# The FRC Survival Guide

A compilation of resources for the
FIRST Robotics Competition

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# Introduction

This guide was created to be the ultimate collection of FRC resources. It was started by two alumni from FRC team 4468, Fernbank LINKS Robotics, with the help of a friend from FRC team 4188, Columbus Space Program, based on resources and tutorials we found useful, both as students and as mentors. This guide is a compilation of already-existing resources made available by various individuals and teams. You will notice asterisks (*) next to resources that we deemed to be especially useful and have chosen to be our "Editors' Picks." We want to give an extra big thank you to all of the teams and individuals that created and shared the resources included in this guide. If you have any feedback or suggestions for future editions, please feel free to email us or message us on Chief Delphi.

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Extra thanks to Trent Callan, Megan Guttieri, Nate Laverdure, Andrew Lawrence, Billfred Leverette, Tynan Purdy, Valeria Shum, and Pauline Tasci  for their input and help in creating and reviewing this guide.

# General Resources

*[**Game and Season Materials**](#) - The official FIRST page that houses all game-related manuals and resources for the current year. If there is one website in this guide that you check regularly, it should be this one, because it is the only place where official game rules and season information is updated and clarified.

*[**Chief Delphi**](#) - The unofficial forum of FIRST Robotics. You will find threads on anything and everything FRC-related. If you have a question about something, there is a good chance that there is already a thread on it, and if not, someone will probably respond to your question within a matter of hours. Be warned that the search function is not the best so you are better off doing a Google search for *site:chiefdelphi.com [topic you want to search]* (do not include the brackets in the search).

[**FRC Blog**](#) - This is the official FIRST Blog. The posts tend to be interesting bits of information or opportunities related to the FRC community. All FRC Blog posts end up on Chief Delphi, so if you want to learn more about a certain post or see what others have to say about it, check out it's corresponding thread on Chief Delphi.

[**Rookie FIRSTs**](#) - A blog from FRC team 3504, *Girls of Steel*, with tips and tricks to help rookie teams get started in FRC. Most tips are also applicable to veteran FRC teams.

[**FIRST Help Now**](#) - A 24/7 helpline during build season for any technical questions you may have while working on your robot.

[**Advice for New FIRST Teams**](#) - A presentation from FRC team 33, *Killer Bees*, that outlines everything it takes to be a successful FRC team.

[**FRCLinks**](#) - A page with shortcuts to get to different FIRST and FRC official websites.

# Team Organization

**Running a FIRST Team** - A presentation by Karthik Kanagasabapathy, former mentor of Hall-of-Fame team 1114, *Simbotics*, that highlights the organization and components of an FRC team and an overview of an average FRC season.

**Team 254 Team Handbook** - The team handbook of Hall-of-Fame team 254, *The Cheesy Poofs*, that outlines all of the rules and responsibilities of their team members.

**Team 1538 Team Handbook** - The team handbook of Hall-of-Fame team 1538, *The Holy Cows*, that outlines all of the rules and responsibilities of their team members.

**Team 2614 Team Handbook** - The team handbook of Hall-of-Fame team 2614, *MARS*, that outlines all of the rules and responsibilities of their team members.

**Team 1923 Team Handbook** - The team handbook of FRC team 1923, *the MidKnight Inventors*, that outlines all of the rules and responsibilities of their team members.

***Slack** - A great team communication platform that breaks team communication down into different channels that can be made for everything from subgroups to events. Slack also allows for easy app integrations with apps such as Google Drive and Trello. If your team is registered as a non-profit, you can qualify for Slack Standard which includes many additional features and tools.

**Trello** - An online task management platform that allows you to create different boards and to-do lists for the various aspects of your team, as well as assign tasks to different team members.

# Team Branding

[3 Tips for Making Legit FRC Videos](#) - Simple tips from FRC Nation on making an effective and good looking video for your team.

[How to Film Your Robot](#) - An in-depth paper from FRC team 3710, *FSS Cyber Falcons*, on how to effectively film and make a video about your team's robot.

[FIRST Brand and Logo](#) - The official FIRST logos and branding standards.

*[254 Branding Standards](#) - An example of the branding standards of Hall-of-Fame team 254, *The Cheesy Poofs*.

*[1538 Branding Standards](#) -  An example of the branding standards of Hall-of-Fame team 1538, *The Holy Cows*.

[Using Social Media](#) - A guide from Hall-of-Fame team 1538, *The Holy Cows*, on how to effectively utilize different social media platforms for your team.

# News and Entertainment

**FIRST Updates Now (FUN)** - An online FRC talk show that discusses FRC community news and "hot topics," gives recaps of FRC competitions, and hosts a weekly Top 25 robot ranking show during the competition season.

***RoboSports Network** - An FRC online talk show network with shows that focus on strategy, game play, check-ins with various FRC teams, and live commentary and coverage of both FRC championships.

**FRC Nation** - An FRC blog, similar to BuzzFeed, with articles ranging from cool things in the FRC community to tips for build season.

**Robotics Competition News** - A YouTube channel devoted to interviewing different teams and sponsors with many videos highlighting different teams' unique features and programs.

**Robot in 3 Days** - Teams of alumni and professional engineers who build entire FRC robots in the three days following FRC kickoff. Their YouTube page is a great resource at the beginning of the FRC season if you need inspiration on various mechanisms for the current years' game.

***The Blue Alliance** - Your one-stop shop for everything game day. You will find information for almost every FRC event including the latest competition scores, live streams, team lists, award lists, elimination brackets, and match score breakdowns.

**GameDay** - The best place to watch live streams from all of the events going on at any given time. GameDay allows you to watch up to nine streams at once, and includes a special stream during championships from RoboSports Network that jumps between the "must-watch" matches and gives insightful commentary.

**The Blue Alliance Blog** - A blog highlighting specific FRC teams and their robot designs as well as event predictions, event insights, and features on different aspects of The Blue Alliance.

**A Diner's Guide to FRC** - A blog post written by Nate Laverdure, mentor of FRC team 2363, *Triple Helix*, and Jared Russell, mentor of Hall-of-Fame team 254, *The Cheesy Poofs*, on words and terms that were coined in the FRC community, what they mean, and how they started.

**2012 Einstein Investigation Report** - The report following one of the largest "scandals" in FIRST Robotics that occurred on Einstein in 2012 and lead to FIRST releasing a whitepaper on the FMS system. If you are interested in learning more about this incident from individuals directly involved, check out this segment of FIRST Updates Now.

# Judging and Awards

**Exploding Bacon Judges Packet** - The judging packet that FRC team 1902, *Exploding Bacon*, gives to judges that describes their team history and outreach efforts.

***Chairman's Award Questions** - A list of all of the Chairman's Award questions Hall-of-Fame team 27, *Team RUSH*, was asked from 2008 to 2014.

**2014 Chairman's Submission** - The full 2014 winning Chairman's Award submission of Hall-of-Fame team 27, *Team RUSH*.

**The Complete Guide to the FRC Chairman's Award** - An in-depth guide developed by FRC team 2486, *CocoNuts*, that describes all aspects of applying and competing for the Chairman's award.

**Talking to Judges** - A blog post from FRC team 3504, *Girls of Steel*, with tips on what to expect during judging at competitions.

**Business Plan** - The full business plan from Hall-of-Fame team 2614, *MARS*, that won the Entrepreneurship Award at championships in 2013.

**How to Win More Awards** - A presentation by Kristine Atiyeh, mentor of FRC team 125, the *Neutrons*, on how to go about applying for and winning more judged awards.

***Past Winners of the Chairman's Award** - A collection of the videos, essays, and presentations from FRC Hall-of-Fame members.

**The Chairman's Award** - A presentation by Karthik Kanagasabapathy, former mentor of Hall-of-Fame team 1114, *Simbotics*, on what it takes to submit for and be competitive with the Chairman's Award.

**\*Chairman's Award Definitions** - The official FIRST definition guide on what it means to have started, mentored, assisted, and provided published resources for other teams, as well as what it means to have run, hosted, and assisted an event.

**Chairman's Presentation Examples Playlist** - A YouTube playlist made by Megan Guttieri, mentor of FRC team 971, *Spartan Robotics*, of Chairman's presentations from a variety of different teams.

**Chairman's Video Examples Playlist** - A YouTube playlist made by Megan Guttieri, mentor of FRC team 971, *Spartan Robotics*, of Chairman's videos from a variety of different teams.

# Strategy

*[**Effective FIRST Strategies**](#) - A championship conference presentation from Karthik Kanagasabapathy, former mentor of Hall-of-Fame team 1114, *Simbotics*, on effective design and competition strategies.

[**"Spanking the Children," A Brief History of Penalties in the FRC**](#) - An article by Jim Zondag, mentor of FRC team 33, *Killer Bees*, highlighting the history of penalties in FRC and how they affected the different games over the years.

[**Weighted Objectives**](#) - A guide by John V-Neun, mentor of FRC team 148, the *Robowranglers*, on using weighted objective to decide on a strategy.

[**Strategic Decision Making in FRC**](#) - A presentation by Kellen Hill, mentor of FRC team 1746, *OTTO*, on making strategic decisions throughout the season to make the best robot within team constraints and limitations, with the added bonus of Kellen's presentation notes.

# CAD

**Simbot Solidworks Series** - A series of solidworks tutorials from Hall-of-Fame team 1114, *Simbotics*, that start with the basics of CAD and go into designing a 1114-style sheet metal chassis.

*****973 RAMP** - Solidworks CAD videos from FRC team 973, *Greybots*, that go over how to CAD FRC-specific mechanisms including a West Coast Drive train.

**How to Make a Bellypan** - A brief tutorial by Andrew Lawrence, mentor of FRC team 1323, *Madtown Robotics*, FRC team 971, *Spartan Robotics*, and FRC team 299, *Valkyrie Robotics*, on how to CAD a belly pan with a weight reduction pattern.

**Robot Weight Watcher** - A tutorial from Isaac Rife, mentor of FRC team 33, *Killer Bees*, on how to actively reduce weight while building FRC robots.

**Designing with Belts** - YouTube tutorials from West Coast Products on designing and CADing with belts.

**Gearbox Plate Tutorial** - A tutorial from Hall-of-Fame team 254, *The Cheesy Poofs*, on designing a gearbox plate in SolidWorks.

**Part Numbering and Nomenclature** - Information from Hall-of-Fame team 254, *The Cheesy Poofs*, on how they name and organize their CAD files.

*****Field and Kit of Parts CAD** - SolidWorks files for the field, field elements, and Kit of Parts elements.

# Mechanical Design and Build

## General

**Weight Budgeting Tool** - A spreadsheet made by Mark Kramarczyk, mentor of FRC team 1189, *The Gearheads*, to help figure out how to budget weight for different robot components.

**Center of Gravity Over Bumps** - A presentation from FRC team 33, *Killer Bees*, that illustrates how a robot's center of gravity changes while driving over bumps and gives some instructions on how to model your own robot's changing center of gravity in Powerpoint.

**Parts Organization** - A paper from FRC team 469, *Las Guerrillas,* on how they organize and label their current robot and practice robot parts during the build season.

**Notes on Nuts and Bolts** - A explanation of the terminology used when describing nuts and bolts and what the different specifications actually mean.

**How to Build Your Everything Really Really Fast** - An instructables guide that details how to effectively design and build almost anything in a short time frame.

**Ed's Machine Shop Notebook** - A notebook written by Edouard Forcier that details good practices and methods for machining parts.

## Design Process

**Design Tutorials** - An in depth tutorial from FRC team 610, *Crescent Robotics*, on different design considerations when designing an FRC Robot.

**Mechanical Design** - A presentation from Ian Mackenzie, mentor of Hall-of-Fame team 1114, *Simbotics*, that goes into detail about design aspects of different mechanisms on FRC robots.

**234 Design Process** - A walkthrough of the robot design process of FRC team 234, *Cyber Blue.*

**254 Technical Binder** - A walkthrough of the strategy, design, and build process of Hall-of-Fame team 254, *The Cheesy Poofs*,' 2016 robot.

**JVN 2010 Build Journal** - The build journal of John V-Neun, mentor of FRC team 148, *Robowranglers*, that describes the design and build process of team 148 during the 2010 build season.

**Designing a FRC Robot, a Team Approach** - An outline and basic timeline of how to approach an FRC season presented by Andy Baker, mentor of FRC team 3940, *CyberTooth*.

**Engineering Design Process in Competition Robotics** - An in depth paper on the engineering design process from John V-Neun, mentor of FRC team 148, *Robowranglers*.

**Shockwave Build Blog** - The build blog of Hall-of-Fame team 254, *The Cheesy Poofs*, while they were building their T-shirt shooting robot.

**118 Everybot** - The build blog of FRC team 118, *Robonauts*,' annual "Everybot" that is made using limited resources and a $1,000 budget.

**The 26 Rules to FRC Design** - A blog post by Jay Trzaskos with 26 ideas to keep in mind when designing and building an FRC robot.

**History of Design in FRC** - A presentation by Andy Baker, mentor of FRC team 3940, *CyberTooth*, of some of the pivotal game and design moments in FRC as well as some overall good practices that have been adopted over the years.

# Bumpers

**Robot Bumper Creation** - A guide from FRC team 971, *Spartan Robotics*, with tips and photos of how they build their bumpers.

**Bumper Tutorials** - A YouTube channel with tutorials on how to build bumpers.

# Gearing, Chain, and Belts

\***JVN Design Calculator** - A spreadsheet by John V-Neun, mentor of FRC team 148, *Robowranglers*, to figure out the gear ratios and needed gears using any of the FRC motors and the main COTS (commercial-off-the-shelf) gearboxes.

**WCP/VexPro Gear Calculator** - A design calculator to find the gear ratio and center to center spacing of gears when designing a gear box.

**Gates GT3 Drive Design Manual** - A Gates belt design guide with that describes the applications of different types of belts and has details on selecting a belt under specific parameters.

**Sprocket and Chain Calculator** - An online sprocket center distance and chain length calculator.

**How To: Gears** - A guide from West Coast Products that explains the basic properties of gears and includes a gear calculator.

**How To: Belts** - An online pulley and belt calculator from West Coast Products.

**Understanding Motor and Gearbox Design** - A blog post by Ian Walters that discusses why and how to choose motors and gearboxes.

# Pneumatics

**Pneumatics** - A presentation from Ian Mackenzie, mentor of Hall-of-Fame team 1114, *Simbotics*, that goes over what pneumatics are, the different components involved, and some of their applications.

**Piston Analysis** - A presentation from Andrew Keisic, mentor of FRC Team 4201, *Vitruvian Bots*, on the math behind mounting and controlling pneumatic cylinders.

**FRC Pneumatics Manual** - The official FIRST guide to pneumatics with photos and descriptions of all of the pneumatic components and how to set them up.

**Pneumatic Resources**- A guide from FRC team 358, *Robotic Eagles*, on the different pneumatic components, tips and tricks for working with pneumatics, and troubleshooting advice.

# Manipulators

**Manipulators Design in FIRST Robotics** - A presentation from Andy Baker, mentor of FRC team 3940, *CyberTooth*, that goes over different manipulator designs and their applications using successful robots from over the years as examples.

**Conveyors**- A presentation from Hall-of-Fame team 254, *The Cheesy Poofs*, on the use of different types of conveyors in FRC.

**Mechanisms and Manipulators**- A presentation by Andrew Keisic, mentor of FRC Team 4201, *Vitruvian Bots*, on the different design considerations and approaches when designing a manipulator.

# Drive Systems

**Omnidirectional Drive Systems** - An overview from Ian Mackenzie, mentor of Hall-of-Fame team 1114, *Simbotics*, on the main types of omnidirectional drives in FRC, including some of the math behind them and highlighting teams that use the specific drive styles.

**FIRST Robotics Drive Systems**- Pros and cons from Ian Mackenzie, mentor of Hall-of-Fame team 1114, *Simbotics*, of the different simple drive train styles and a walkthrough of some of the design considerations.

**Drivetrain Design**- a comparison from Ben Bennett, mentor of Hall-of-Fame team 1114, *Simbotics*, of the different FRC drivetrain styles with the key principles behind designing a drivetrain.

**Derivation of Inverse Kinematics for Swerve** - Swerve drive and the vector math behind it.

**Belt Driven West Coast Drive Train**- A step-by-step guide with pictures from FRC team 4719, *Bulldogs*, on how to design and build a West Coast Drive driven by belts.

**Belt vs. Chain**- The results of an experiment performed by FRC team 234, *Cyber Blue*, on the use of chain versus the use of belt for FRC drive trains.

**FRC Drive Trains**- A presentation by Jesse Knight, mentor of FRC team 1885, *iLITE Robotics*, on the important considerations when designing a drive train.

**The Theory Behind 6 CIM vs. 4 CIM Drives**- A paper by Anand Rajamani, mentor of FRC team 1072, *Harker Robotics*, and FRC team 299, *Valkyrie Robotics*, that compares and contrasts a 6-CIM and 4-CIM drivetrain.

# Controls

## Electronics

*[WPI Library](#) - The official resources and walkthroughs for the entire FRC control system, including how to wire and program it.

[Advanced Robot Electrical Design](#) - A presentation from Michael Dessingue and Al Skierkiewicz, mentor of Hall-of-Fame FRC team 111, *WildStang*, on designing an effective electrical system.

[The Book of FRC Electrical](#) - A walkthrough from FRC team 2853, *Hot Spot Robotics*, of the entire FRC controls system.

[Electrical Documentation](#) - A visual guide from FRC team 868, *TechHOUNDS*, on FRC electronics with a how-to guide on how to wire an FRC robot.

[Battery Load Limiting](#) - A presentation from FRC team 1736, *Robot Casserole*, on understanding what brownouts are, what causes them, and how to prevent them.

[FRC Robot Wiring](#) - An Instructables guide from FRC team 1477, *Texas Torque*, that goes through the different steps of creating an organized electronics system. While the control system used in the tutorial is outdated, everything else is still very relevant and useful.

[2015 roboRio Control System](#) - A guide from FRC team 358, *Robotic Eagles*, on the different components of the FRC control system, advise on how to properly wire them, mounting tips, and troubleshooting advice.

[2008 FRC Sensors Miller](#) - An overview from Brad Miller, from WPI, of different sensors that can be used in FRC and their different applications.

[DIY 'Encoder Stage' for VersaPlanetary](#) - A DIY guide by Nate Laverdure, mentor of FRC team 2363, *Triple Helix*, on adding a speed sensor within a VersaPlanetary gearbox.

# Programming

**Codecademy Java Course** - An online course to learn the basics of Java.

**\*WPI Library** - The official FRC programming guide.

**\*GitHub** - An online platform to host and share code. Many FRC teams have public GitHub's so that you can learn from other teams' code.

**PID Without a Ph.D**. - A paper to learn about what PID is and how it works.

**Programming Handbook** - A guide to FRC programming in LabView created by Hall-of-Fame Team 2614, *MARS*.

**The FRC Robot Project LabView** - A step by step LabView tutorial created by FRC team 1986, *Team Titanium*, that goes through how to program an FRC robot.

**Current Limiting to Prevent Brownouts** - A paper from FRC team 1736, *Robot Casserole*, that describes how to use code to limit current going to motors to try and prevent brownouts.

**Positional Motion Profiling** - A paper from FRC team 900, *The Zebracorns*, that describes their implementation of motion profiling using LabView.

**ZebraVision 4.0 Goal Detection** - A paper from FRC team 900, *The Zebracorns*, that describes their use of vision processing for goal detection.

**Integrating Computer Vision with Motion Control** - A presentation from Jared Russell and Tom Bottiglieri, mentors of Hall-of-Fame team 254, *The Cheesy Poofs*, on how to use computer vision in FRC.

# Competition

## Inspection

*[How to Pass Inspection](#) - A blog post by Nate Laverdure, mentor of FRC team 2363, *Triple Helix*,  that talks about ways to more efficiently get through the robot inspection process.

## Drive Team

[Driver Selection Criteria](#) - A description of the criteria that Hall-of-Fame team 254, *The Cheesy Poofs*, use to select drivers and the expectations that they have of their drivers.

[Drive Team Selection and Practice](#) - A guide from FRC team 3418, *RoboRiot*, that has descriptions of the main drive team roles and the best practices that lead to a strong overall drive team.

[Keys to a Successful Drive Team](#) - A blog post interview with Travis Covington, mentor of Hall-of-Fame team 254, *The Cheesy Poofs*, on how to create and coach a successful drive team.

## Scouting

[Tableau](#) - An introduction and how- tutorials on creating a scouting program using Tableau.

[Scouting Process](#) - A guide created by Hall-of-Fame team 2614, *MARS*, that describes the process and tasks involved with scouting as well as gives examples of different types of scouting systems that teams use.

[Ctrl-Z Electronic Scouting](#) - A guide from FRC team 4096, *Ctrl-Z*, on how they created their electronic scouting system and an explanation of how other teams can create their own.

[Citrus Circuits 2016 Scouting System](#) - A guide from FRC team 1678, *Citrus Circuits*, on the development and implementation of their electronic scouting system.

**An Overview and Analysis of Statistics Used to Rate FIRST Robotics Teams** - A guide by William Gardner that goes through different methods of analysing scouting data for FRC and FTC teams.

**Scouting 101** - A guide by FRC team 3476, *Code Orange*, on the different types of scouting and the different considerations that come into play with each scouting method.

**Scouting Plan** - A guide by FRC team 1983, *Skunk Works Robotics*, on the different aspects of scouting and how to implement them.

**1678 Scouting Workshop** - A presentation by Richard McCann, Jake McCann, and Colin Unger, mentors of FRC team 1678, *Citrus Circuits*, on how to analyze a game strategy, utilizing reported statistics, analyzing qualitative and quantitative qualities, deciding on a scouting system, and implementing scouting at a competition.

**Scouting Tutorial** - A presentation by FRC team 1477, *Texas Torque*, on the different aspects of scouting and how to utilize them while scouting at a competition.

## Pit Spaces

**973 Super Pit** - The documentation of how FRC team 973, *Greybots*, built their competition super pit.

**Pit Carts** - A walkthrough of how FRC team 1619, *Up-A-Creek Robotics*, designed and built their competition super pit.

# Parts and Suppliers

**Find Robot Parts** - A website that allows you to search for different common FRC robot components and returns the different suppliers that have them available for purchase.

## Supplier Overviews

\***Vex Pro** - FRC products designed by FRC alumni that are easily integrated onto robots. Parts range from VersaFrame robot structure to gearboxes, including the popular VersaPlanetary gearbox.

\***McMaster-Carr** - A supply company that has almost everything and anything you could possibly want. McMaster has a large variety of raw materials, tools and equipment, fasteners of every kind, and if you are lucky enough to live in Atlanta, Chicago, Cleveland, Los Angeles, or New Jersey, you can benefit from their same day (sometimes same hour) in-store pickups and incredibly fast shipping.

\***AndyMark** - A supplier that specializes in FRC and FTC parts, robot kits, and, since 2011, the official FRC game pieces.  AndyMark may be best known for the AM14U-series drive systems, which has been included in the Kit of Parts since 2014 and allow a team to get a reliable drivetrain built very quickly.  All rookie teams receive a drivetrain in the Kickoff kit, while veteran teams may opt out of receiving one in exchange for a voucher to use at AndyMark.  AndyMark also sells many parts that are specific to FRC robots, including the roboRIO robot controller, control system parts, pneumatics components, wheels, motors, batteries, and bumper parts.

*FIRST* **Choice** - Part of the official FRC Kit of Parts, every FRC teams gets an allotted number of credits each year to use for all different types of robot parts, tools, and game pieces available on the *FIRST* Choice website. Teams only pay for shipping, which must be done with a credit card. While *FIRST* Choice is run by AndyMark, be aware that it is a completely different system and website, and credits can not be used to purchase items on the AndyMark website. Similarly, you can't purchase *FIRST* Choice items with cash (accurate as of the 2017 season).

**West Coast Products** - FRC products and project designs from FRC alumni. Parts range from gearboxes to sensors and sensor boards, such as the Spartan Sensor Board designed by FRC team 971, Spartan Robotics. West Coast Products also sells VexPro products and is an alternate supplier depending on shipping costs to where you live and the current products in stock at VexPro.

**CTR Electronics** - An electronics supplier that sells electronics components and tools used for FRC including Powerpole connectors, battery cables, and motor controllers.

**BaneBots** - FRC supplier best known for their high traction wheels.

**Automation Direct** - FRC supplier that specializes in industrial controls products. Most FRC teams use them for their electrical and pneumatics components.

**Bimba** - FRC supplier that specializes in pneumatic, hydraulic, and electronic components. Most FRC teams use them for their pneumatic components.

**Ruland** - FRC supplier that specializes in shaft collars, shaft couplers, and shaft couplings.

**Home Depot -** A home improvements and hardware store that sells a large variety of tools and equipment, some raw materials, and random odds and ends that you may need throughout the build season.

**Lowes** - A home improvements and hardware store that sells a large variety of tools and equipment, some raw materials, and random odds and ends that you may need throughout the build season.

**Southern Aluminum Finishing Company -** An Atlanta based aluminum company that sells aluminium sheet and extrusion. They tend to have some of the lowest unit prices when you buy in large quantities, so plan what you need ahead of time and try to make larger orders.

**Metal Supermarket -** A metal supplier with good prices for metal sheets, bars, and common extrusions.

**Gem City Steel -** An Atlanta based metal supplier with good prices for metal sheets, bars, and common extrusions.

**The Robot Space** - An alternative supplier to VexPro based in Michigan that sells many VexPro products and can be especially useful depending on shipping costs to where you live and the current products in stock at VexPro.

**Competition Robot Parts** - A smaller supplier that specializes in parts specifically for FRC. They currently sell different types of tubing and brackets as well as roller and elevator kit components.

**REV Robotics** - An FRC supplier run by FIRST mentors that created the SPARK motor controller and sells several other electrical and structural components for FRC.

# Suppliers by Part Type

*Motors and Gearboxes*
- **Vex Pro**
- **AndyMark**
- **BaneBots**
- **West Coast Products**
- **The Robot Space**

*Raw Materials*
- **McMaster-Carr**
- **Home Depot**
- **Lowes**
- **Southern Aluminum Finishing Company**
- **Metal Supermarket**
- **Gem City Steel**

*Electrical Components*
- **Vex Pro**
- **AndyMark**
- **CTR Electronics**
- **West Coast Products**
- **Automation Direct**
- **The Robot Space**
- **REV Robotics**

*Wheels*
- **Vex Pro**
- **The Robot Space**
- **AndyMark**
- **BaneBots**
- **West Coast Products**
- **McMaster-Carr**

*Pneumatics*
- **Automation Direct**
- **Bimba**
- **McMaster-Carr**

*Shaft Collars and Couplers*
- **Ruland**
- **Vex Pro**
- **AndyMark**
- **McMaster-Carr**
- **The Robot Space**
- **West Coast Products**

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