2018-2019 FIRST® Tech Challenge
Game Manual Part 2

Presented By Qualcomm

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Gracious Professionalism® - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
Introduction

What is FIRST® Tech Challenge?
FIRST® Tech Challenge is a student-centered program that focuses on giving students a unique and stimulating experience. Each year, teams engage in a new game where they design, build, test, and program autonomous and driver operated robots that must perform a series of tasks. To learn more about FIRST® Tech Challenge and other FIRST® Programs, visit www.firstinspires.org.

FIRST® Core Values
We express the FIRST® philosophies of Gracious Professionalism® and Coopertition® through our Core Values:

- **Discovery:** We explore new skills and ideas.
- **Innovation:** We use creativity and persistence to solve problems.
- **Impact:** We apply what we learn to improve our world.
- **Inclusion:** We respect each other and embrace our differences.
- **Teamwork:** We are stronger when we work together.
- **Fun:** We enjoy and celebrate what we do!

Gracious Professionalism®

FIRST® uses this term to describe our programs’ intent and Gracious Professionalism® is not clearly defined for a reason. It has different meanings to everyone. Some possible meanings of Gracious Professionalism include:

- Gracious attitudes and behaviors are win-win.
- Gracious folks respect others and let that respect show in their actions.
- Gracious Professionals make valued contributions in a way that is pleasing to others and to themselves.

In the end, Gracious Professionalism® is part of everyday life. When professionals use their knowledge graciously and individuals act with integrity and sensitivity, everyone wins, and society benefits.

Watch Dr. Woodie Flowers explain Gracious Professionalism in this short video.

Gracious Professionalism for Volunteers
It is a good idea to spend time going over this concept with volunteers. Provide volunteers with real-life examples of Gracious Professionalism in practice before, during, and after the event and recognize great Gracious Professionalism when you see it in action!

Youth Protection Program

The FIRST YPP sets minimum standards recommended for all FIRST activities. Adults working in FIRST programs must be knowledgeable of the standards set by the FIRST YPP, as well as those set by the school or organization hosting their team.

Youth Protection Expectations and Guidelines
Coaches and mentors should read and follow the FIRST Youth Protection Program guide. Anything labeled as required is mandatory in the United States and Canada, and cannot be waived without approval from the FIRST Youth Protection Department. FIRST recommends that the standards set forth in the FIRST Youth

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Protection Program guide be applied outside of the United States and Canada to the extent possible. At a minimum, local regulations regarding youth protection must be complied with.

Most up to date forms are available here: [http://firstinspires.org/resource-library/youth-protection-policy](http://firstinspires.org/resource-library/youth-protection-policy)

The US Screening process, the Canadian Screen process, Frequently Asked Questions (FAQ), and additional information are on the FIRST Youth Protection Program Website: [http://firstinspires.org/resource-library/youth-protection-policy](http://firstinspires.org/resource-library/youth-protection-policy)

**NOTICE OF NON-DISCRIMINATION**

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### 1.0 The Game

#### 1.1 Introduction

This document describes ROVER RUCKUS™ presented by Qualcomm® Incorporated, the FIRST® Tech Challenge game for the 2018-2019 season. Teams must comply with all rules and requirements stated in this document and in the Game Manual Part 1. Clarifications to the game rules are issued on the Question & Answer section of the forum at [ftcforum.usfirst.org](http://ftcforum.usfirst.org). Forum rulings take precedence over information in the game manuals.

#### 1.2 Game Description

Matches are played on a Playing Field initially set up as illustrated in Figure 1.3-1 below. Two Alliances – one “Red” and one “Blue,” composed of two Teams each – compete in each Match. The object of the game is to attain a higher Score than the opposing Alliance by descending from the Lander, collecting Minerals from the Crater, sorting and Scoring Minerals into the Cargo Hold of the Lander, performing Autonomous tasks, and navigating to specific parts of the Playing Field. The Scoring Elements for the game are 60 Silver Minerals and 90 Gold Minerals, and a Team supplied Team Marker. The game is played in two distinct periods: Autonomous and Driver-Controlled.

The Match starts with a 30-second Autonomous Period in which Robots operate using only pre-programmed instructions and sensor inputs. Alliances earn points by: (1) **Landing** – Robots lower themselves from the Lander onto the Playing Field; (2) **Sampling** – Robots identify the single Gold Mineral in each Sample Field; (3) **Claiming** – Robots place the Team Marker in their corresponding Depot; and (4) **Parking** – Robots that end the Autonomous Period in a Crater earn points.

The two-minute Driver-Controlled Period follows the Autonomous Period. During this period, Teams earn points for their Alliance by placing Minerals into their Alliance’s Cargo Holds and/or Depot. Gold Minerals must be placed in the Gold Cargo Hold and Silver Minerals into the Silver Cargo Hold to Score. Either Mineral in the Depot earns points for the Alliance.

The final 30 seconds of the Driver-Controlled Period is called the End Game. In addition to the previously listed Driver-Controlled Period Scoring activities, Alliances earn points by (1) **Latching** onto the Lander and (2) Parking In or Completely In any Crater.
1.3 Playing Field Illustration

The following illustrations identify the Game Elements and gives a general visual understanding of the Playing Field. Teams should refer to andymark.com/FTC for the exact Game Element dimensions. The official Playing Field documents including the official Field Setup Guide are available at https://tinyurl.com/ftcgame. Please note: Playing Field Wall heights may be different depending on the manufacturer. Wall height measurements are in the official Field Setup Guide. Across the season, Teams may attend events that use Playing Field Walls from different manufacturers, please incorporate that into the design of your Robot.

![Isometric view of the Playing Field](image1)

**Figure 1.3-1 – Isometric view of the Playing Field**

![Overhead view of the Playing Field](image2)

**Figure 1.3-2 – Overhead view of the Playing Field**

*Gracious Professionalism*® - “Doing your best work while treating others with respect and kindness - It’s what makes FIRST, first.”
1.4 Game Definitions

The following definitions and terms are used in ROVER RUCKUS™ presented by Qualcomm® Incorporated:

**Alliance** – A grouping of two Teams that work together for a given Match. Alliances are designated as either “Red” or “Blue.”

**Alliance Station** – The designated “Red” or “Blue” Alliance Area adjacent to the Playing Field where the Drivers and Coach stand during a Match. Station One is the Alliance Station closest to the audience.

**Area** – The space defined by the vertical projection of the outside edge of a region’s boundary (for example, gaffers tape, goal, Playing Field Wall). The boundary element (tape, wall, markings, etc.) is considered to be part of the Area for the purposes of determining Inside and Outside.

**Autonomous Period** – A thirty-second period in which the Robots operate and react only to sensor inputs and to commands pre-programmed by the Team onto the onboard Robot control system. Human control of the Robot is not permitted during this time.

**Block / Blocking** – Preventing an opposing Alliance Robot from accessing an Area or Alliance-specific Game Element or all remaining Alliance-neutral Game Elements for an extended period by obstructing ALL paths of travel to the object or Area. Active defense played by a Robot shadowing an opposing Alliance Robot that eliminates all paths of travel between the opposing Alliance Robot and an Area or Alliance-specific Game Element or all remaining Alliance-neutral Game Elements is considered Blocking, even though at any frozen point in time there is an open path. See also Trap / Trapping (which may be considered the same except it is from a Game Element or Area of the Playing Field).

**Cargo Holds** – Four Areas (two per Alliance) within the Lander where Robots deposit Minerals to Score points.

**Claimed** - A Depot is Claimed when a Robot has placed and released a Team Marker in its Alliance’s Depot during the Autonomous Period. Once successfully placed, the Team Marker does not have to remain in the Depot to earn the Claiming Score.

**Coach** – A student Team member or adult mentor designated as the Drive Team advisor during the Match and identified by wearing a “Coach” badge or identifying marker.

**Competition Area** – The Area where all the Playing Fields, Alliance Stations, scoring tables, on-deck queuing tables, event officials, and other tournament items relating to Match play are located. The Team Pit Area and practice Playing Fields are not part of the Competition Area.

**Completely Claimed** – A Depot is Completely Claimed when both Robots on an Alliance have placed and released their Team Markers in their Alliance’s Depot during the Autonomous Period. There is no requirement that both Team Markers must be in the Depot at the same time for the Depot to be Completely Claimed.

**Contaminant** - A Mineral In an incompatible Cargo Hold (for example, Silver In a Gold Cargo Hold).

**Control / Controlling** – An object is considered to be Controlled by a Robot if the object is following the movement of the Robot. Objects that are Controlled by a Robot are considered to be part of the Robot. See Possess / Possessing to learn about a related term. Examples include, but are not limited to:

- Carrying – holding Game Elements Inside or Outside of a Robot.
- Herding – pushing or impelling Game Elements to a desired location or direction that gains a strategic advantage beyond moving the Robot around the Playing Field.
- Holding – *Trapping* one or more *Scoring Elements* against a *Game Element, Playing Field Wall, or Robot* in an attempt to shield or guard them.

- Launching – propelling *Game Elements* into the air.

Examples of interaction with *Game Elements* that are not *Controlled* include, but are not limited to:

- Plowing – *Inadvertent* contact with *Game Elements* while in the path of the *Robot* moving about the *Playing Field*.

- Deflecting – *Inadvertent* contact with a launched *Game Element* as it bounces off a *Robot*.

**Crater** – An *Area* surrounded by the *Playing Field Wall* and the Outer edge of the *Crater Rim* into which the *Minerals* are placed prior to the start of a *Match*. There are two (2) *Craters located in opposite corners of the Playing Field*. See Figure 1.3-1 for the location of the *Craters*.

**Crater Rim** – An assembly of wedge-shaped pieces on the *Playing Field* that forms the outside edge of a *Crater*. A single *Crater Rim* piece measures approximately 7.6 inches wide x 9 inches long x 3 inches tall (193 mm x 229 mm x 76 mm).

**Deployed** - *Robot* is not *Latched* to the *Lander*.

**Depot** – A segment of the *Playing Field* that is bounded by red or blue tape where *Game Elements* may be deposited. The *Depots* are *Alliance* specific, there is one (1) *Depot* per *Alliance*.

**Disable / Disabled** – A *Robot* that is no longer active for the remainder of the *Match* due to a *Robot* failure or by the request of a referee. *Drive Teams* may not *Disable a Robot* without the permission of a Field Technical Advisor or referee. If a referee *Disables a Robot* during a *Match*, he/she will ask the *Team* to drive their *Robot* to a neutral position on the *Playing Field*, issue a stop command with the *Driver Station*, and place their *Driver Station* in a hands-off location on a tournament-provided structure or the *Alliance Station* floor.

**Disqualified / Disqualification / Disqualify** – A *Team* that is *Disqualified* from a *Match* will not receive credit for the *Match* (that is, no Ranking or TieBreaker points).

**Drive Team** – Up to three representatives (two (2) *Drivers* and one (1) *Coach*) from the same *Team*.

**Driver** – A pre-college student *Team* member responsible for operating and controlling the *Robot* and identified by wearing a tournament supplied “*Driver*” badge or identifying marker.

**Driver-Controlled Period** – The two-minute time period in which the *Drivers* operate the *Robots*.

**Driver Station** – Hardware and software used by a *Drive Team* to control their *Robot* during a *Match*. The *Driver Station* consists of an Android device, *FIRST* Tech Challenge supplied Android App, adapter cable(s), optional non-powered USB Hub (i.e., does not draw power from a DC power input port), an optional commercial off the shelf USB external battery connected to the USB Hub to charge the Android device at any time, and up to two controllers to drive the *Robot*. The only allowed controller models are the Logitech F310 Gamepad and the Xbox 360 Controller for Windows. The *Driver Station* also includes decorations and any components used to hold the above listed legal devices.

**End Game** – The *End Game* is a named period of time that is the last thirty seconds of the two-minute *Driver-Controlled Period*.

**End of the Period/Match** - The moment when the *Match* timer reaches 0:00.

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*Gracious Professionalism*® - “Doing your best work while treating others with respect and kindness - It’s what makes *FIRST*, first.”
**Game Element** – Any item Robots interact with to play the game. *Game Elements* for this year’s game include: Minerals, Crater Rims, Team Markers and the Lander.

**In (Inside) / Completely In (Completely Inside)** – An object that has crossed into the upwards vertical (i.e., at a right angle to the *Playing Field Floor*) extension of a defined *Area*’s boundary is *Inside* the *Area*. An object that is entirely within the upwards vertical extension of a defined *Area*’s boundary is *Completely Inside* the *Area*. The boundary element (tape, wall, markings, etc.) is part of the *Area* for the purposes of determining *Inside* and *Outside*.

**Inadvertent** – An outcome that is not a planned strategy and not the predictable result of persistent or repeated actions.

**Inconsequential** – An outcome that does not influence Scoring or gameplay.

**Interference** - Interaction between opposing *Alliance Robots* that amplifies the difficulty of a *Scoring* activity. Actions that constitute *Interference* should not be considered illegal except as specified by a *Game Rule*.

**Lander** – The structure on the *Playing Field Floor* where Robots may begin the *Match* and includes the Cargo Hold Scoring Areas where Robots deposit Minerals. See Figure 1.3-1 for the location of the Lander.

**Lander Support Bracket** – An attachment point on the *Lander* where Robots may start Supported at the beginning of the *Match* and may Latch onto during the *End Game*. There are four (4) *Alliance* specific Lander Support Brackets.

**Landing Zone** – A triangular *Area* underneath the Lander defined by the red or blue tape.

**Latched** – A Robot is considered Latched when it is *Completely Supported* by the Lander Support Bracket on the Lander and is not in contact with any other *Game Element*, Robot, or the Playing Field Floor. Incidental contact with *Scoring Elements*, the Lander sides or legs is allowed (for example, *Possession* of *Scoring Elements* is allowed). Latching is evaluated and Scored by earthlings. *Teams* are encouraged to make these actions obvious and unambiguous.

**Match** – A head-to-head competition between two *Alliances*. A *Match* consists of a thirty-second *Autonomous Period* followed by a two-minute *Driver-Controlled Period* for a total time of two minutes and thirty seconds.

**Minerals** – *Scoring Elements* for this year’s game. There are two kinds of Minerals:

- **Silver**: White, spherical shaped objects.
- **Gold**: Yellow, cube shaped objects.

**Navigation Targets** – Four unique images mounted on the *Playing Field Walls* (one image per wall) that Robots can use to navigate around the *Playing Field*. Images are printed on standard letter size paper for the tournament location, 8 1/2 inch x 11 inch (216 mm x 279 mm) or A4 (210 mm x 297 mm) paper.

**Off** – Not physically in contact with or *Supported* by an object, surface, etc. Objects that are Off are also considered Completely Off.

**On / Completely On** – An object that is physically in contact with and at least partially *Supported* by an object, surface, etc. is considered On. An object that is entirely *Supported* by another object, surface, etc. is Completely On.
**Out / Outside** – An object that has not crossed into any part of a defined Area is Outside the Area.

**Park / Parked** – The condition where a Robot is motionless.

**Penalty** – The consequence imposed for a rule or procedure violation that is identified by a referee. When a Penalty occurs, points will be awarded to the Alliance that did not incur the Penalty. Penalties are further defined into Minor Penalties (ten points) and Major Penalties (forty points). Penalties may also escalate to issuing of a Yellow Card or Red Card as a result of a continued occurrence of a rule violation and upon discretion of the Referee.

**Yellow Cards and Red Cards** – In addition to rule violations explicitly listed in section 1.6, Yellow Cards and Red Cards are used in the FIRST Tech Challenge to manage Team and Robot behavior that does not align with the mission of FIRST. Yellow and Red Cards are not limited to just the Competition Area. Teams that display egregious behavior in the pit area, judging rooms, stands, or any other location of the tournament can be issued a yellow or red card for egregious behavior.

Egregious or repeated (3 or more) Robot or Team member behavior at the tournament can result in a Yellow and/or Red Card. Yellow Cards are additive, meaning that a second Yellow Card is automatically converted to a Red Card. A Team is issued a Red Card for any subsequent incident in which they receive an additional Yellow Card, for example, earning a second Yellow Card during a single Match.

**Yellow and Red Cards at the Competition Field**

The Head Referee may assign a Yellow Card as a warning, or a Red Card for Disqualification in a Match. A Yellow Card or Red Card is signaled by the Head Referee standing in front of the Team’s Alliance Station and holding a yellow card and/or red card in the air.

To issue the second Yellow Card, the Head Referee will stand in front of the Team’s Alliance Station and hold a yellow card and red card. The Head Referee will signal the second Yellow Card after the Match has ended.

A Team that has received either a Yellow Card or a Red Card carries a Yellow Card into following Matches, except as noted below. A Red Card results in Match Disqualification. Multiple Red Cards may lead to tournament Disqualification. Once a Team receives a Yellow Card or Red Card, the Team number is presented with a yellow background on the audience screen at the beginning of all following Matches. This is a reminder to the Team, referees, and audience the Team carries a Yellow Card.

Yellow Cards do not carry over from the Qualification Matches to the Elimination Matches. During the Elimination Matches, Yellow and Red Cards count against the entire Alliance, not a specific Team. If a Team receives a Yellow Card or Red Card, it results in the entire Alliance receiving the Yellow Card or Red Card for that Match. If two different Teams on the same Alliance are issued Yellow Cards, the entire Alliance is issued a Red Card. A Red Card results in zero (0) points for that Match, and the Alliance loses the Match. If both Alliances receive Red Cards, the Alliance which committed the action earning the Red Card first chronologically loses the Match.

Yellow and Red Cards may also be issued off the competition field. For details please make sure to read the Tournament Rules outlined in section 4.3 of the Game Manual Part 1.

**Pin / Pinning** – Preventing the movement in all directions of an opposing Alliance Robot while it is in contact with the Playing Field Wall, one or more Game Elements, or another Robot.
**Playing Field** – The part of the *Competition Area* that includes the 12 ft. x 12 ft. (3.66 m x 3.66 m) field and all the *Game Elements* described in the official field documents. From the audience viewpoint, the Red *Alliance Station* is on the right side of the *Playing Field*.

**Playing Field Damage** – A physical change to a *Game Element* or *Playing Field* that affects game play or an action that causes harm to the playability of a *Game Element* or *Playing Field*.

For Example: Black tire marks on a *Game Element* is not considered *Playing Field Damage*. However, digging a hole larger than 1 inch (2.54cm) diameter (approximately the size of a US quarter) or a series of smaller holes into the *Playing Field Floor* is considered *Damage*.

**Playing Field Floor** – The surface of the *Tiles* that make up the base of the *Playing Field*.

**Playing Field Perimeter** – The outside face of the *Playing Field Wall*.

**Playing Field Wall** – An approximate 12 inches (0.3 m) tall, 12 ft. (3.66 m) long by 12 ft. (3.66 m) wide wall surrounding the *Playing Field Floor*. The height of the *Wall* will vary depending on which *Playing Field Wall* is being used at the event. *Robots* should be built to interact with all legal perimeters.

**Possess / Possessing** – An object is in *Possession* by a *Robot* if, as the *Robot* moves or changes orientation (for example, moves forward, turns, backs up, spins in place), the object remains in approximately the same position relative to the *Robot*. Objects in *Possession* of a *Robot* are considered to be *Controlled*, and they are part of the *Robot*. See also *Control/Controlling*.

**Pre-Load** - A *Game Element* that a *Drive Team* positions during pre-*.Match setup so that it is *Possessed* by a *Robot* at the start of the Autonomous Period.

**Robot** – A mechanism that has passed *Robot* inspection and a *Drive Team* places on the *Playing Field* prior to the start of a *Match*. A detailed definition of *Robot* is in the *Robot* rules section in Game Manual Part 1.

**Sample Field** – Three (3) positions on the *Playing Field Floor* that are in front of each *Robot* starting location onto which the *Samples* are placed prior to the start of a *Match*. Each position is defined by a red or blue taped *Area*.

**Samples** – Two (2) *Silver* and one (1) *Gold Minerals* that are randomly placed onto each *Sample Field* prior to the start of a *Match*.

**Scoring / Score** – *Robots* earn points for their *Alliance* by interacting with *Scoring Elements* and *Parking* in specific *Areas* of the *Playing Field*. *Scoring Elements* are considered to be *Scored* when they are placed in the appropriate location and are no longer in contact with a *Robot* from the corresponding *Alliance*. The *Scoring* achievements and their point values are described in section 1.5.

**Scoring Elements** – Objects that *Robots* manipulate to earn points for their *Alliance*. The *Scoring Elements* for ROVER RUCKUS™ are *Minerals and Team Markers*.

**Scoring Referee Station** – The designated “Red” or “Blue” *Area Inside an Alliance Station* where the *Scoring Referee* sits or stands during a *Match*.

**Stop Playing The Game** - A *Robot* that is *Parked* for the remainder of the *Match* period.
**Support / Supported / Completely Supported** – A Robot is Supported by an object if that object is bearing at least some of the weight of the Robot. If the object is bearing all the Robot’s weight, the Robot is Completely Supported by the object.

**Team** – Mentors, supporters, and pre-college-aged students affiliated with an entity registered with FIRST and for the competition.

**Team Marker** – A Team provided Scoring Element. A detailed definition of Team Marker is in section 8.4 of the Game Manual Part 1. Compliance with construction rules will be verified during Robot Inspection.

**Tile** – The approximately 24 inch x 24 inch (0.61 m x 0.61 m) foam rubber mat, 36 of which make up the Playing Field Floor.

**Trap / Trapping** – Preventing an opposing Alliance Robot from escaping a constrained Area of the Playing Field or from a Game Element for an extended period of time by obstructing all paths of travel from the object or Area. See also Block / Blocking (which may be considered the same except it is to a Game Element or Area of the Playing Field).

### 1.5 Game Play

Prior to the start of the Match, Drive Teams perform some basic Robot setup steps that are described in section 1.5.1. Matches are made up of several periods totaling two minutes and thirty seconds. There is a thirty-second Autonomous Period, followed by a two-minute Driver-Controlled Period. The last thirty seconds of the Driver-Controlled Period is called the End Game. When the Match is over and referees signal, Drive Teams collect their Robots and Team Markers, return Game Elements and Flags, and exit the Competition Area.

#### 1.5.1 Pre-Match

Field personnel will place approximately half of the fifty-two (52) Silver and half of the eighty-six (86) Gold Minerals into each of the Craters. The Silver and Gold will be randomly mixed.

Drive Teams receive an Alliance-colored Robot-identification flag from field personnel. This flag must be securely mounted on the Robot as defined in the Robot rules.

Minerals are not Pre-Loaded onto the Robot. Drive Teams may Pre-Load one Team Marker.

The Drive Team must select one of the following starting locations for their Robot:

1. **Latched to the Lander** - Robot is Completely Supported by their Alliance-specific side of the Lander with the following constraints:
   a. The Robot must be Completely Supported by the Lander Support Bracket. Incidental contact with the Lander walls or the legs is allowed.
   b. The lowest point on a Robot and Team Marker can be no closer than four (4) inches (102 mm) from the Playing Field Floor.
   c. When Completely Supported by the Lander, Robots must be within the 18 inch x 18 inch x 18 inch (45.7 cm x 45.7 cm x 45.7 cm) starting volume constraint.

2. **Deployed from the Lander** - Robots that start the Match Deployed are not eligible to earn the Landing achievement points. Deployed Robots are placed on the Playing Field Floor in any orientation with the following constraints:
   a. The Robot must be In the Landing Zone within the vertical projection of the Lander Support Bracket. For example, a portion of the Robot must be directly beneath the Lander Support Bracket.
   b. The Robot must start Outside the opposing Alliance’s Landing Zone.

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After the Robots are either Latched or Deployed, and Autonomous programs have been initialized, Referees will give a setup complete signal to the Drive Team, signifying the following:

1. **Drive Teams** may no longer touch their Robots until the conclusion of the Match, and

2. **Drive Teams** may not touch their Driver Stations or controllers until the Autonomous Period has ended, except to start their Autonomous program with a single touch to the Driver Station Android device screen.

3. Prior to the start of the Match, Referees will place Samples in the Sample Field. Referees will randomly arrange two Silver and one Gold into a grouping. This grouping will be repeated in front of each Robot starting location.

### 1.5.2 Autonomous Period

The Match starts with a thirty-second Autonomous Period where Robots are operated via pre-programmed instructions only. Teams are not allowed to control Robot behavior with the Driver Station or any other actions during the Autonomous Period. The Driver Station is placed in a hands-off location during the Autonomous Period so that it is evident that there is no human control of Robots. The only exception is to allow Drive Teams to start their Robot with a single start command issued on the Driver Station Android device using the built-in thirty-second timer. The Autonomous Period begins following a start countdown (for example, 3-2-1-go) by field personnel, signaling Drive Teams with Robots that plan to run an Autonomous Op Mode to issue a Robot start command with their Driver Station. Failure to adhere to this procedure may subject the Team and/or Alliance to a Penalty as specified in the game rules in Section 1.6.2.

The Autonomous Score is based on completing tasks during the Period. Points are awarded for the following achievements:

1. **Landing** – Robots lower themselves from the Lander onto the Playing Field Floor. Each Robot that is in contact with the Playing Field Floor and not in contact with the Lander Support Bracket will earn 30 points for their Alliance.

2. **Claiming** – Each Robot that successfully places their Team Marker In their Alliance’s Depot will earn 15 points for their Alliance. The Team Marker may only be delivered by placing it into the Depot. Launching, shooting, throwing, etc. of a Team Marker is not allowed. If an Alliance Completely Claims their corresponding Depot, then descoring of Minerals by the Opposing Alliance will not be allowed from that Depot during the Driver-Controlled Period. Completely Claimed Depots are permanent for the Match.

3. **Parking** – Each Robot In a Crater at the End of the Autonomous Period will earn 10 points for their Alliance.

4. **Sampling** – Each Sample Field that has its Gold Mineral Out of the corresponding taped Area and the two (2) Silver Minerals remaining In their corresponding taped Areas will earn 25 points for the corresponding Alliance.

Minerals placed in the Depot or Cargo Hold during the Autonomous Period are Scored as described in section 1.5.3.

### 1.5.3 Driver-Controlled Period

Directly following the end of the Autonomous Period, Drive Teams have five (5) seconds plus a “3-2-1-go” countdown to prepare their Driver Stations for the start of the Driver-Controlled Period. On the countdown
word "go," the Driver-Controlled Period starts and Drive Teams press their Driver Station start buttons to resume playing the Match.

The Driver-Controlled Score is based on completing tasks as outlined below. Points are awarded for the following achievements: Minerals Scored earn points as follows:

1. Minerals Scored into the Depot earn two (2) points each. Minerals removed from the Depot deduct two (2) points each.
2. Gold Scored into the Gold Cargo Hold on the Lander earns five (5) points.
3. Silver Scored into the Silver Cargo Hold on the Lander earns five (5) points.
4. Minerals placed into the wrong Cargo Hold (that is, Gold into Silver or Silver into Gold) on the Lander are considered Contaminants and Score zero (0) points.
5. To be considered Scored for either the Depot or a Cargo Hold, a Mineral must be In the volume defined by the Scoring Area. For the Depots, the volume is defined by the outer edge of the tape and extending infinitely upwards from the Playing Field Floor. For a Cargo Hold, the volume is defined by the 5 inner surfaces of the Cargo Hold and the horizontal extension of the upper edge of the clear panel on the outside of the Cargo Hold.

1.5.4 End Game
The last thirty seconds of the Driver-Controlled Period is called the End Game. Driver-Controlled Period Scoring can still take place during the End Game.

Points are awarded at the End of the Match for the following End Game achievements:

1. Robots Latched – Each Robot that Deployed during pre-Match setup or in the course of game play and is Latched onto either of their own Alliance-specific Lander Support Brackets at the End of the Match earns 50 points for their Alliance.
2. Robots Parked In any Crater – Each Robot that is Parked In any Crater at the End of the Match earns 15 points for their Alliance.
3. Robots Parked Completely In any Crater – Each Robot that is Parked Completely In any Crater at the End of the Match earns 25 points for their Alliance.

1.5.5 Post Match
After the Match ends, field personnel will finalize the Score. Referees will signal for the Drive Teams to enter the Playing Field and retrieve their Robots and Team Markers. Drive Teams should not step on the Crater Rim when retrieving their Robots and Team Markers. The Drive Teams should return any Minerals that are Possessed by the Robot to the Playing Field and return the Alliance-colored Robot identification flag to the field personnel. The Playing Field reset crew will set up the Playing Field for the next Match.

1.5.6 Penalty Scoring
Penalty points are added to the non-offending Alliance’s Score at the end of the Match. Minor Penalties give the non-offending Alliance ten (10) points per occurrence. Major Penalties give the non-offending Alliance forty (40) points per occurrence.

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1.5.7 Flowchart of Match Play
The following figure shows the flow of the Match and the actions taken on the Driver's Station Android device.

1.6 Rules of Game Play
Game play is restricted by the Safety rules (<S#>), the General rules (<G#>), and the Game-Specific rules (<GS#>). Other rules to pay close attention to are the Robot rules, Team Marker rules, the inspection rules, and the tournament rules defined in the Game Manual Part 1. Violation of rules may lead to Penalties, Yellow Cards and/or Red Cards, a Disabled Robot, Disqualification of the offending Team and/or Alliance from either a Match or the tournament. Rules apply to all periods of play unless specifically called out otherwise. If rules are in conflict, Safety rules take precedence over all rules and Game-Specific rules take precedence over General rules. The official FIRST Tech Challenge Question & Answer Forum rulings take precedence over all information in the game manuals.

1.6.1 Safety Rules
<S1> Unsafe Robot and Playing Field Damage – If at any time the Robot operation is deemed unsafe or has damaged the Playing Field or another Robot, by the determination of the referees, the offending Robot may be Disabled, and the Team may be issued a Yellow Card. Re-inspection of the Robot is required before it may play another Match. Damage that requires significant repair and/or delays subsequent Match play is likely to escalate to a Red Card.

The intent of this rule is to immediately stop unsafe Robot actions or Playing Field Damage that is likely to persist with continued Robot operation. Robots that can continue safe operation without damaging the Playing Field will receive a warning and may continue to play the Match. Robots will be Disabled for unsafe operation or Playing Field Damage that occurs after the first warning for the tournament. Damage that affects game play is likely to escalate to a Yellow Card.
<S2> **Robot Extension Outside the Playing Field Perimeter** – If any portion of the Robot contacts anything Outside the Playing Field Perimeter, the Team will be issued a Yellow Card and it may be Disabled immediately for the remainder of the Match, unless allowed by Game-Specific rule(s) listed in Section 1.6.3. See the game definitions in section 1.4 for a complete description of the Playing Field Perimeter.

The intent of this rule is not to Penalize an Alliance for Inadvertent, safe Robot extension Outside the Playing Field Perimeter. Intentional Robot extension Outside the Playing Field is not permitted, except as allowed by game-specific rules listed in Section 1.6.3.

<S3> **Safety Gear** – All members of the Drive Team are required to wear approved eye protection and shoes with closed-toes and a closed-back. If any member of the Drive Team is not wearing these safety items, the referee will issue a warning and if the situation is not remedied within thirty seconds, the offending member(s) of the Drive Team must leave the Competition Area for the remainder of the Match and may not be replaced by another Team member. Failure to comply with a request to leave the Competition Area violates rule <G28>.

### 1.6.2 General Game Rules

<G1> **Drive Team** – Each Drive Team shall include up to two Drivers and one Coach. Electronic communications (cell phone, two-way radio, Wi-Fi, Bluetooth, etc.) by Drive Team members after an Alliance has been called from the queue to the Playing Field for its Match are not allowed. The first instance of violating this rule will result in a warning, with any following instances during the tournament resulting in a Minor Penalty. Items that may be mistaken by a casual observer as being in violation should not be brought to the Competition Area. The Driver Station is exempt from this rule but must be used only for operating the Robot.

<G2> **Pre-Match Robot Setup** - Team members cannot enter the Playing Field for any reason other than to place/retrieve their Robots. Teams may not measure, test, or adjust field or game elements prior to the start of a Match. Inspection of the Playing Field elements by Team members to determine Scoring is not allowed. Individuals and Teams that violate this rule will be subject to possible penalties that could include Match Disqualifications or even removal from the tournament.

<G3> **Pre-Match Robot Placement** – At the beginning of a Match, each Alliance Robot must be set up on the Playing Field according to section 1.5.1 Pre-Match in the Game Manual Part 2. After Robots are set up on the Playing Field, Drive Teams must stand Completely inside the Alliance Station at the location (Station one or Station two) specified by the Qualification Match schedule.

a. During the Qualification Matches, the blue Alliance Robots are set up on the Playing Field first, unless the red Alliance waives their right to set up on the Playing Field second.

b. During the Elimination Matches, the 3rd and 4th seeded Alliance Robots are set up on the Playing Field first, unless the higher seeded Alliance waives their right to set up on the Playing Field second. Alliance color doesn’t change the seeding of a Team during the Elimination Matches. If the 4th seed defeats the 1st seed in the Semi-Finals, they will still have to place their Robot on the field first in the Finals because their seeding will be lower than the 2nd or 3rd seed.

c. During Elimination Matches, 3 Team Alliances may only place Robots that are intended to compete in that Match. Once two Robots are placed for the two Teams competing in a Match, the Alliance cannot swap in the 3rd Alliance’s Robot for a Robot already placed.

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d. **Teams** may implicitly waive their right to place their **Robots** on the **Playing Field** last by placing their **Robots** on the **Playing Field** before or with the opposing **Alliance**. There is no need to tell the referees; **Teams** waive their right by the act of placing their **Robots** on the **Playing Field**.

e. **Teams** that unnecessarily delay the beginning of a **Match** and/or field reset will incur a **Minor Penalty** for each offense.

> **Drive Teams** are expected to stage their **Robots** for a **Match**, and remove it from the **Playing Field** afterwards, safely and swiftly. **Drive Team** efforts that either intentionally or unintentionally delay the start of a **Match** or the **Playing Field** reset are not allowed. Examples include, but are not limited to:

- Late arrival to the **Playing Field**.
- **Robot** maintenance once on the **Playing Field**.

<**G4**) **Robot Starting Volume** – Before the start of a **Match**, each **Robot** in its starting location must not exceed a volume of 18 inches (45.7 cm) by 18 inches (45.7 cm) by 18 inches (45.7 cm) unless otherwise allowed or restricted by Game Specific Rules detailed in Section 1.6.3. The **Alliance** identification flag and **Pre-Loaded Scoring Elements** may extend **Outside** the 18-inch (45.7 cm) cube volume constraint. An offending **Robot** will be removed from the **Playing Field** for the length of the **Match**.

After the start of a **Match**, the **Robot** may extend in any dimension unless restricted by the Game-Specific rules detailed in Section 1.6.3.

<**G5**) **Robot Setup/Alignment** – **Teams** may align their **Robots** during Pre-**Match** setup if they do so with legal components that are part of the **Robot** and can be reset to be within the 18-inch (45.7 cm) cube starting volume constraint. A single member of the **Drive Team** may also align the **Robot** by sight, assuming that he/she is next to the **Robot** and does not delay the start of a **Match**. A **Minor Penalty** will be assessed to the **Team** for violation of this rule.

<**G6**) **Alliance Station** – During a **Match**, the **Drivers** and **Coach** must remain **Completely Inside** their **Alliance Station**. The first instance of leaving the **Alliance Station** will result in a warning, with any following instances resulting in a **Minor Penalty**. Leaving the **Alliance Station** for safety reasons will not result in a warning or **Penalty**.

<**G7**) **Starting Game Play Early** – **Robots** that start play of the game (**Autonomous** or **Driver-Controlled Period**) prior to the start of a **Match Period** receive a **Minor Penalty**. **Referees** have the option of issuing a **Major Penalty** in place of the **Minor Penalty** if the early start results in a competitive advantage for the offending **Alliance**.

<**G8**) **Late Start of the Autonomous Period** – **Teams** participating in the **Autonomous Period** are expected to press the "start with 30-second" button on their **Driver Station** Android device and then place the **Driver Station** in a hands-off location without delay when field personnel signal the start of the **Autonomous Period**. A **Minor Penalty** is assessed for violating this rule. **Referees** have the option of issuing a **Major Penalty** in place of the **Minor Penalty** if the late start results in a competitive advantage for the offending **Alliance**.

<**G9**) **Robot Control During Autonomous Period** - During the **Autonomous Period**, **Drive Teams** may not directly or indirectly control or interact with **Robots** or **Driver Stations**. Early stopping of the **Robot** while running its **Autonomous** code is not allowed, except in cases of personal or equipment safety. A **Major Penalty** will be assessed for violating this rule.
<G10> Stopping Game Play Late – Robots that do not Stop Playing The Game at the end of the Autonomous or Driver-Controlled Periods when competition personnel or timer software announce the end of a Match period receive a Minor Penalty and the actions of the Robot occurring after the end of a Match period do not count towards their Alliance’s Score. Referees have the option of issuing a Major Penalty in place of the Minor Penalty if the late stop results in a competitive advantage (other than Scoring) for the offending Alliance.

Scoring Elements that were launched before the End of the Period are eligible to be counted as Scored. Other Robot Scoring achievements that occur after the announced end of the Autonomous Period and before the start of the Driver-Controlled Period do not count towards the Score for the Autonomous or Driver-Controlled Periods. Referees may remove any Scoring Elements from a Scoring Area that are improperly Scored in this manner.

The intent of this rule is for Robots to Stop Playing The Game within a reasonable human reaction time following the start of the game sound (i.e., buzzer) signaling the End of the Period. Drive Teams should make their best effort to stop game play immediately when the End of the Period game sound begins. Before the consequences come into play, referees will use their discretion to give Drive Teams an approximate one second grace period following the conclusion of the game sound signaling the End of the Period for Robots to Stop Playing the Game.

<G11> Drive Team Contact with the Playing Field or Robot – During a Match, the Drivers and Coaches are prohibited from making contact with the Playing Field, any Game Element, or any Robot. The first instance of contact will result in a warning, with any following instances resulting in a Minor Penalty. Contact that affects Scoring and/or game play will result in issuance of a Yellow Card at the discretion of the referees. Contact with the Playing Field, a Game Element, or a Robot for safety reasons will not result in a warning or Penalty.

For example, a Game Element is launched from a Robot on the Playing Field and it Inadvertently hits a Team member in the Alliance Station and is deflected back onto the field. The Team would not receive a Penalty because the Team member was protecting him/herself (safety). However, if that same Game Element is caught and/or directed to a specific location on the Playing Field, the Team may be issued a Penalty.

<G12> Autonomous to Driver-Controlled Period Transition – At the conclusion of the Autonomous Period, Robots will remain in a hands-off state. Field personnel will not enter the field and will not touch Robots on the field during the Autonomous to Driver-Controlled transition. Drive Teams will have 5 seconds to pick up their Driver Station. The scoring system display will provide visual and audio cues for Drive Teams to pick up their Driver Stations. After the 5 seconds, there will be a 3-2-1 countdown and the Driver-Controlled Period of the Match will begin.

<G13> Drive Team Coach Driver Station Control – During the Driver-Controlled Period, Robots must be remotely operated only by the Drivers using the Gamepads connected to the Team’s Driver Station and/or by software running on the on-board Robot control system. The first instance of Coach controlling a Robot (for example, operating a Gamepad) will result in a warning, with any following instances resulting in a Major Penalty. During the Driver-Controlled Period, Drive Team Coaches and/or Drivers are allowed to hold the Team’s Driver Station Android device and interact with it to select an Op Mode, view information displayed on the screen, and initialize, start, stop, and reset the Robot.

<G14> Certifying the Score at Match End – Scores will be tracked by field personnel throughout the Autonomous and Driver-Controlled Periods of the Match. At the conclusion of the Match, the final Score will be certified as quickly as possible. A change in state of a Game Element or Robot at the end of the Match after its final Score is recorded will not change an already-recorded Score. Scoring Elements will not be recounted at the end of the Match.

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<G15> **Robots Deliberately Detaching Parts** – Parts may not be deliberately detached from **Robots** during a **Match** or leave mechanisms on the **Playing Field** unless permitted by a **Game Specific Rule**. The consequence of deliberately detaching a part is a **Minor Penalty** if it does not **Block** an opposing **Alliance Robot**, **Alliance-specific Scoring Element** or **Scoring Area**. If a deliberately-detached component or mechanism affects gameplay by any **Robot**, the offending **Robot** will receive a **Major Penalty** and will be issued a **Yellow Card**. **Robots** parts that are released but remain connected by a tether are considered detached for the purposes of this rule.

Tethered components that move independent of the main **Robot** are considered a detached component and are illegal.

<G16> **Robots Grasping Game Elements** – **Robots** may not grab, grasp and/or attach to any **Game Element**, **Robot**, or structure other than **Scoring Elements**, unless specifically allowed by game-specific rule(s) listed in Section 1.6.3. The first instance will result in a warning with any following violations resulting in a **Major Penalty**.

<G17> **Destruction, Damage, Tipping, etc.** – Strategies and/or mechanisms aimed solely at the destruction, damage, tipping over, or entanglement of **Robots** or **Game Elements** are not in the spirit of the **FIRST Tech Challenge** and are not allowed. However, **FIRST Tech Challenge** games are highly interactive and **Robot-to-Robot** contact and defensive game play should be expected. Some tipping, entanglement, and damage may occur as a part of normal gameplay. If the tipping, entanglement, or damage is ruled to be deliberate or chronic, the offending **Team** will receive a **Major Penalty** and a **Yellow Card**.

<G18> **Pinning, Trapping, or Blocking Robots** – A **Robot** cannot cause an opposing **Alliance Robot** to become **Pinned, Trapped, or Blocked** for more than five seconds. If a referee determines this rule is violated, the offending **Alliance** will receive a **Minor Penalty** for every five seconds that they are in violation. If a referee declares a **Pinning, Trapping, or Blocking** warning during the **Match**, the offending **Robot** must immediately move away at least 3 feet (0.9 m), approximately 1.5 floor **Tiles**, from the **Pinned, Trapped, or Blocked Robot**.

The intent of this Rule is that **Drive Teams** begin to immediately move their **Robots** away and have a five second grace period to move the required distance, and not that they are permitted to intentionally **Block** for up to five seconds.

A **Robot** cannot incur this type of **Penalty** during the **Autonomous Period** unless it is determined by the Referee to be part of a deliberate strategy and will be penalized as described above. If the violation happens during the **Autonomous Period**, the first action done by the offending **Robot** during the **Driver-Controlled Period** must be to move away from the **Pinned, Trapped, or Blocked Robot** or a **Minor Penalty** will be assessed immediately and again for every five-seconds that they are in violation. Game-specific rule(s) listed in Section 1.6.3 that further define **Pinning, Trapping, or Blocking** take precedence over this general game rule.

<G19> **Forcing an Opponent to Break a Rule** – The actions of an **Alliance** or their **Robots** shall not cause an opposing **Alliance** or **Robot** to break a rule and thus incur **Penalties**. Any forced rule violations committed by the affected **Alliance** shall be excused, and no **Penalties** will be assigned.

<G20> **Removing Game Elements from the Playing Field** – **Robots** may not deliberately remove **Game Elements** from the **Playing Field** during a **Match**. **Game Elements** that **Inadvertently** fall **Outside** the **Playing Field** will be returned to the **Playing Field** by field personnel at the earliest safe and convenient opportunity at a non-Scoring location approximately where it left the field. **Game Elements** removed from the **Playing Field** in an attempt to **Score** are also not subject to this **Penalty**. **Teams** deliberately removing **Game Elements** from the **Playing Field** will incur a **Minor Penalty** per **Game Element** removed from the **Playing Field**. Game-specific
rule(s) listed in Section 1.6.3 that allow the removal of specified Scoring Elements from the Playing Field take precedence over this general game rule.

<G21> **Scoring Elements in Contact with Robots** – Scoring Elements in a Scoring Area that are in contact with or Controlled by a Robot on the corresponding Alliance for the Scoring Area have zero Score value. Game-specific rule(s) listed in Section 1.6.3 that allow Robot contact with Scoring Elements take precedence over this general game rule.

<G22> **Post-Match Removal of Game Elements from Robots** – Robots must be designed to permit easy removal of Game Elements from the Robot after the Match. Robots should also be able to be removed from the Playing Field without damaging the Playing Field. A Minor Penalty will be assessed for violations of this rule.

The intent of this rule is to have timely removal of Robots from the Playing Field following a Match.

> Drive Teams are expected to stage their Robots for a Match, and remove them from the Playing Field afterwards, safely and swiftly. Drive Team efforts that either intentionally or unintentionally delay the start of a Match or the Playing Field reset are not allowed. Examples include, but are not limited to:

- Failing to exit the Playing Field once instructed by a Referee.
- Failing to remove Driver Stations in a timely manner.

<G23> **Robot Manipulation of Scoring Elements** – Scoring Elements that are Controlled or Possessed by a Robot are considered to be part of the Robot except when determining the location of the Robot.

> For Example: If a Robot possesses a Scoring Element, and only that Scoring Element breaks the plane of a Scoring Area, the Robot does not receive points for being in that Area.

<G24> **Robot or Scoring Elements In Two or More Scoring Areas** – Robots or Scoring Elements that are In two or more Scoring Areas earn points only for the highest value achievement. If the achievement values are equal, only one achievement counts as Scored. Exceptions to this general rule may be specified in the Game Play section (1.5) or in the game-specific rules.

<G25> **Disabled Robot Eligibility** - If a referee Disables a Robot, it will not be eligible to Score or earn points for the remainder of the Match. A Disabled Robot (whether referee induced or failure) does not earn Penalties after becoming Disabled.

<G26> **Playing Field Tolerances** – Tournament provided Playing Field and Game Elements will start each Match with tolerances that may vary by as much as +/-1.0 inch (2.5 cm). Teams must design their Robots accordingly.

<G27> **Match Replay** – Matches are replayed at the discretion of the Head Referee only for a failure of a non-Team supplied Game Element or verified Wi-Fi interference that was likely to have impacted which Alliance won the Match.

Unexpected Robot behavior will not result in a Match replay. Team-induced failures, such as low battery conditions, processor sleep time-outs, Robot mechanical, electrical, software, or communication failures, etc. are NOT valid justifications for a replaying of a Match.

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Egregious Behavior – Egregious Robot or Team member behavior at the Playing Field, as determined by the referees, will result in a Major Penalty and issuance of a Yellow Card and/or Red Card. Subsequent violations will result in Team Disqualification from the tournament. Egregious behavior includes, but is not limited to, repeated and/or flagrant violation of game rules, unsafe behavior or actions, and uncivil behavior towards Drivers, Coaches, competition personnel, or event attendees.

Illegal Usage of Game Elements - Robots may not deliberately use Game Elements in an attempt to ease or amplify the difficulty of any Scoring or game activity. A Major Penalty will be assessed for violations of this rule. Continued violations of this rule will escalate to Yellow Cards quickly.

Inadvertent and Inconsequential - Robot actions that violate a rule may be ruled at the referee’s discretion to be Inconsequential and Inadvertent and will not be Penalized.

1.6.3 Game-Specific Rules
Drive Teams Touching Robots or Driver Stations after Sample Randomization – Drive Teams are not allowed to touch or interact with their Robots or Driver Stations once field personnel have begun the randomization process. If this occurs, a Minor Penalty will be assessed, and the affected Robot is not eligible to earn the Sample Score in the Autonomous Period. This Penalty only affects the offending Team. The non-offending Alliance Partner Robot remains eligible for the Sample Scoring achievement.

Autonomous Period Robot Interference – Robots may not Interfere with the opposing Alliance’s Scoring attempts or Sample Field during the Autonomous Period. A Major Penalty will be assessed for violating this rule. Robots attempting to Score in a Crater are exempt from this rule.

The intent of this rule is to allow Robots to Score their Autonomous points without defensive play by the opposing Alliance. Inadvertent and Inconsequential actions will be treated per <G30>.

Since both Craters are Alliance neutral, Inadvertent and/or Inconsequential interaction between opposing Alliance Robots attempting to enter the Craters should not be considered illegal Interference. Robot actions that run an unnecessary risk of preventing opposing Robot access to the Crater is likely to be seen as illegal Interference. Teams should take this into consideration when designing their autonomous program.

Control/Possession Limits of Minerals – A Robot may Control or Possess a maximum of two (2) Minerals at a time. However, due to the density of Minerals within the Crater, Robots may temporarily exceed this limit while collecting Minerals that are In the Crater. Robots are required to shed excess Minerals before performing any other gameplay activities. Within the Crater, plowing through any quantity of Minerals is allowed but herding or directing multiple Minerals beyond the allotted maximum to gain a strategic advantage (i.e., Scoring, accessibility, defense) is not allowed. The Penalty for Controlling or Possessing more than the allotted maximum is an immediate Minor Penalty for each Mineral above the limit plus an additional Minor Penalty per Mineral for each 5-second interval that this situation continues. A Major Penalty will be assessed.

Robot designs that obscure visibility of Minerals within a Robot may prevent referees from providing feedback to Drive Teams about violations of <GS3> and may lead to the Robot earning Penalties.
for each Mineral Scored while a Robot Controls or Possesses more than the allotted maximum. Continued violation of this rule will escalate to Yellow Cards quickly.

<GS4> De-scoring Minerals – Robots may not remove or re-position Minerals from the Cargo Holds. Robots may remove Minerals from their opposing Alliance’s Depot if it was not Completely Claimed in the Autonomous Period. Robots may remove Minerals from their own Alliance’s Depot. A Minor Penalty will be assessed for each Mineral illegally removed or re-positioned.

<GS5> Blocking Access to Scoring in the Lander - Robots may not Block access to an opposing Alliance’s Lander Cargo Hold or Lander Support Bracket. The first instance will result in an immediate Major Penalty and an additional Minor Penalty assessed for every five-seconds that the rule violation persists. If the referee declares a Blocking access Penalty, the offending Robot must move away at least 3 ft. (0.9 m), approximately 1.5 floor Tiles from the opponent’s Landing Zone. Additional occurrences of violations of this rule will escalate to Yellow Cards quickly.

<GS6> Interfering with Scoring at the Lander – Robots may not Interfere with the opposing Alliance’s Robot while that Robot is In their Alliance’s Landing Zone attempting to Score Minerals or Latch to the Lander. Interference results in an immediate Major Penalty and an additional Minor Penalty assessed for every five-seconds that the rule violation persists. The intent of this rule is to allow Robots to Score Minerals or Latch without Interference. Additional occurrences of violations of this rule will escalate to Yellow Cards quickly.

<GS7> Latching before the End Game - Deployed Robots are not allowed to intentionally Support any portion of their weight with the Lander Support Bracket prior to the start of the End Game. Robots that attempt to Latch to the Lander Support Bracket before the start of the End Game are not eligible to Score the End Game Latching achievement.

<GS8> Latching to the Lander - Robots may latch only onto either of their Alliance specific Lander Support Brackets. A Major Penalty is assessed for violating this rule.

<GS9> Launching Game Elements - Robots In the Landing Zone for their corresponding Alliance may Launch Game Elements in an attempt to Score in a Cargo Hold. Robots Outside their Alliance’s Landing Zone may not Launch Game Elements. A Minor Penalty is assessed for each illegally Launched Game Element. Additional occurrences of violations of this rule will escalate to Yellow Cards quickly.

Illegally Launched Scoring Elements are eligible to be counted as Scored and a Minor Penalty is assessed for each illegally Launched Game Element.

<GS10> Robot Scoring while In Crater - Robots In a Crater are not eligible to Score Minerals. Violations of this rule will result in a Minor Penalty per offense. Additional occurrences of violations of this rule will escalate to Yellow Cards quickly.

<GS11> Obstructing Travel Between Lander and Crater – Robots may not obstruct another Robot’s path of travel in the area between the Lander and a Crater for more than 5 seconds. If a referee determines this rule is violated, the offending Alliance will receive a Minor Penalty for every five seconds that they are in violation of this rule. This rule only applies during the Driver-Controlled Period.

The intent of this Rule is that Drive Teams begin to immediately move their Robots away and have a five second grace period to move the required distance, and not that they are permitted to intentionally Block for up to five seconds.
1.7 Scoring Summary
The following table shows the possible Scoring achievements and their point values. The table is a quick reference guide and not a substitute for a thorough understanding of the game manual.

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<td></td>
</tr>
<tr>
<td>Mineral</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Any Mineral in Depot</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1.5.3 - 1</td>
</tr>
<tr>
<td>- Gold in Gold Cargo Hold</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>1.5.3 - 2</td>
</tr>
<tr>
<td>- Silver in Silver Cargo Hold</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>1.5.3 - 3</td>
</tr>
<tr>
<td>- Gold in Silver Cargo Hold</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.5.3 - 4</td>
</tr>
<tr>
<td>- Silver in Gold Cargo Hold</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.5.3 - 4</td>
</tr>
</tbody>
</table>

** - The End Game occurs during the last thirty-seconds of the Driver-Controlled Period.

1.8 Rule Summary
The following table shows the possible rule violations and their consequences. The table is a quick reference guide and not a substitute for a thorough understanding of the complete rule descriptions in section 1.6.

<table>
<thead>
<tr>
<th>Rule #</th>
<th>Rule</th>
<th>Consequence</th>
<th>Warning Disable</th>
<th>Minor Penalty</th>
<th>Major Penalty</th>
<th>Card Issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Rules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;S1&gt;</td>
<td>Unsafe Robot.</td>
<td>Disable if unsafe operation is likely to persist. Optional Yellow Card.</td>
<td>D</td>
<td></td>
<td></td>
<td>YC*</td>
</tr>
<tr>
<td></td>
<td>Damage to the Playing Field.</td>
<td>Warning escalating to Disable. Optional Yellow Card.</td>
<td>W D</td>
<td></td>
<td></td>
<td>YC*</td>
</tr>
<tr>
<td>&lt;S2&gt;</td>
<td>Contact Outside the Playing Field.</td>
<td>Immediate Yellow Card and Optional Disable unless allowed by rule.</td>
<td>D*</td>
<td></td>
<td></td>
<td>YC</td>
</tr>
<tr>
<td>&lt;S3&gt;</td>
<td>Drive Team missing safety gear.</td>
<td>Warning and if not resolved within 30 seconds, the offending member(s) of the Drive Team must leave the Competition Area and may not be replaced.</td>
<td>W+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Rules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;G1&gt;</td>
<td>Drive Team using disallowed electronic communication.</td>
<td>Warning followed by a Minor Penalty.</td>
<td>W</td>
<td>1x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rule #</td>
<td>Rule</td>
<td>Consequence</td>
<td>Warning Disable</td>
<td>Minor Penalty</td>
<td>Major Penalty</td>
<td>Card Issued</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>---------------</td>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>&lt;G2&gt;</td>
<td>Pre-Match Robot setup – Entering the Playing Field.</td>
<td>May lead to Disqualification from Match or Tournament.</td>
<td></td>
<td></td>
<td></td>
<td>DQ*</td>
</tr>
<tr>
<td>&lt;G3&gt;</td>
<td>Pre-Match Robot placement.</td>
<td>Minor Penalty if Teams delay start of Match.</td>
<td></td>
<td></td>
<td></td>
<td>1x</td>
</tr>
<tr>
<td>&lt;G4&gt;</td>
<td>Robot starting volume.</td>
<td>Robot is Disabled, powered off, and removed from the Playing Field.</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>&lt;G5&gt;</td>
<td>Robot setup alignment devices/Match Delay.</td>
<td>Minor Penalty for each offense.</td>
<td></td>
<td></td>
<td></td>
<td>1x</td>
</tr>
<tr>
<td>&lt;G6&gt;</td>
<td>Drive Team member(s) leaving the Alliance Station.</td>
<td>Warning for the first instance with any following instances resulting in a</td>
<td>W</td>
<td></td>
<td></td>
<td>1x</td>
</tr>
<tr>
<td>&lt;G7&gt;</td>
<td>Starting Game Play Early.</td>
<td>Minor Penalty with the option of a Major Penalty if the early start results in a competitive advantage for the offending Alliance.</td>
<td></td>
<td></td>
<td></td>
<td>1x 1x</td>
</tr>
<tr>
<td>&lt;G8&gt;</td>
<td>Late Start of the Autonomous Period.</td>
<td>Minor Penalty with the option of a Major Penalty if the late start results in a competitive advantage for the offending Alliance.</td>
<td></td>
<td></td>
<td></td>
<td>1x 1x</td>
</tr>
<tr>
<td>&lt;G9&gt;</td>
<td>Robot control during Autonomous Period / Early stopping of Autonomous code.</td>
<td>Major Penalty for each offense.</td>
<td></td>
<td></td>
<td></td>
<td>1x</td>
</tr>
<tr>
<td>&lt;G10&gt;</td>
<td>Stopping Game Play Late.</td>
<td>Minor Penalty and the actions of the Robot that occur after the end of game play do not count towards their Alliance’s Score. Major Penalty if the late stop results in a competitive advantage for the offending Alliance.</td>
<td></td>
<td></td>
<td></td>
<td>1x 1x</td>
</tr>
<tr>
<td>&lt;G11&gt;</td>
<td>Drive Team contact with the Playing Field, Game Element, or Robot.</td>
<td>Warning for the first instance with any following instances resulting in a Minor Penalty. Optional Yellow Card if contact affects Scoring and/or game play. Contact for safety reasons will not result in a warning or Penalty.</td>
<td>W</td>
<td></td>
<td></td>
<td>YC*</td>
</tr>
<tr>
<td>&lt;G13&gt;</td>
<td>Drive Team Coach Driver Station Control.</td>
<td>Warning for the first instance with any following instances resulting in a Major Penalty.</td>
<td>W</td>
<td></td>
<td></td>
<td>1x</td>
</tr>
<tr>
<td>&lt;G15&gt;</td>
<td>Robots deliberately detaching parts.</td>
<td>Minor Penalty. Major Penalty and a Yellow Card if it affects gameplay.</td>
<td></td>
<td></td>
<td></td>
<td>YC</td>
</tr>
<tr>
<td>&lt;G16&gt;</td>
<td>Robots illegally grasping Game Elements.</td>
<td>Warning for the first instance with any following instances resulting in a Major Penalty.</td>
<td>W</td>
<td></td>
<td></td>
<td>1x</td>
</tr>
<tr>
<td>&lt;G17&gt;</td>
<td>Destruction, damage, tipping, etc.</td>
<td>Deliberate or chronic violations of this rule will receive a Major Penalty and a Yellow Card.</td>
<td></td>
<td></td>
<td></td>
<td>YC</td>
</tr>
</tbody>
</table>
## Game-Specific Rules

<table>
<thead>
<tr>
<th>Rule #</th>
<th>Rule</th>
<th>Consequence</th>
<th>Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;GS1&gt;</td>
<td>Touching Robots or Driver Stations after Sample Randomization.</td>
<td>Minor Penalty and Robot is not eligible to earn the Sample Score.</td>
<td>1x+</td>
</tr>
<tr>
<td>&lt;GS2&gt;</td>
<td>Interference with opposing Alliance Scoring or Sample Field during Autonomous.</td>
<td>Major Penalty will be assessed.</td>
<td>1x</td>
</tr>
<tr>
<td>&lt;GS3&gt;</td>
<td>Control / Possession limits of Minerals.</td>
<td>Minor Penalty per Mineral plus an additional Minor Penalty per five seconds. Major Penalty if Mineral is Scored. May escalate to Yellow Card.</td>
<td>1x 1x+ YC</td>
</tr>
<tr>
<td>&lt;GS4&gt;</td>
<td>De-scoring Minerals from Cargo Holds or Completely Claimed Depots.</td>
<td>Minor Penalty per Mineral.</td>
<td>1x+</td>
</tr>
<tr>
<td>&lt;GS5&gt;</td>
<td>Blocking access to Scoring in Lander.</td>
<td>Major Penalty is assessed plus an additional Minor Penalty per 5 seconds in violation. May escalate to Yellow Card.</td>
<td>1x 1x YC*</td>
</tr>
<tr>
<td>&lt;GS6&gt;</td>
<td>Interfering with Scoring in Lander.</td>
<td>Major Penalty is assessed plus an additional Minor Penalty per 5 seconds in violation. May escalate to Yellow Card.</td>
<td>1x 1x YC*</td>
</tr>
<tr>
<td>&lt;GS7&gt;</td>
<td>Latching before End Game begins.</td>
<td>Robot ineligible to Score the Latching achievement.</td>
<td></td>
</tr>
<tr>
<td>Rule #</td>
<td>Rule</td>
<td>Consequence</td>
<td>Warning</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>-------------</td>
<td>---------</td>
</tr>
<tr>
<td>&lt;GS8&gt;</td>
<td>Latching to opposing Alliance’s Lander Support Bracket.</td>
<td>Major Penalty is assessed.</td>
<td></td>
</tr>
<tr>
<td>&lt;GS9&gt;</td>
<td>Launching Game Elements illegally.</td>
<td>Minor Penalty per occurrence. May escalate to Yellow Card.</td>
<td>1x</td>
</tr>
<tr>
<td>&lt;GS10&gt;</td>
<td>Illegally Scoring Minerals while In Crater</td>
<td>Minor Penalty per occurrence. May escalate to Yellow Card.</td>
<td>1x</td>
</tr>
<tr>
<td>&lt;GS11&gt;</td>
<td>Obstructing travel between the Lander and Crater</td>
<td>Minor Penalty per 5 seconds in violation.</td>
<td></td>
</tr>
</tbody>
</table>

**Column Key**
- 1x: Penalty at normal (single) cost
- 2x: Penalty at double cost
- D: Robot Disabled
- D*: Robot optionally Disabled
- DQ*: Possible Disqualification
- RC: Red Card issued
- W: Warning
- YC: Yellow Card issued
- YC*: Yellow Card optionally issued

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Appendix A – Resources

Game Forum Q&A
http://ftcforum.usfirst.org/forum.php
Anyone may view questions and answers within the FIRST® Tech Challenge Game Q&A forum without a password. To submit a new question, you must have a unique Q&A System User Name and Password for your team.

Volunteers that apply for a specific volunteer role will receive an email from FTCTrainingSupport@firstinspires.org with their username and password to the forum. You will receive access to the forum thread specific to your role.

FIRST Tech Challenge Game Manuals

FIRST Headquarters Pre-Event Support
Phone: 603-666-3906
Mon – Fri
8:30am – 5:00pm Eastern Time
Email: firstechallengeteams@firstinspires.org

FIRST Websites
FIRST homepage – www.firstinspires.org
FIRST Tech Challenge Page – For everything FIRST Tech Challenge.
FIRST Tech Challenge Volunteer Resources – To access public Volunteer Manuals.
FIRST Tech Challenge Event Schedule – Find FIRST Tech Challenge events in your area.

FIRST Tech Challenge Social Media
FIRST Tech Challenge Twitter Feed - If you are on Twitter, follow the FIRST Tech Challenge Twitter feed for news updates.
FIRST Tech Challenge Facebook page - If you are on Facebook, follow the FIRST Tech Challenge page for news updates.
FIRST Tech Challenge YouTube Channel – Contains training videos, Game animations, news clips, and more.
FIRST Tech Challenge Blog – Weekly articles for the FIRST Tech Challenge community, including Outstanding Volunteer Recognition!
FIRST Tech Challenge Team Email Blasts – contain the most recent FIRST Tech Challenge news for Teams.

Feedback
We strive to create support materials that are the best they can be. If you have feedback about this manual, please email firstechallengeteams@firstinspires.org. Thank you!
Appendix B - Field Details

Sample Field

The type of Minerals positioned at the three locations in the Sample Field will be randomized prior to each Match. There will always be one (1) Gold and two (2) Silver Minerals. The starting locations for the Samples are 2” x 2” strips of red or blue Gaffer tape located as shown in Figure B1-1. The two outside tape strips are positioned in the corners of the Tile, adjacent to the inside edge of the Tile tabs. The third tape strip is located midway between the two outside strips.
**Lander**

![Lander Diagram](image)

**Figure B-3  Lander Detail**

**Lander Support Bracket**

![Lander Support Bracket Diagram](image)

**Figure B-4  Lander Support Bracket Detail**
**Navigation Target**

The center of the Target is centered on the Perimeter Wall.

The middle of the Target is 5.75” above the floor outside the field.

**Figure B-5  Navigation Target Location**

- **Target 1**
  - Front Wall (audience facing)

- **Target 2**
  - Red Alliance Wall

- **Target 3**
  - Back Wall

- **Target 4**
  - Blue Alliance Wall

**Figure B-6  Navigation Targets**

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Crater

Figure B-7  Silver and Gold Minerals will be randomly mixed. Each Crater will contain approximately half the available Minerals.

Landing Zone

Figure B-8  Landing Zone Dimensions
Appendix C – Game Elements

Minerals

Figure C-1 There are sixty (60) Silver and ninety (90) Gold Minerals on the Playing Field.

Team Markers

Figure C-2 A Team Marker is supplied by the Team and is constrained by the rules in section 8.4 in the Game Manual Part 1.
Appendix D – Sample Field

Example 1: Red earns the Sampling points. The Gold Sample has been moved Completely Off the starting location and the Silver Samples are still In their starting locations.

Example 2: Red does not earn the Sampling points. The Gold Sample has been moved Completely Off the starting location but one of the Silver Samples is Outside of it's starting location.

Example 3: Red does not earn the Sampling points. The Gold Sample has not been moved Completely Off the starting location.

Figure D-1  Sample Field Scoring Examples

Note: The Gold Sample will always be placed such that the hole pattern is facing up.

Figure D-2  Sample Field Pattern determined by die roll
Appendix E – Cargo Hold Scoring

Per section 1.5.3 – 5, the Cargo Hold volume is defined by the 5 inner surfaces of the Cargo Hold and the horizontal extension of the upper edge of the clear panel on the outside of the Cargo Hold.

Figure E-1 Cargo Hold Scoring