant way or affect the outcome of the *Match*. These decorations must be in the spirit of the event. Inspectors will have the final say in what is considered "non-functional".
   i. Any decorations must be backed by legal materials that provide the same functionality (i.e. if your *Robot* has a giant decal that prevents *Game Objects* from falling out of the *Robot*, the decal must be backed by VEX IQ material that also prevents the *Game Objects* from falling out).
   ii. The use of non-toxic paint is considered a legal non-functional decoration. However, any paint being used as an adhesive or to impact how tightly parts fit together would be classified as functional.
b. Rubber bands that are identical in length and thickness to those included in the VEX IQ product line (#32 & #64).
c. ⅛" metal shafts from the VEX EDR product line.

<R9> Additional VEX IQ products that are released during the season are legal for use.
Some "new" components may have certain restrictions placed on them upon their release. These restrictions will be documented on their VEX IQ product webpage, or in the VEX IQ Legal Parts appendices.

<R10> One Brain per Robot. *Robots* are limited to one (1) VEX IQ Robot Brain.

a. Robot Brains, microcontrollers, or other electronic components that are part of the VEX Robotics by HEXBUG, VEX EDR, or VEXpro product lines are not allowed.
   i. The Robot AA Battery Holder (228-3493) is the only exception to this rule, per <R12>.
b. *Robots* must use one (1) VEX IQ 900 MHz radio, VEX IQ 2.4 GHz radio, or VEX IQ Smart Radio in conjunction with their VEX IQ Robot Brain.
c. The only legal method of driving the *Robot* during *Teamwork Matches* and *Driving Skills Matches* is the VEX IQ Controller.

<R11> Six motors per Robot. *Robots* may use up to six (6) VEX IQ Smart Motors.

a. Additional motors cannot be used on the *Robot* (even ones that aren't connected).

<R12> One battery pack per Robot. The only allowable sources of electrical power for a VEX IQ Challenge *Robot* is one (1) VEX IQ Robot Battery or six (6) AA batteries via the *Robot* AA Battery Holder (228-3493).

a. Additional batteries cannot be used on the *Robot* (even ones that aren't connected).
b. *Teams* are permitted to have an external power source (such as a rechargeable battery pack) plugged into their VEX IQ Controller during a *Match*, provided that this power source is connected safely and does not violate any other rules (such as <G7>).

<R13> Parts may NOT be modified.

a. Examples of modifications include, but are not limited to, bending, cutting, sanding, gluing, or melting.
b. Cutting metal VEX IQ or VEX EDR shafts to custom lengths is permitted. This is the only legal exception to this rule.

Teams should remember to prioritize student safety at all times if attempting to cut metal shafts. Adult assistance in the spirit of <G2> is a must-have, and sharp edges should be sanded or otherwise rounded off. Similarly, any use of power tools in a pit space while at an event must be discussed with the *Event Partner* in advance. Even if used in a safe capacity, there is still a possibility of violating venue / event rules, or causing alarm for nearby *Teams*. If used without significant regard for safety, it could be considered a violation of the REC Foundation Code of Conduct.

<R14> Robots may not be dangerous. The following types of mechanisms and components are NOT allowed:

a. Those that could potentially damage *Field Elements* or *Game Objects*.
b. Those that could potentially damage other *Robots*.
c. Those that pose an unnecessary risk of entanglement.

<R15> Inspection concludes when the form is signed. A *Robot* is deemed successfully inspected when it has been recorded as "passed" by an inspector and the inspection form has been signed by both the inspector and a *Student Team* member.

<R16> Robots are ready to play at the Field. *Teams* must be prepared to play when they bring their *Robots* to the *Field*. For example, *Teams* should ensure that their batteries are charged and their VEX IQ Controller is paired with their *Robot* before placing the *Robot* on the *Field*.

<R17> Keep the Robot up to date. *Teams* should make sure that their VEX IQ firmware (VEXos) is up to date. *Teams* can download the latest version of VEXos at https://link.vex.com/vexos.

Section 3
The Tournament

Description

The VEX IQ Challenge encompasses both the *Teamwork Challenge* and the *Robot Skills Challenge*. This section determines how the *Teamwork Challenge* and *Robot Skills Challenge* are to be played at a given event.

Awards may be given to top *Teams* in each format, as applicable. Awards may also be given for overall performance in the judged criteria. Please review the Awards Appendix for more details, available in the VEX IQ Challenge Squared Away section of www.vexrobotics.com or www.roboticseducation.org.

Tournament Definitions

Event Partner - The VEX IQ Challenge tournament coordinator who serves as an overall manager for the volunteers, venue, event materials, and all other event considerations. *Event Partners* serve as the official liaison between the REC Foundation, the event volunteers, and event attendees.

Finals Match – A *Teamwork Match* used to determine the *Teamwork Challenge* champions.

Head Referee - An impartial volunteer responsible for enforcing the rules in this manual as written. *Head Referees* are the only people who may discuss ruling interpretations or scoring questions with *Teams* at an event.

Match Stop Time – The time remaining (i.e. displayed on the timer or audience display) in a tiebreaker *Finals Match* when an *Alliance* ends the *Match* early by placing their controllers on the ground. The *Match Stop Time* is rounded down to the nearest even number. For example, if controllers are set down when the displayed time is 13 seconds, the *Match Stop Time* is recorded as 12 seconds. If an *Alliance* does not finish the *Match* early, they receive a default *Match Stop Time* of 0 seconds.

Practice Match – An un-scored *Match* used to provide time for teams to get acquainted with the official playing field.

Qualifying Match – A *Teamwork Match* used to determine the event rankings.

Robot Skills Challenge – A portion of the VEX IQ Challenge. The *Robot Skills Challenge* consists of *Driving Skills Matches* and *Programming Skills Matches*.

Teamwork Challenge – A portion of the VEX IQ Challenge. The *Teamwork Challenge* consists of *Teamwork Matches*. The *Teamwork Challenge* includes *Qualifying Matches* and *Finals Matches*, and may include *Practice Matches*.

Tournament Rules

<T1> Head Referees have ultimate authority during the event, including all three types of Matches. The Head Referees' rulings are final.

a. Referees and event staff are not allowed to review any photo or video *Match* recordings to settle disputes.
b. Referees will review the *Field* at the end of each *Match* and accurately record the game *Scored*. If there is a disagreement with the scoring, only the *Drivers*, not an adult, may share their questions or concerns with the *Head Referee*. Once the *Field* is cleared for the next *Match*, *Drivers* can no longer dispute the *Match score*.

<T2> During Teamwork Matches, two (2) Teams form an Alliance that will play on the Field.

a. Qualifying *Match Alliances* are randomly selected.
b. Finals *Match Alliances* are assigned as follows:
   i. The first and second ranked *Teams* form an *Alliance*
   ii. The third and fourth ranked *Teams* form an *Alliance*
   iii. And so on, until all *Teams* participating in Finals *Matches* have formed *Alliances*.

<T3> There are no time outs in *Qualifying Matches*, *Finals Matches* or *Robot Skills Matches*.

<T4> If an *Alliance* wants to end a *Qualifying Matches* or a *Finals Match* early, both *Teams* should signal the referee by ceasing all *Robot* motion and placing their controllers on the ground. The referee will then signal to the *Teams* that the *Match* is over and will begin to tally the score. If the *Match* is a tiebreaker *Finals Match*, then the *Match Stop Time* will also be recorded.

<T5> *Practice Matches* may be played at some events, but are not required. If *Practice Matches* are run, every effort will be made to equalize practice time for all *Teams*.

<T6> *Qualifying Matches* will occur according to the official *Match* schedule. This schedule will indicate *Match* partners, *Qualifying Match* time, and, if the event has multiple *Fields*, which *Field* the *Qualifying Match* will be played on.
Note: The official Match schedule is subject to changes at the Event Partner's discretion.

<T7> *Teams* are ranked by their average *Qualifying Match* scores. Every *Team* will be ranked based on the same number of *Qualifying Matches*.

a. A certain number of a *Team*'s lowest *Qualifying Match* scores will be excluded from the rankings based on the quantity of *Qualifying Matches* each *Team* plays.

Number of Qualifying Matches per Team	Number of excluded Match scores
Between four (4) and seven (7)	1
Between eight (8) and eleven (11)	2
Between twelve (12) and fifteen (15)	3
Sixteen (16) or more	4

Table 1: Matches that will be "dropped" from a Team's final average Qualifying Match scores.

b. In some cases, a *Team* will be asked to play an additional *Qualifying Match.* The extra *Match* will not impact the *Team*'s ranking. *Teams* are reminded that <G1> is always in effect and *Teams* are expected to behave as if the additional *Qualifying Match* counted.
c. Ties in *Team* ranking are broken by:
    i. Removing the *Team*'s lowest score and comparing the new average score.
    ii. Removing the *Team*'s next lowest score and comparing the new average score (on through all scores).
    iii. If the *Teams* are still tied, the *Teams* will be sorted by random electronic draw.

<T8> If no member of a *Team* is present in the *Driver Station* at the start of a *Qualifying Match*, that *Team* is considered a "no show" and will receive zero (0) points. The other *Team* in the *Alliance* will still play and receive points for the *Match*.

<T9> A *Team* that is *Disqualified* in a *Qualifying Match* receives zero (0) points for the *Match*. The other *Team* on their *Alliance* will still receive points for the *Match*.
a. In *Finals Matches*, *Disqualifications* apply to the whole *Alliance*, not just one *Team*. An *Alliance* that is *Disqualified* in a *Finals Match* will receive zero (0) points.

<T10> The number of *Finals Matches*, and therefore the number of *Teams* who will participate in *Finals Matches*, is determined by the event organizer.
Note: Each year, the REC Foundation releases an event Qualifying Criteria document which will provide further case-by-case tournament structure guidelines. The 2019-2020 Qualifying Criteria can be found here.

<T11> *Finals Matches* are played sequentially, starting with the lowest ranked *Alliance*. Each *Alliance* will participate in one (1) *Finals Match*. The *Alliance* with the highest *Finals Match* score is the *Teamwork Challenge* champion.
a. *Alliances* are ranked by their *Finals Match* score. The highest scoring *Alliance* is in first place, the second highest scoring *Alliance* is in second place, etc.
b. Ties for first place in *Finals Matches* will result in a series tiebreaker *Finals Matches*, starting with the lower ranked *Alliance*. The *Alliance* with the highest tiebreaker *Finals Match* score will be declared the *Teamwork Challenge* champion.
    i. If the tiebreaker *Finals Match* scores are tied, the *Alliance* with the higher *Match Stop Time* will be declared the winner.
    ii. If the *Match Stop Time* is also tied, a second series of tiebreaker *Finals Matches* will be played. If this second series of tiebreaker *Finals Matches* is also tied, then the higher ranked *Alliance* will be declared the winner.
c. If there is a tie for a place other than first, the higher ranked *Alliance* will receive the higher rank.

Example 1: Alliance 6 and Alliance 3 are tied for first place. During the tiebreaker *Finals Matches*, Alliance 6 scores 13 points and has a *Match Stop Time* of 12 seconds. Alliance 3 scores 13 points and has a Match Stop Time of 10 seconds. Alliance 6 is the *Teamwork Challenge* winner.

Example 2: Alliance 4 and Alliance 5 are tied for third place. Alliance 4 is the third place winner and Alliance 5 is the fourth place winner.

The lower ranked *Alliance* must "overcome" the higher ranked *Alliance* in order to become the *Teamwork Challenge* champion.

<T12> At many events, the playing *Field* will be placed on the ground. Some events may choose to elevate their *Fields*. At the 2020 VEX Robotics World Championship, the *Fields* will be 18" high.

Robot Skills Challenge Rules

<RSC1> All rules, scoring, and field layouts from previous sections apply to the *Skills Matches*, unless otherwise specified.

<RSC2> For each *Skills Match*, teams are awarded a score based on the standard game and scoring rules. *Teams* will be ranked based on the sum of their highest *Programming Skills Match* score and highest *Driving Skills Match* score.

a. If two *Teams* are tied for the highest score, the tie will be broken by looking at both *Teams*' next highest *Programming Skills Match* score. If the *Teams* remain tied, the tie will be broken by looking at both teams' next highest *Driving Skills Match* score. This process will repeat until the tie is broken.
b. If the tie cannot be broken (i.e. both *Teams* have the exact same scores for each *Programming Skills Match* and *Driving Skills Match*), then the following ordered criteria will be used to determine which team had the "best" *Programming Skills Match*:
    i. Points for *Balls Scored* inside of *Cubes*.
    ii. Points for *Balls Scored* on top of *Cubes*.
    iii. Points for *Cubes* that are *Scored* in *Corner Goals*.
    iv. Points for *Cubes* that are *Scored* on *Platforms*.
c. If the tie still cannot be broken, the same process in the step above will be applied to the *Teams*' highest *Driving Skills Match*.
d. If the tie still isn't broken, *Event Partners* may choose to allow *Teams* to have one more deciding *Match*, or both *Teams* may be declared the winner.

<RSC3> During *Skills Matches*, *Robots* may be placed in either of the two (2) *Starting Positions* on the *Field*.

<RSC4> *Teams* play *Matches* on a first-come, first-served basis. The *Event Partner* will determine how many *Skills Matches* every *Team* is allowed to play.

<RSC5> A *Team* may handle their *Robot* as many times as desired during a *Programming Skills Match*.

a. Upon handling the *Robot*, it must be immediately brought back to any legal *Starting Position*.
    i. *Driver* may reset or adjust the *Robot* as desired from this position, including pressing buttons on the Robot Brain or activating sensors.
b. Any *Game Objects* being controlled by the *Robot* while being handled must be removed from the *Robot* and gently placed in a non-*Scored* position by the *Team*.
c. Any *Game Object* in the *Starting Position* may be moved out of the *Starting Position* and gently placed into a non-*Scored* position by the *Team*.

d. During a *Programming Skills Match*, *Drivers* may move freely around the *Field*, and are not restricted to the *Driver Station* when not handling their *Robot*.
   i. An intent of this exception is to permit *Drivers* who wish to "stage" *Robot* handling during a *Programming Skills Match* to do so without excessive running back and forth to the *Driver Station*.

      Note: This rule only applies to *Programming Skills Matches*. *Driving Skills Matches* are still governed by <G17>, especially for strategic violations.

e. The rest of *<G8>*, which states that *Drivers* are not allowed to use any communication devices during their *Match*, still applies.

<RSC6> *Drivers* must start a *Robot*'s *Programming Skills Match* routine by pressing a button on the Robot Brain or manually activating a sensor. Because there is no VEX IQ Controller handoff, only one (1) *Driver* is required for *Programming Skills Matches* (although *Teams* may still have two (2) if desired). <G6> still applies to any *Drivers* participating in the *Match*.

a. Pre-*Match* sensor calibration is considered part of the standard pre-*Match* setup time, i.e. the time when *Teams* would typically be turning on the *Robot*, moving any mechanisms to their desired legal start position, etc.

In accordance with <G4>, *Teams* should be mindful of event schedules and set their *Robots* up as promptly as possible. The definition of "prompt" is at the discretion of the *Event Partner* and *Head Referee*, and could depend on things like how much time is left for the *Robot Skills Challenge* field(s) to be open, how many *Teams* are waiting in line, etc. As a general guideline, three seconds to calibrate a Gyro Sensor would be acceptable, but three minutes to debug a program would not.