

# 1 INTRODUCTION

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## 1.1 About FIRST®

FIRST® (For Inspiration and Recognition of Science and Technology) was founded by inventor Dean Kamen to inspire young people's interest in science and technology. As a robotics community that prepares young people for the future, FIRST is the world's leading youth-serving nonprofit advancing STEM education. For 30 years, FIRST has combined the rigor of STEM learning with the fun and excitement of traditional sports and the inspiration that comes from community through programs that have a proven impact on learning, interest, and skill-building inside and outside of the classroom.

FIRST provides programs that span a variety of age groups:

- FIRST® Robotics Competition for grades 9-12, ages 14-18
  - FIRST® Tech Challenge for grades 7-12, ages 12-18
  - FIRST® LEGO® League for grades Pre-K -8, ages 4-16
    - FIRST® LEGO® League Challenge for grades 4-8 (ages 9-16\*)
    - FIRST® LEGO® League Explore for grades 2-4 (ages 6-10)
    - FIRST® LEGO® League Discover for grades Pre-K-1 (ages 4-6)
- \*Ages and grades vary by country

Please visit our website: [www.firstinspires.org](http://www.firstinspires.org) for more information about FIRST and its programs.

## 1.2 In Memoriam

In October 2019, Dr. Woodie Flowers, an innovator in design and engineering education and the Distinguished Advisor to FIRST and supporter of our mission, passed away. As thousands of heartfelt tributes to Woodie have poured in from around the world, it is clear his legacy will live on indefinitely through the gracious nature of our community and our ongoing commitment to empowering educators and building global citizens.



Figure 1-1 Dr. Woodie Flowers, 1943-2019

## 1.3 FIRST® Robotics Competition

FIRST® Robotics Competition combines the excitement of sport with the rigors of science and technology. Teams of students are challenged to design, build, and program industrial-size robots and compete for awards, while they also create a team identity, raise funds, hone teamwork skills, and advance respect and appreciation for STEM within the local community.

Volunteer professional mentors lend their time and talents to guide each team. It's as close to real-world engineering as a student can get. Plus, high school students gain access to exclusive scholarship opportunities from colleges, universities, and technical programs.

Prior to the 2021 season, a new, challenging game was introduced each January at an event known as "Kickoff." Due to the 2020 season being disrupted by the COVID-19 pandemic, the 2021 Kickoff presented a modified version of the 2020 game, INFINITE RECHARGE<sup>SM</sup>. Each exciting competition combines the practical application of science and technology with the fun, intense energy and excitement of a championship-style sporting event. Teams are encouraged to display *Gracious Professionalism*<sup>®</sup>, help other teams, and cooperate while competing. This is known as *Coopertition*<sup>®</sup>.

The 2021 season includes a series of three new challenges in which teams can engage from "home" and virtually compete with teams from around the world.

1. **INFINITE RECHARGE at Home** invites teams to engage in two ways: compete for judged awards using their 2020/2021 robot and compete in a Skills Competition, a series of challenges for teams who have access to their robot.
2. **The Game Design Challenge** invites teams to design a FIRST Robotics Competition game and compete for judged awards and an opportunity to share their design with FIRST Robotics Competition game designers.
3. **The FIRST Innovation Challenge presented by Qualcomm** invites teams to identify a real-world global issue and develop an innovative solution.

This manual and details about the At Home Challenges were presented at the 2021 FIRST Robotics Competition Kickoff on Saturday, January 9, 2021.

At the 2020 Kickoff, teams:

- saw the 2020 game, INFINITE RECHARGE, for the first time
- learned about the 2020 game rules and regulations
- received a Kickoff Kit that provided a starting point for robot build

At the 2021 Kickoff, all teams:

- learned details about the 2021 At Home Challenges, for the first time
- were provided resources for the 2021 game, which is a modified version of the 2020 game, INFINITE RECHARGE
- gained access to the FIRST Choice component of the [2021 Kit of Parts](#)

### 1.4 Gracious Professionalism<sup>®</sup>, a FIRST<sup>®</sup> Philosophy

*Gracious Professionalism*<sup>®</sup> is part of the ethos of FIRST. It's a way of doing things that encourages high quality work, emphasizes the value of others, and respects individuals and the community.

*Gracious Professionalism* is not clearly defined for a reason. It can and should mean different things to everyone.

Some possible meanings of *Gracious Professionalism* include:

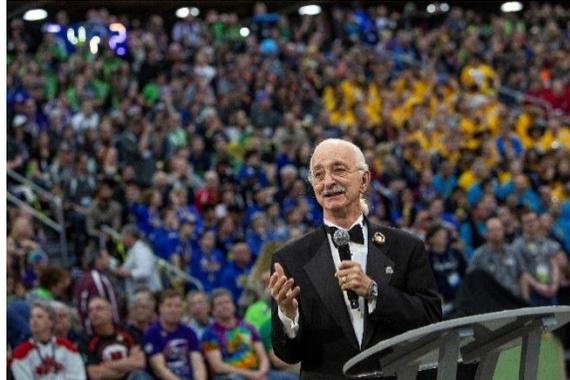
- Gracious attitudes and behaviors are win-win.
- Gracious folks respect others and let that respect show in their actions.
- Professionals possess special knowledge and are trusted by society to use that knowledge responsibly.
- Gracious Professionals make a valued contribution in a manner pleasing to others and to themselves.

In the context of *FIRST*, this means that all teams and participants should:

- Learn to be strong competitors, but also treat one another with respect and kindness in the process.
- Avoid leaving anyone feeling as if they are excluded or unappreciated.

Knowledge, pride and empathy should be comfortably and genuinely blended.

In the end, *Gracious Professionalism* is part of pursuing a meaningful life. When professionals use knowledge in a gracious manner and individuals act with integrity and sensitivity, everyone wins and society benefits.



*The FIRST spirit encourages doing high-quality, well-informed work in a manner that leaves everyone feeling valued. Gracious Professionalism seems to be a good descriptor for part of the ethos of FIRST. It is part of what makes FIRST different and wonderful.*

*- Dr. Woodie Flowers, (1943 – 2019)  
Distinguished Advisor to FIRST*

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It is a good idea to spend time going over this concept with your team and reinforcing it regularly. We recommend providing your team with real-life examples of *Gracious Professionalism* in practice, such as when a team loans valuable materials or expertise to another team that they will later face as an opponent in competition. Routinely highlight opportunities to display *Gracious Professionalism* at events and encourage team members to suggest ways in which they can demonstrate this quality themselves and through outreach activities.

## 1.5 Coopertition<sup>®</sup>

At *FIRST*, *Coopertition*<sup>®</sup> is displaying unqualified kindness and respect in the face of fierce competition. *Coopertition* is founded on the concept and philosophy that teams can and should help and cooperate with one another even as they compete. *Coopertition* involves learning from teammates and mentors. *Coopertition* means competing always but assisting and enabling others when you can.

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***A Message from Woodie Flowers Award Recipients***

*The Woodie Flowers Award is the most prestigious mentoring award in FIRST. The prior award recipients created an important message for all FIRST Robotics Competition teams as we approach the challenges for the 2021 season.*

*Performing at your best is important. Winning is important. This is a competition.*

*However, winning the right way and being proud of what you have accomplished and how you have accomplished it is more important. FIRST could create rules and penalties to cover almost any scenario or situation, but we prefer an understandable challenge with simpler rules that allow us to think and be creative in our designs and solutions.*

*We want to know that everyone is playing at their best in every challenge. We want to know they are playing with integrity and not using strategies based on questionable behaviors.*

*As your team prepares for the challenges of the 2021 season, implements your ideas and solutions, execute your strategies, and live your daily lives, remember what Woodie said time and time again, and let's 'Make your Grandmother proud.'*

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<i>Woodie Flowers</i>	<i>Paul Copioli (3310, 217)</i>	<i>Fredi Lajvardi (842)</i>
<i>Liz Calef (88)</i>	<i>Rob Mainieri (812, 64, 498, 2735, 6833)</i>	<i>Lane Matheson (932)</i>
<i>Mike Bastoni (23)</i>	<i>Dan Green (111)</i>	<i>Mark Lawrence (1816)</i>
<i>Ken Patton (51, 65)</i>	<i>Mark Breadner (188)</i>	<i>Eric Stokely (258, 360, 2557, &amp; 5295)</i>
<i>Kyle Hughes (27)</i>	<i>John Novak (16, 323)</i>	<i>Glenn Lee (359)</i>
<i>Bill Beatty (71)</i>	<i>Chris Fultz (234)</i>	<i>Gail Drake (1885)</i>
<i>Dave Verbrugge (5110, 67)</i>	<i>John Larock (365)</i>	<i>Allen Gregory (3847)</i>
<i>Andy Baker (3940, 45)</i>	<i>Earl Scime (2614)</i>	<i>Lucien Junkin (118)</i>
<i>Dave Kelso (131)</i>		

## **1.6 This Document & Its Conventions**

The 2021 INFINITE RECHARGE Game Manual is a resource for all FIRST Robotics Competition teams for information specific to the 2021 INFINITE RECHARGE game. Its audience will find the following detail:

- a general overview of the INFINITE RECHARGE game
- detail about the INFINITE RECHARGE playing field
- description of how to play the INFINITE RECHARGE game
- all season rules (e.g. safety, conduct, game play, inspection, etc.)
- description of how teams advance at 2021 tournaments and throughout the season (pending approval of in-person events)

All participants should also study the [Event Rules Manual](#) as it details event rules and expectations that perpetuate from season to season. That content complements, and carries the same weight as, this document.

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

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

Links to other section headings in this manual and external articles appear in [blue underlined text](#).

Key words that have a particular meaning within the context of the *FIRST* Robotics Competition and INFINITE RECHARGE are defined in the [Glossary](#) section and indicated in ALL CAPS throughout this document.

The rule numbering scheme uses an indication of the section in which the rule is stated plus a serial numbering system (e.g. safety rules begin with “S,” game rules begin with “G,” etc.). References to specific rules use this scheme (e.g. “S1” is the [Safety Rules](#) section).

Warnings, cautions and notes appear in blue boxes. Pay close attention to their contents as they’re intended to provide insight into the reasoning behind a rule, helpful information on understanding or interpreting a rule, and/or possible “best practices” for use when implementing systems affected by a rule.

While blue boxes are part of the manual, they do not carry the weight of the actual rule (if there is an inadvertent conflict between a rule and its blue box, the rule supersedes the language in the blue box).

Imperial dimensions are followed by comparable metric dimensions in parentheses to provide metric users with the approximate size, weight, etc. Metric conversions for non-rules (e.g. FIELD dimensions) round to the nearest whole unit, e.g. “17 in. (~43 cm)” and “6 ft. 4 in. (~193 cm).” Metric conversions in rules round such that the metric dimension is compliant with the rule (i.e. maximums round down, minimums round up). The metric conversions are offered for convenient reference only and do not overrule or take the place of the imperial dimensions presented in this manual and the field drawings (i.e. field dimensions and rules will always defer to measurements using imperial units).

Some sections and rules include colloquial language, also called headlines, in an effort to convey an abbreviated intent of the rule or rule set. This language is differentiated using **bold blue text**. Any disagreement between the specific language used in the rules and the colloquial language is an error, and the specific rule language is the ultimate authority. If you discover a disparity, please [let us know](#) and we will correct it.

Team resources that aren't generally season specific (e.g. what to expect at an event, communication resources, team organization recommendations, robot transportation procedures, and award descriptions) can be found on the [FIRST Robotics Competition website](#).

## 1.7 Translations & Other Versions

The *INFINITE RECHARGE Game Manual* and the *At Home Challenge Manual* are originally and officially written in English and are occasionally translated into other languages for the benefit of FIRST Robotics Competition teams whose native language is not English.

Text-based English versions can be provided only for use with assistive devices for visually and hearing-impaired persons, and not for redistribution. For more information, please contact [frcteamadvocate@firstinspires.org](mailto:frcteamadvocate@firstinspires.org).

In the event that a rule or description is modified in alternate versions of these manuals, the English pdf versions as published on the [INFINITE RECHARGE - Season Materials](#) are the commanding versions.

## 1.8 Team Updates

Team Updates are used to notify the FIRST Robotics Competition community of revisions to the official season documentation (e.g. the manuals, drawings, etc.) or important season news. Between Kickoff and February 2, 2021, Team Updates are posted each Tuesday and Friday. Starting February 9, 2021, Team Updates will be posted on Tuesdays only, and edits will be limited to only those that won't impact challenge submission content (e.g. correcting an award count error, control system updates, etc.). Additional Team Updates and their posting frequency will be announced if an in-person season is approved. Team Updates are posted on the [Season Materials web page](#) and are generally posted before 5 pm, Eastern. Users 18 years old and older may request email alerts to be notified when Team Updates are posting using [this form](#).

Generally, Team Updates follow the following convention:

- Additions are highlighted in yellow. **This is an example.**
- Deletions are indicated with a strikethrough. ~~This is an example.~~
- Notes that are added for clarity or explanation for the change but are not retained as part of the manual appear in bold. **This is an example.**

## 1.9 Question and Answer System Sponsored by Autodesk®

The Q&A sponsored by Autodesk® is a resource for clarifying *2021 INFINITE RECHARGE Game Manual*, *2021 At Home Challenge Manual*, [Awards web page](#), [Self-Inspection Checklist](#), [official FIELD drawings](#), and/or [FIRST Robotics Competition Event Experience web page](#) content. For questions about other materials (e.g. Game Design Activities), please inquire using the [2021 Season Supplemental Resources section of the FIRST Forums](#). Teams can search for previously asked questions and responses or pose new questions. Questions can include examples for clarity or reference multiple rules to understand the relationships and differences between them.

The Q&A opens on January 13, 2021, 12:00 PM Eastern. Details on the Q&A can be found on the [INFINITE RECHARGE – Season Materials web page](#). The Q&A may result in revisions to the text in the official Manuals (which are communicated using [Team Updates](#)).

The responses in the Q&A do not supersede the text in the manuals, although every effort will be made to eliminate inconsistencies between them. While responses provided in the Q&A may be used to aid discussion at each event, per [Inspection & Eligibility Rules](#) and [REFEREE Interaction](#) sections,

REFEREES and Inspectors are the ultimate authority on rules. If you have concerns about enforcement trends by volunteer authorities, please notify *FIRST* at [firstroboticscompetition@firstinspires.org](mailto:firstroboticscompetition@firstinspires.org).

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

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

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

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

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

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

Questions from "FRC 99999" represent content asked by key volunteers (e.g. Referees, Inspectors, etc.), answered by *FIRST* headquarters, and are considered relevant to teams.



