FTC Resources

Whether your team is entering its rookie year or you have lots of experience under your belt, there are lots of resources that can inspire you and help your team grow its skills. The following list is a few of our favorite sources of inspiration. If there are others you love and use regularly, please drop us a note. We will be delighted to add them to the list.

Wishing you a happy and successful FTC season!

Books

- ***FTC Robotics: Tips, Tricks, Strategies, and Secrets: 2016-17 Edition*** by The Pope John XXIII High School Robotics Team - This is the only book written specifically for and about FTC that we have found. - https://smile.amazon.com/FTC-Robotics-Strategies-Secrets-Updated/dp/1546969012/ref=pd_sim_14_1?_encoding=UTF8&psc=1&refRID=EZ6M91HJRC3EJ0C3DBXC -
- ***FIRST Robots: Behind the Design - 30 Profiles of Design, Manufacturing, and Control*** 2015 by Vince Wilczynski (Author), Stephanie Slezycki - While this book is about FRC, rather than FTC, it offers an excellent on robot design. We have found it very useful for FTC.- https://www.amazon.com/FIRST-Robots-Profiles-Manufacturing-Control/dp/0692540628/ref=sr_1_1?s=books&ie=UTF8&qid=1506111185&sr=1-1&keywords=FIRST+robotics -
- ***Robot Building for Beginners***, 2nd Edition, by David Cook - This book is in no way specific to the types of robots you will build in FTC, it does provide a really good introduction to robotics for new team members and new teams. https://smile.amazon.com/Robot-Building-Beginners-Technology-Action/dp/1430227486/ref=sr_1_8?s=books&ie=UTF8&qid=1506111610&sr=1-8&keywords=robotics
- ***Getting Started in Electronics***, 2003, by Forrest M. Mims III - For teams that need to brush up (or learn) basic electronics skills, this is a great book.
- ***Practical Electronics for Inventors***, 4th Edition, by Paul Scherz -This book is a slightly more advanced introduction to electronics than the book listed above, offering more project ideas and hands-on experience. - https://smile.amazon.com/Practical-Electronics-Inventors-Fourth-Scherz/dp/1259587541/ref=sr_1_1?s=books&ie=UTF8&qid=1506111979&sr=1-1&keywords=electronics
- **Java: A Beginner's Guide, Sixth Edition,** 6th Edition by Herbert Schildt - Because the FTC tech team has abstracted away so much of Android, the real need is to learn Java (if you don't want to use block programming). This is a good beginners guide to the Java programming language and programming in general. https://www.amazon.com/Java-Beginners-Guide-Herbert-Schildt/dp/0071809252/ref=lp_3608_1_7?s=books&ie=UTF8&qid=1506118047&sr=1-7

Web Resources

FTC Information

- **FIRST Tech Challenge Home** - https://www.firstinspires.org/robotics/ftc
- **FIRST Tech Challenge YouTube Channel** - https://www.youtube.com/user/FIRSTTechChallenge
- **FIRST Tech Challenge Twitter Feed** - https://twitter.com/FTCTeams?ref_src=twsrc%5Egoogle%7Ctwcamp%5Eserp%7Ctwgr%5Eauthor
- **FIRST Tech Challenge Blog** - http://firsttechchallenge.blogspot.com/
- **FIRST Tech Challenge Facebook Page** - https://www.facebook.com/FTCTeams/
- **FIRST Tech Challenge Reddit Account** - https://www.reddit.com/r/FTC/

Programming

- ***The FTC Blocks Programming Training Manual- Rev Robotics*** - For those using the Blocks Programming environment with Rev Robotics, this manual provides a valuable starting place. https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/blocksprogramming-trainingmanual.pdf
- ***The FTC Blocks Programming Training Manual- Modern Robotics*** -For those using the Blocks Programming environment with Modern Robotics, this manual provides a valuable starting place. - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/2017-2018/blocks-programming-training-manual-mr.pdf
- ***FTC Block Tutorials*** on YouTube - This channel offers a long list of training modules on the Block Programming environment. - https://www.youtube.com/playlist?list=PLEuGrYl8iBm4A4yrRcatGcK7q0od0LYov
- ***FTC Android Studio Resources*** - This GitHub repository contains the source code that is used to build an Android app to control a *FIRST* Tech Challenge competition robot. To use this SDK, download/clone the entire project to your local computer. - https://github.com/ftctechnh/ftc_app
- ***FTC Java Tutorials*** on YouTube -This channel offers a long list of training modules on the Android Programming environment. - https://www.youtube.com/playlist?list=PLEuGrYl8iBm7wW9gyxpLDhBJAOWDZid1P
- ***FTC App Inventor Resources*** - This web page contains a long list of App Inventor training materials you can download. - https://frc-events.firstinspires.org/FTCImages/2016

- ***FTC App Inventor Tutorials*** on YouTube - This channel offers a long list of training modules on the App Inventor Programming environment. - https://www.youtube.com/playlist?list=PLEuGrYl8iBm7XLd4ekLsEmCEXa1HyIIan
- ***FTC Using Vuforia Vumarks*** - This guide takes teams through the process of setting up and using Vuforia Vumarks - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/using-vumarks.pdf
- ***FTC Java Programming*** by Eric Weber - This presentation provides a good introduction and a variety of tips for using the Java Programming environment more effectively. - http://paws.kettering.edu/~webe3546/FTCJavaProgramming.pdf
- ***Advanced Programming Techniques & Autonomous Strategy*** by FTC Team Height Differential - This presentation offers a high-level introduction to useful tips and techniques for FTC programming. - http://www.heightdifferential.com/assets/Advanced_Programming_Techniques_Autonomous_Strategy.pdf

Design & Building

- ***The FTC Robot Wiring Guide 2017-18*** - This is an essential handbook for any team with wiring questions. Failure to follow these guidelines (or to improve upon them) risk robot failure. - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/robot-wiring-guide.pdf
- ***The FTC Robot Reliability Checklist*** - Reviewing and confirming that your robot is in compliance with this checklist before every event will save you so much heartache. Download it and use it often! - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/robot-reliability-checklist.pdf
- ***The Robotics Design Process*** by the Galileo organization - This site offers a good introduction to the processes teams should follow as they plan and build their robots. - http://www.galileo.org/robotics/design.html
- ***Pushbot Build Guides*** from FTC - If this is your first robot rodeo, having a step-by-step building guide can get your team off to a quick start. Pushbot is a simple starting place. There are three reference guides for Pushbot:
  - ***Pushbot Horizontal Reach Guide*** - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/pushbot-build-guide-horizontal.pdf
  - ***Pushbot Tetrix Sensors Guide*** - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/pushbot-build-guide-tetrix-sensors-supplement.pdf
  - ***Pushbot Vertical Reach Guide*** - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/pushbot-build-guide-vertical.pdf

- ***Appendages and Manipulators in FTC*** by Andy Baker, founder of AndyMark - This presentation provides a very useful look at the many ways teams may collect, carry and deliver objects in FTC. This PowerPoint presentation is available to download. Search for it by name.
- ***Introduction to Manipulators*** by a FIRST Intern - This short guide provides an excellent overview of the key manipulator types that FIRST teams are likely to encounter. - http://www.instructables.com/id/Introduction-to-Manipulators/
- ***Tetrix Robot Builder's Guide*** by Tetrix - This very basic build guide is useful for those who are just getting started in FTC and planning to use the Tetrix kit. https://www.tetrixrobotics.com/rcbuildersguide/files/resources/Print_All_TETRIX_BG.pdf
- ***How to Build a Structurally Sound Robot*** by FTC Team Height Differential - This PowerPoint presentation provides tips on how to build a strong robot. - http://www.heightdifferential.com/assets/How_to_Build_a_Structurally_Sound_Robot.pdf

The Notebook

- ***The FTC Engineering Notebook Guidelines 2017-18*** - Even if your team has written a dozen notebooks and especially if your team has not, it is important to review these guidelines. The requirements can and often do change from year-to-year. - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/engineering-notebook-guidelines.pdf
- ***10 Tips on Engineering Notebooks*** from ECN - Frankly, producing an engineering notebook is the task our teams have disliked the most of the years. (They would honestly rather take out the trash and sweep the floors!) These tips make the process a little less painful. - http://www.edn.com/electronics-blogs/embedded-basics/4441329/10-Tips-On-Engineering-Notebooks

Team-Building

- ***Building Teams that Build Robots*** by FTC - This is a useful introduction for mentors and team leaders on how to build strong team ties and processes. - https://www.firstinspires.org/sites/default/files/uploads/resource_library/ftc/building-teams-that-build-robots.pdf
- ***Committed Teams: Three Steps to Inspiring Passion and Performance***, 2016, by Mario Moussa - Though this book is not specific to FTC or even to high school teams, it contains many useful tips for creating a shared mission, working together effectively and being successful. - https://smile.amazon.com/Committed-Teams-Inspiring-Passion-Performance/dp/1119157404/ref=sr_1_8?ie=UTF8&qid=1506114057&sr=8-8&keywords=team+building+high+school

Curriculum

- **FTC Curriculum -** This is a useful curriculum with many tips and tricks collected from coaches, mentors and teams. Access must be requested. Search for FTC Curriculum Schoology.
- **Intelik Curriculum** - http://www.intelitek.com/engineering/rec_curriculum/ - This is a general robotics curriculum that is of good quality, but it is not specific to FTC.
- **Tetrix Curriculum** - https://www.tetrixrobotics.com/GettingStartedGuide/index.htm - Good general introduction to the kinds of hardware solutions you may want to build for FTC and lots of specific details on how to build with Tetrix parts.
- **VEX Curriculum** - http://curriculum.vexrobotics.com/curriculum - While the specifics of VEX hardware and competitions do not apply, there is a lot of valuable ideas about how to design and build a robot and assemblies.

Suppliers & Recommended Supplies

Pitsco

https://www.tetrixrobotics.com

- Tetrix Robotics Kit and Parts
- FTC discounts available
- Ships very quickly to Kansas City area
- Helpful staff - give them a call
- Carries the full complement of tetrix parts
  - Structural parts
  - Gears, Sprockets and Chain
    - Gears and sprockets attach easily to the Tetrix hubs (which attach easily to 6mm D-shaft motors and 3/16" inch D-shaft axles)
  - Wheels, hubs and axles
    - All-terrain
    - Omni wheels
    - 3" and 4" plastic wheels
  - Motors, motor mounts and Servos
    - Old style tetrix motors should generally be avoided
      - Encoders are sold separately and they are expensive and delicate
      - Can burn out quickly compared to NeverRest motors
    - New TETRIX® MAX TorqueNADO™ Motor - NOTE: Don't know if this is FTC legal or not.
  - Tank tread
    - plastic should be avoided

- ○ Mounts and brackets
- ○ Fasteners, hardware and some tools
- ○ Batteries

AndyMark

http://www.andymark.com/
- ● Provider of the FTC Game Sets and Field Kits
- ● Helpful staff give them a call
- ● Carries a wide variety of parts
  - ○ NeverRest Motors
    - ■ Built-in encoders
    - ■ Much less likely to burn out due to stalling the motor
    - ■ Comes in a variety of speeds with different attached gear boxes
  - ○ S3 Framing System
    - ■ Don't know much about this
    - ■ Made to work well with AndyMark chassis kits
  - ○ TileRunner pre-design chassis kit
    - ■ Does not come assembled (otherwise it wouldn't be FTC legal)
    - ■ Expensive
  - ○ Gears, sprockets and chains
    - ■ NOTE: unlike the gears and sprockets sold by Pitsco, these are made for a wide variety of systems and may or may not attach well to your hubs.
  - ○ Wheels
    - ■ Omni wheels - 4", 6' and 8"
    - ■ Mecanum Wheels - 4", 6", 8" and 10"
    - ■ Wide variety of other plastic/rubber wheels
    - ■ NOTE: Not all wheels sold by AndyMark are FTC legal make sure before you buy. In particular, pneumatic wheels and certain treads are specifically disallowed.
  - ○ Servos
  - ○ Mounting brackets
  - ○ Electronics
    - ■ Wire
    - ■ Powerpole Kits/Crimper
    - ■ Battery Beak battery tester
  - ○ Polycarbonate sheets (LEXAN)
  - ○ Fasteners, hardware and some tools
  - ○ Timing belts and pulleys

Modern Robotics

http://www.modernroboticsinc.com/

- One of two FTC allowed provides for electronics
- Offers the brand new for 2017 goBILDA parts kit (competitor to Tetrix kits)
- Helpful staff give them a call
- Carries a variety of parts
    - Electronics
        - Motor and Servo Controllers
        - Sensor Interface Module
        - Core Power Distribution
    - Sensors
        - Very wide variety of sensors available
            - Color
            - Range
            - Light
            - Touch
            - Optical Distance
            - Multiple Gyros
        - NOTE: Most but not all of the sensors are legal for FTC. Typically a sensor that is not FTC legal will be marked on the page as such.
    - Cables
        - Powerpole extensions
        - Servo extensions
        - Sensor extensions
            - Very hard to find anywhere else
        - OTG Micro-to-Mini Cable
            - Hard to find anywhere else
        - OTG Micro-to-A Cable (needed for Driver Station)
        - Shielded USB Mini-to-A Cable
            - From core power module to controllers
            - Avoid cheap cables from other providers that aren't shielded
    - goBILDA Parts
        - Structural parts
        - Wheels
            - Omni and rubber/plastic 96mm
        - Gears
        - Servos and Accessories
            - Accessories are mostly specific to the goBILDA system
            - Servo extensions
            - Limited number of actual servos available
        - Fasteners and Hardware

- - ■ Axles, hubs and bearings
      - ■ Batteries
          - ● NOTE: The 12v goBILDA offset battery is not FTC legal
  - ○ Matrix Parts
      - ■ Older building system that isn't recommended for new teams

ServoCity

https://www.servocity.com/
- ● Offers the Actobotics building system
- ● Helpful staff give them a call
- ● FTC Discounts and Sponsorships are available
- ● Large selection of parts especially Servos
  - ○ Actobotics Kit
      - ■ Large kit that is an alternative to the Tetrix kit or goBILDA kit
      - ■ Includes, motors, wheels, structural parts and much more
  - ○ Servos
      - ■ Look at the Hitec servos only (not Futoba)
      - ■ Largest selection of Servos we are aware of
      - ■ High quality servo extension cables up to 48" long
  - ○ Servo Blocks and Tetrix Adapter
      - ■ The ServoCity servo blocks are highly recommended they do a great job of taking the load off of the spline (you don't want to break a bunch of $50 servos do you?)
      - ■ The servo blocks are meant to mount to the Actobotics hole pattern. However, a hub adapter is offered that matches the Tetrix hole pattern.
          - ● https://www.servocity.com/hub-adaptor-b
  - ○ Linear Motion
      - ■ Wide variety of rollers and bearing available
      - ■ They pair perfectly with the actobotics system
      - ■ Lead screws
  - ○ Multi-Chargers
      - ■ https://www.servocity.com/hitec-x2-400-multi-charger
  - ○ Fasteners, hardware and some tools
  - ○ Actobotics Parts
      - ■ Structural parts
      - ■ Gears, sprockets, chain, belts and pulleys
      - ■ Wheels
          - ● A variety of wheels are available
              - ○ Omni
              - ○ Off-road rubber
              - ○ Plastic
              - ○ Servo mounted

- ○ Casters
- ● NOTE: some of the wheels are difficult to drive with the standard FTC hubs
- ■ X-Rail - Actobotics equivalent to 80/20 products
- ■ 80/20 Products
- ■ Linkages
- ■ Shafts, tubes, couplers
- ■ Fasteners and Hardware
- ■ Axles, hubs and bearings
- ■ ABS Plastic Sheets
- ■ Extruded box aluminum
- ■ Batteries

Rev Robotics

http://www.revrobotics.com/

- ● One of two FTC allowed provides for electronics
- ● Offers a new building FTC building kit
- ● Electronics
  - ○ New for 2017-18 Expansion Hub
    - ■ This hub is an alternative to the various electronic components offered by Modern Robotics
    - ■ Combines many functions in one box
      - ● Controls 4 motors and encoders
      - ● 6 servos
      - ● 4 analog input ports
      - ● 8 digital input ports
      - ● 4 IC2 ports (many sensors are IC2)
    - ■ Can daisy chain to a second expansion hub
  - ○ Variety of cables to support the new hub's connections and other FTC electronics
- ● Kits
  - ○ Start kit and various add-on kits available
- ● Rev Robotics building system
  - ○ Structural parts
  - ○ Gears, sprockets, chain, belts and pulleys
  - ○ Motors
    - ■ Hex shaft
    - ■ 90 degree motor available
  - ○ Wheels
    - ■ A variety of wheels are available
      - ● Omni
      - ● Plastic/Rubber
  - ○ 15mm Extrusion (similar to 80/20 but smaller)

- ○ Fasteners and Hardware
- ○ Hex axles, hubs and bearings
- ○ Batteries - slim with connector for expansion hub

McMaster-Carr

https://www.mcmaster.com/
- Industrial supplier not a robotics supplier like AndyMark, ServoCity, etc.
- Huge selection of products (many not applicable to FTC)
- Products FTC teams might be interested in
  - ○ Shafts, couplers and collars
  - ○ Sprockets and chain
  - ○ Huge selection of screws, bolts, washers and nuts
  - ○ Set screws
    - ■ NOTE: this is a great source for steel set screws to replace the mediocre ones provided with the Tetrix parts
  - ○ Key stock (for keyed axles)
  - ○ Pulleys
  - ○ Tubing
  - ○ Zip ties
  - ○ Velcro
  - ○ 80/20 parts
  - ○ Springs
  - ○ Bearings
  - ○ Tools
    - ■ Must haves include T-Handle hex keys (allen wrenches)
  - ○ Safety products
  - ○ Chain, wire and rop
  - ○ Zip ties

80/20 Inc

https://8020.net/
- The place for everything 80/20
- If you aren't using 80/20, no reason to go here
- If you are it's perfect

BaneBots

http://banebots.com/
- Great for wheels
- Helpful staff give them a call
  - ○ especially if you are buying Colson wheels to make sure you get the right hubs

- T81 Wheels and Hubs
    - High traction 3", 4" and 5" wheels
    - Unique hub with two set screws
        - much more reliable than the standard single set screw hubs
        - harder to tighten because you have to remove the snap right and wheel to get to the set screws
    - Requires special tool for the snap rings
        - Technically can be done with pliers but much harder
    - To direct drive on NeverRest or Tetrix motors get the 6mm shaft version
- Colson Wheels
    - Very common FRC wheel
    - Sizes range from 1 ⅝" to 5 ⅞"
    - Variety of hubs available - call to find out what you need
    - Requires special equipment to press the hubs into place or you can have BaneBots press them into place before shipment

Powerwerx

https://powerwerx.com/anderson-power-powerpole-sb-connectors
- THE source for powerpole connectors, tools and accessories
- Although you can buy powerpole parts and tools at a variety of outlets (ServoCity, AndyMark, Modern Robotics, Amazon), Powerwerx has many additional accessories
    - Kits
    - Multiple sizes 15, 30 and 45 amp
    - Crimping tool
    - Colored housings
    - Permanently bonded connectors
    - **Retention Clips - Very useful**
    - Chassis mounts for 1, 2 or 4 powerpole connectors
    - Wire

Stock Drive

https://shop.sdp-si.com/catalog/
- This is not specifically a robotics oriented site
- Great selection of
    - Timing belts and pulleys
    - Shafts
    - Bearings
    - Bearing and pillow blocks

Amazon

https://www.amazon.com/

- Phones
    - Unlocked phones
    - Phone cases
    - Phone mounts
- Zip ties
- Tools
- Velcro
- Controllers
- 80/20 parts
- Power cords/strips
- Safety Glasses
- Electrical and Duct Tape

Wal-Mart/Target

- Zip ties
- Tools
- Power cords/strips
- Velcro
- Safety Glasses
- Electrical and Duct Tape
- Tool boxes/carts

Hardware Stores - Home Depot, Lowes, Ace, etc.

- Zip ties
- Screws, bolts, washers and nuts
- Springs
- Tools
- LEXAN
- Aluminum bars
- Steel bars
- Power cords/strips
- Velcro
- Safety Glasses
- Electrical and Duct Tape
- Tool boxes/carts

Outfitting Your Workshop

Must Have Tools

- Allen Wrenches/Hex Keys
  - Common Sizes: 3/32", 1/16" and 5/64" (less often 7/64")
  - T-Handle hex keys are strongly advised
    https://www.mcmaster.com/#hex-keys/=19fdfih
  - Consider color coding your hex keys based on size for easy access (can use colored electrical tape or paint)
  - You might need additional sizes depending on the parts you are using. For example, 80/20 uses 5/32", 3/16" and ¼" depending on the specific products used.
  - Consider ball-end hex keys for hard to reach screws (can be used at an angle to tighten)
- Screwdriver Set
- Plier Set
- Nut driver(s) - 5/16" for the standard nuts
- Measuring Tape
- Cutting/Drilling
  - Hack saw
  - Scissors & Box Cutters
  - Metal files
  - Hand Drill
- Electrical Tape
  - The combination packs with a variety of colors can be handy so the tape can be used to mark various wires.
- Zip Ties - combination packs are good place to start
- Wire Cutters/Strippers
- Chain Splitter (required only if you are using sprockets and chain)
- Sharpie Markers

Common Tools

- Velcro
- Hammer/Rubber Mallet
- Metric Short-Arm Hex Key Set
- Combination Wrench Set
- Marking punch - to mark and start drilling locations
- Powerpole Crimping Tool

- Dremel Tool or Disk Sander
- Level and T-Square
- Vises
- Band Saw

Also Consider

- 3D Printer
- Chop saw
- Drill press
- Shop vac
- Bench grinder
- Belt sander
- Hot air gun
- Jig Saw
- Sheet metal bender
- Tube cutter