

A vibrant red chili pepper is the central focus, positioned diagonally from the bottom left towards the top right. Bright, orange and yellow flames are rising from the pepper, creating a sense of heat and intensity. The background is solid black, which makes the red of the pepper and the fire stand out sharply.

# Mechanical & Electrical Engineering

A Guide for New FTC Students & Teams

From

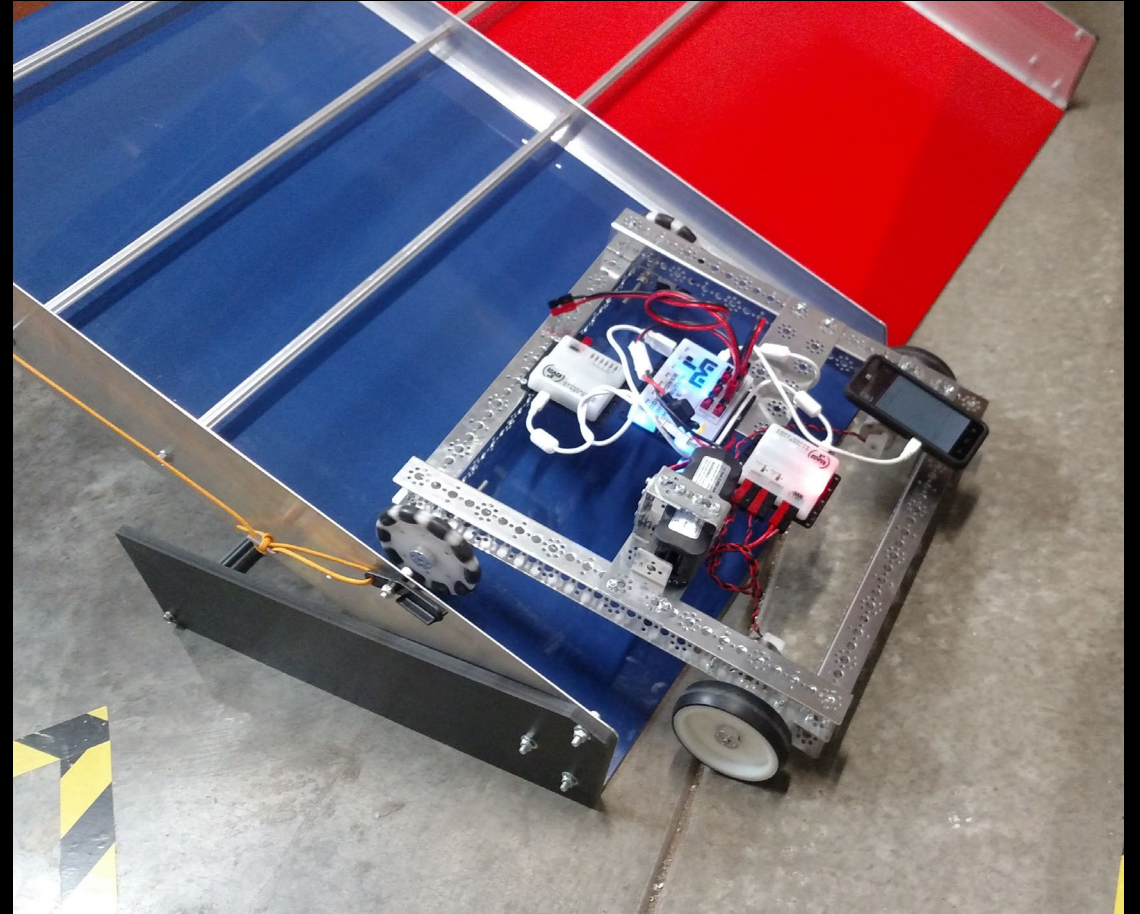
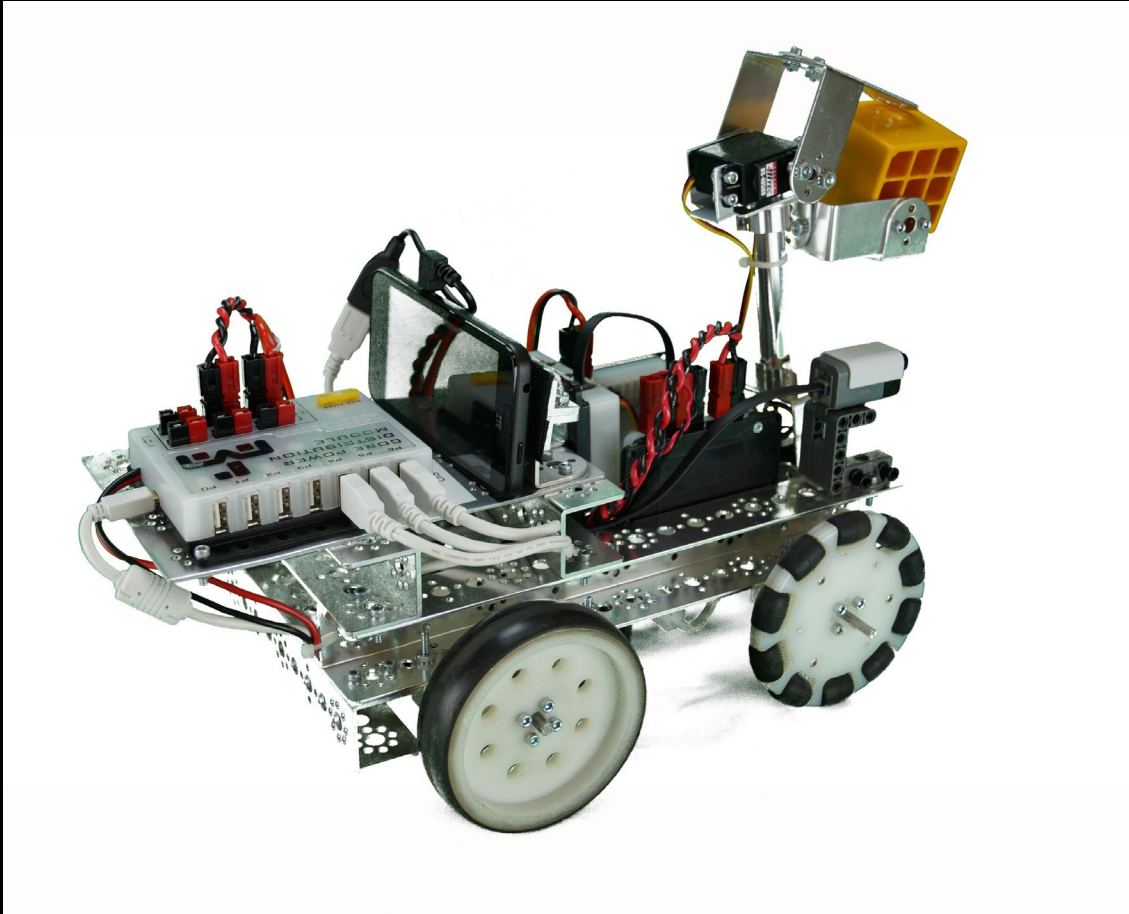
The Red Hot Techie Peppers

# Robot Designs Vary Widely

There Is NO One-Size-Fits-All Design



# Some 'Bots Are Simple



# Some Are Frightfully Complex



# Lots of Kits & Parts to Choose From

- Actobotics
- GoBilda
- Matrix
- Rev Robotics
- Tetrax
- Ready-Made Chasses
- Off-the-Shelf Parts
- Mix & Match Kits
- Roll-Your-Own Strategy



# Good Suppliers

- Andy Mark
- Servo City
- Modern Robotics
- McMaster-Carr
- Online Metals
- And, More!



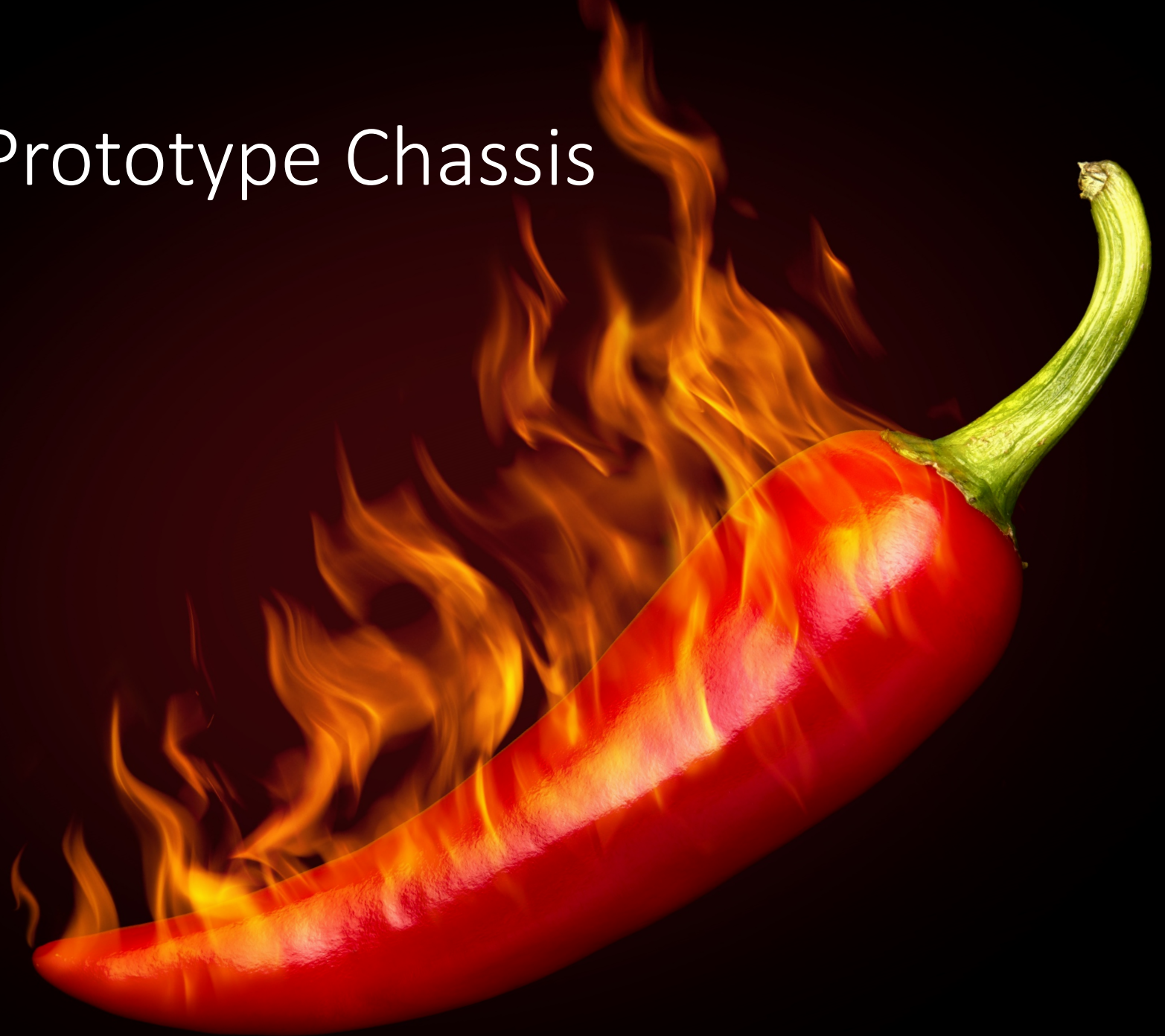
# How To...

Quickly Build & Wire a Prototype FTC Robot



# Build a Simple, Prototype Chassis

- To Test Assemblies
- And, Software
- Sooner!





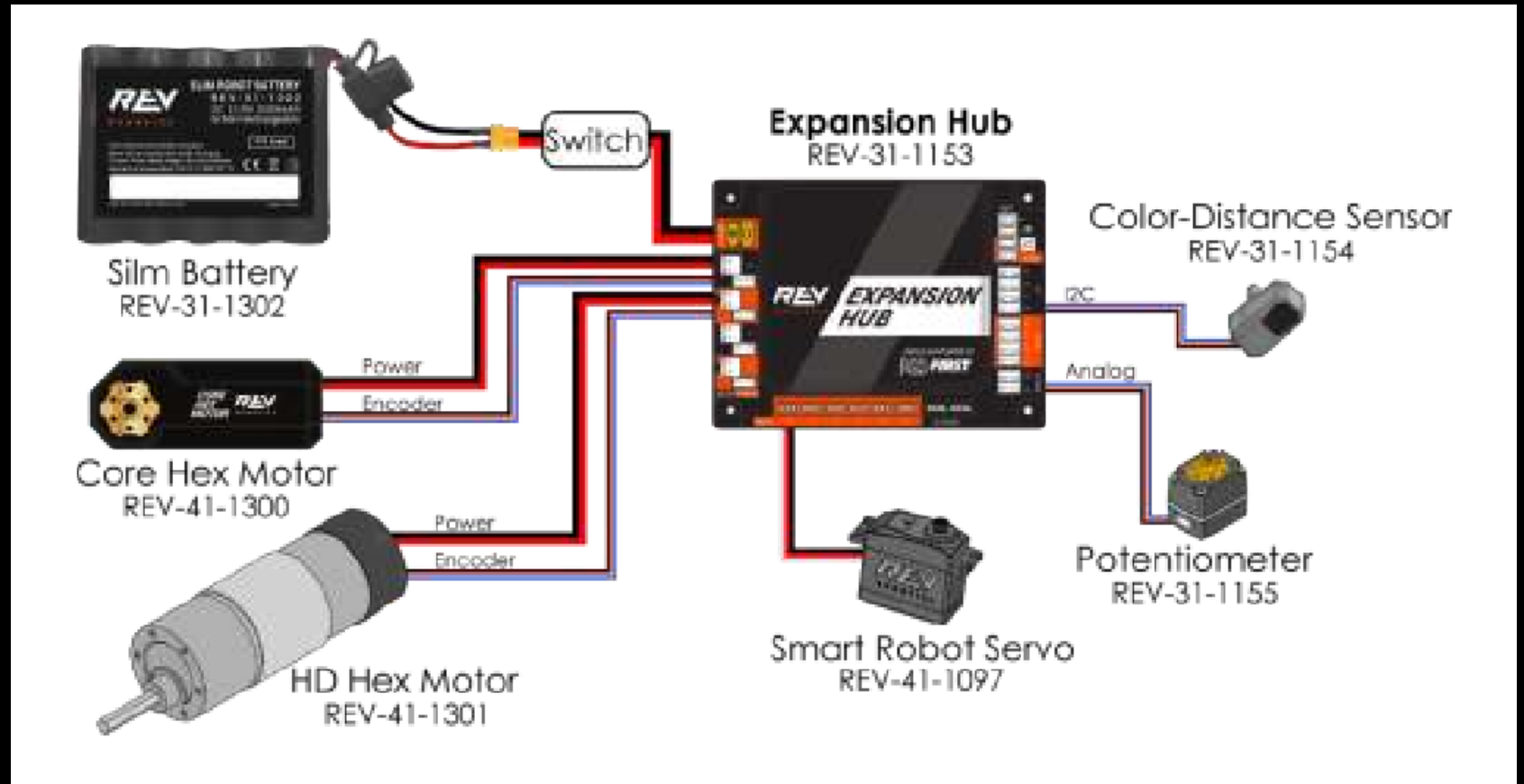
# Build a Simple, Prototype Chassis

- Follow the KISS Principle
- Start with the Simplest Base



# Wire Up Simply

- Follow the KISS Principle
- Do the Minimum Initially
- Clean It Up Later



# Use a Basic Motor Configuration

- Start with Tank Drive
- Choose a Your Motor Type
- Install Encoders



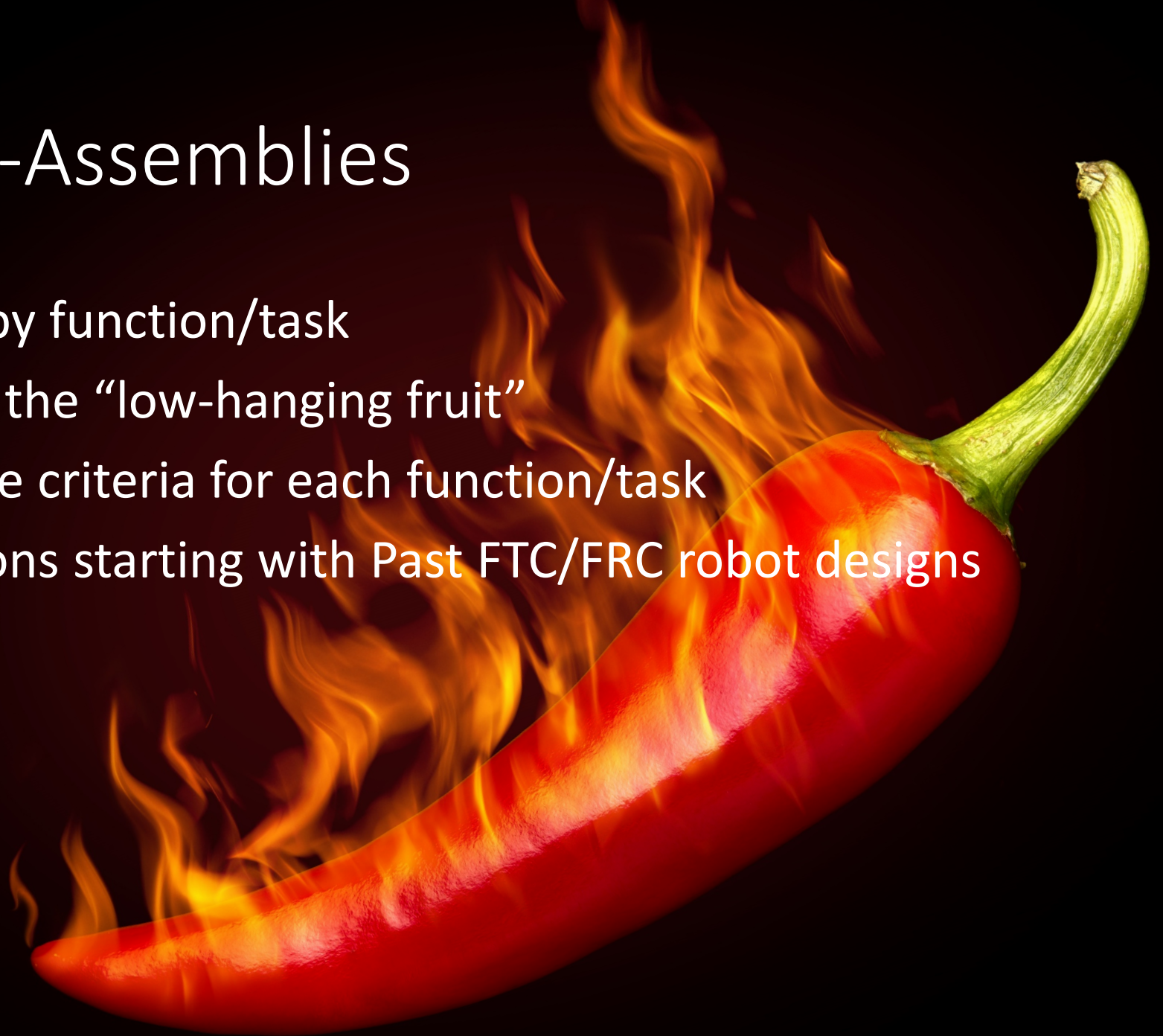
# Get That 'Bot Moving!

- Write Simple Drive Code
- Get Driving!



# Define Your Sub-Assemblies

- Break down the game by function/task
- Identify and act first on the “low-hanging fruit”
- Set specific performance criteria for each function/task
- Research proven solutions starting with Past FTC/FRC robot designs
  - Chasses
  - Lifting Systems
  - Manipulators



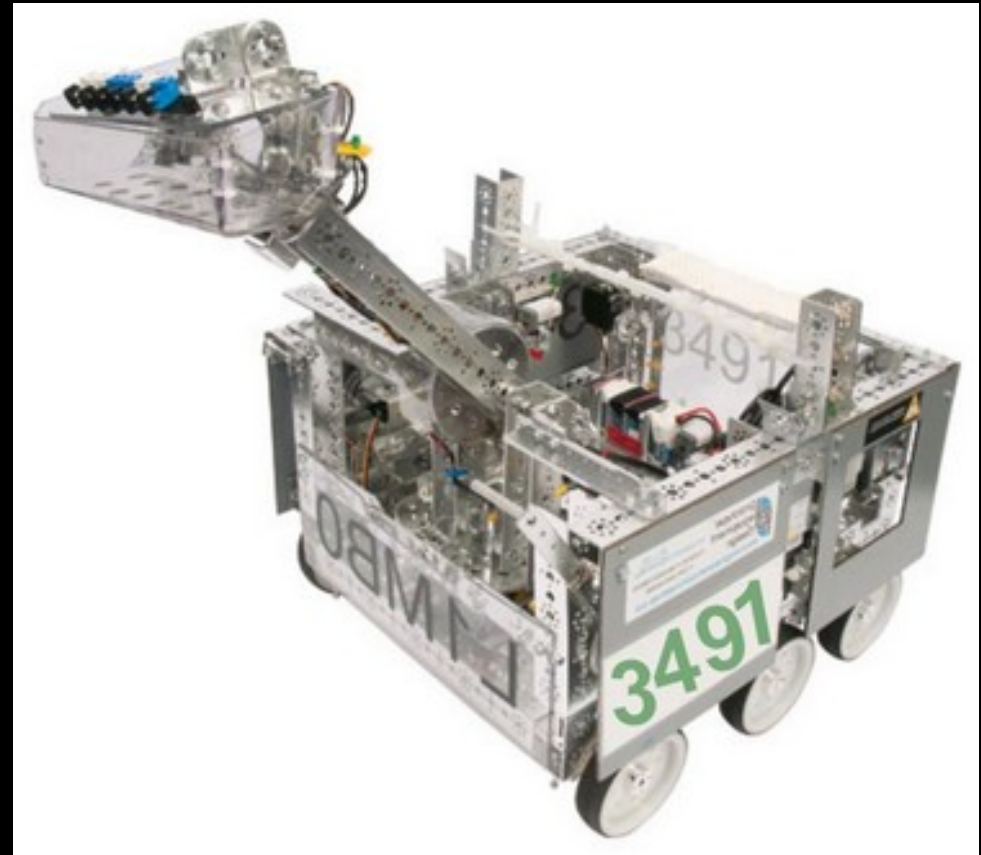
# Chasses – Drive Train Options

- Tank Drive
- Slide
- Holonomic
- Swerve



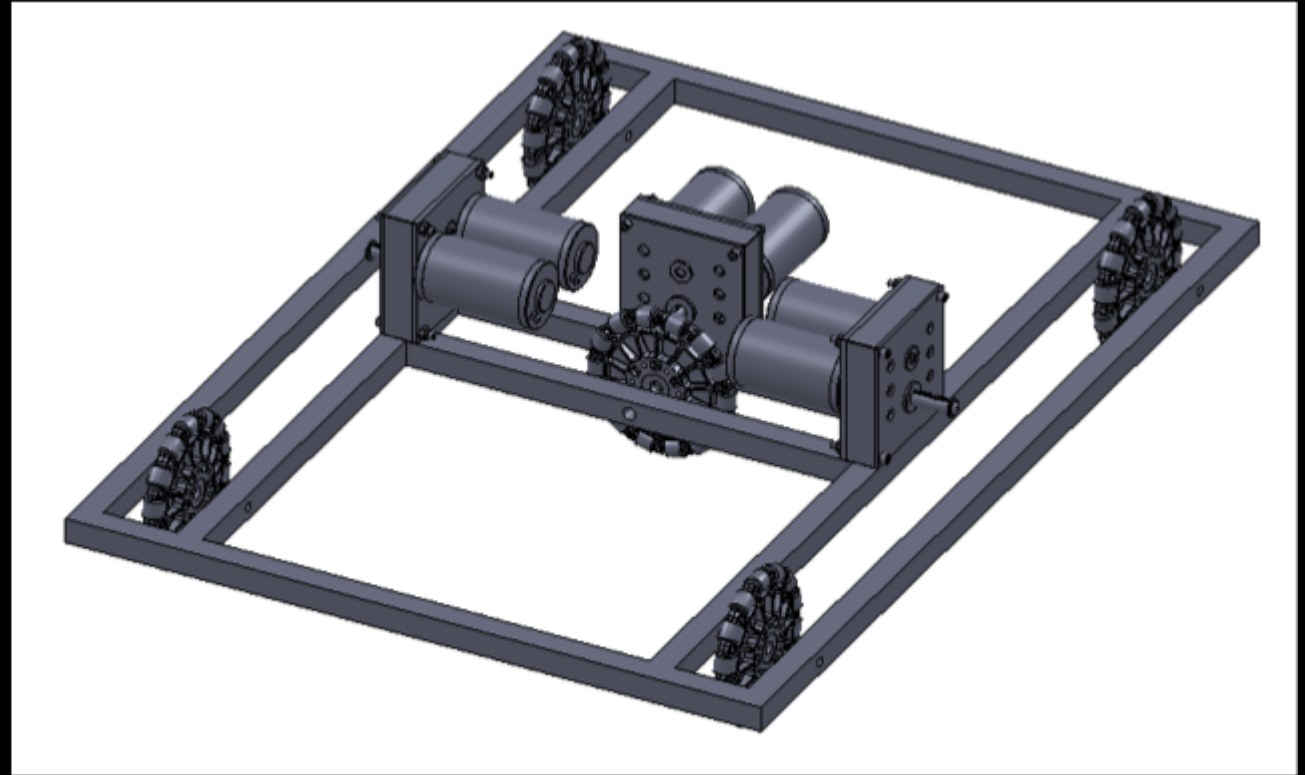
# Tank Drive

- Four to Eight Wheels
- Wheel Placement & Patterns Vary
- Alternate Configurations
- Pluses
- Minuses



# Slide Drive Trains

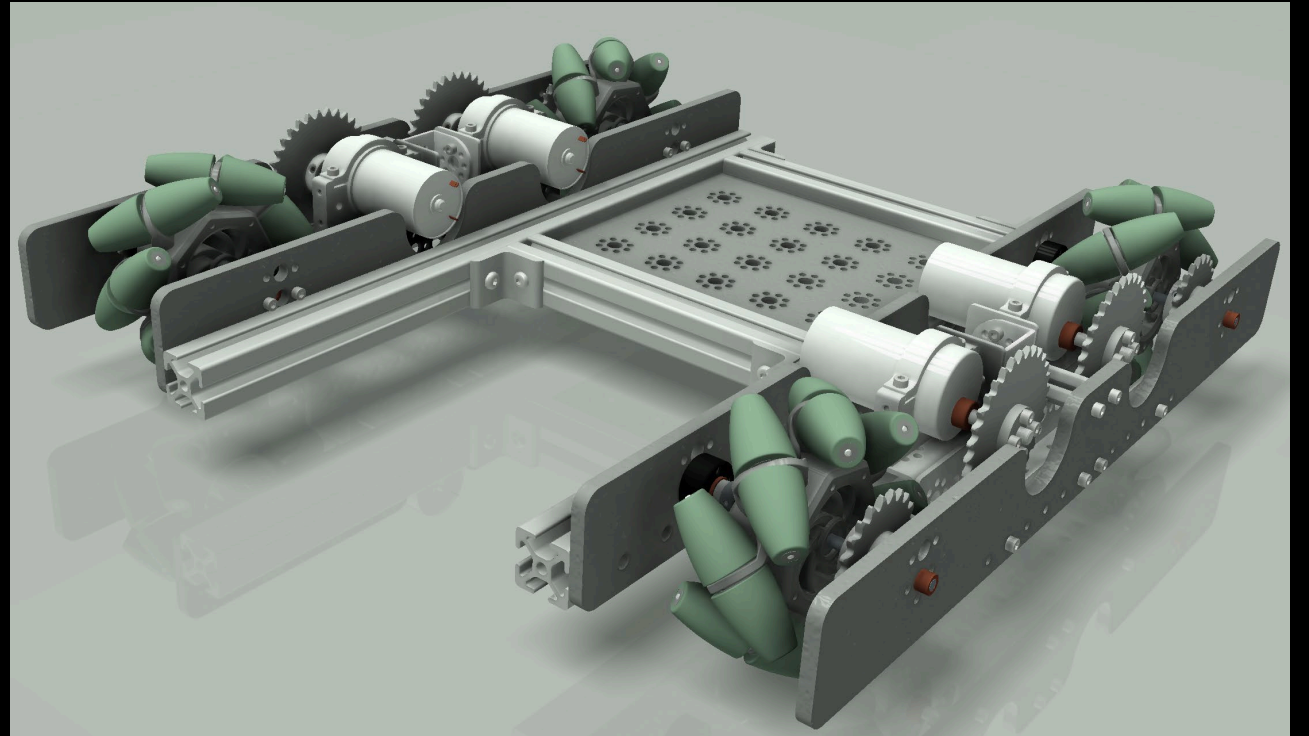
- Five Wheels
- All Omni Wheels
- Pluses
- Minuses





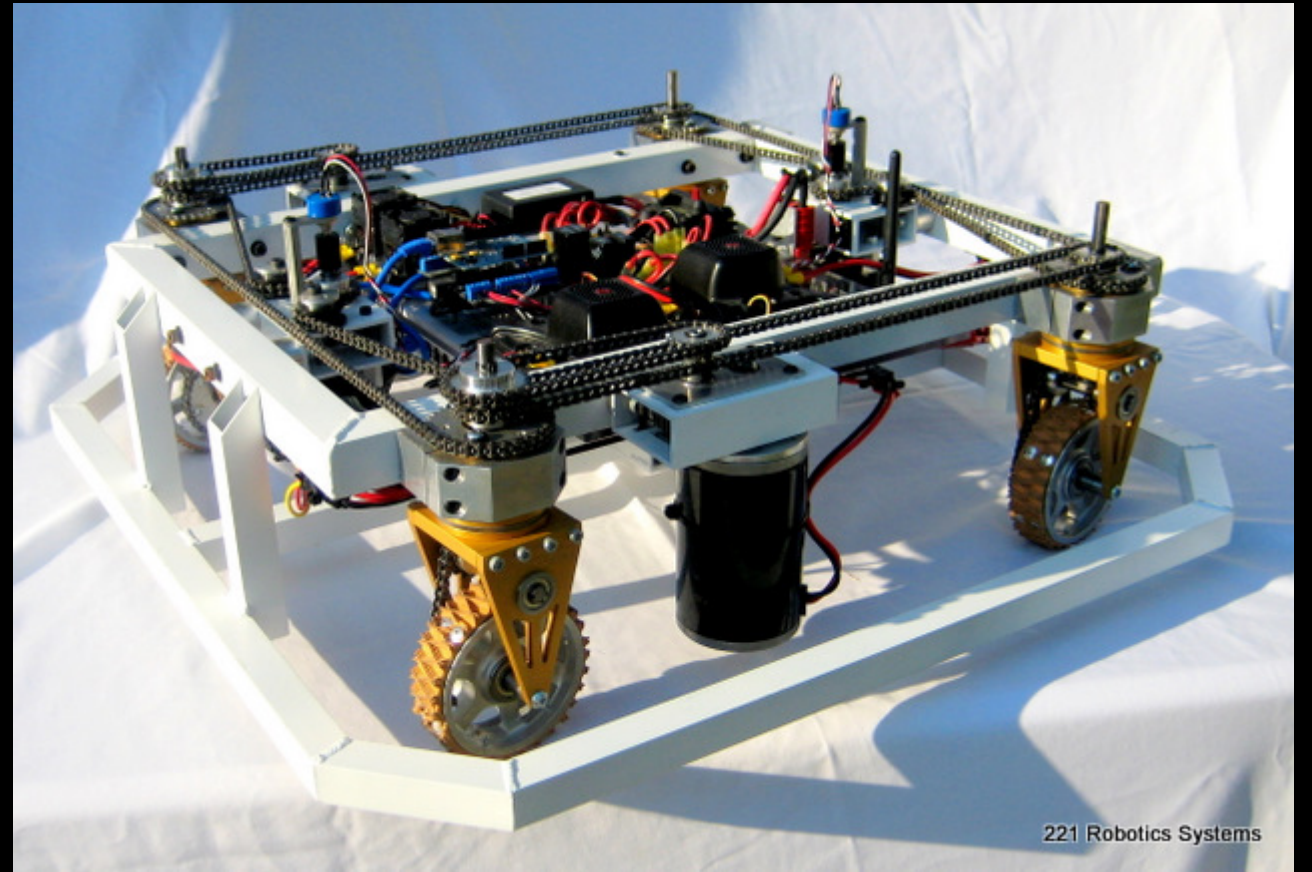
# Holonomic Drive Trains

- Use Four Mecanum or Omni Wheels
- Each Wheel Driven Independently
- To Glide or “Strafe” Across the Field
- Pluses
- Minuses



# Swerve Drive Trains

- Typically Have Four Traction Wheels
- Pluses
- Minuses



# Then, Choose Wheels

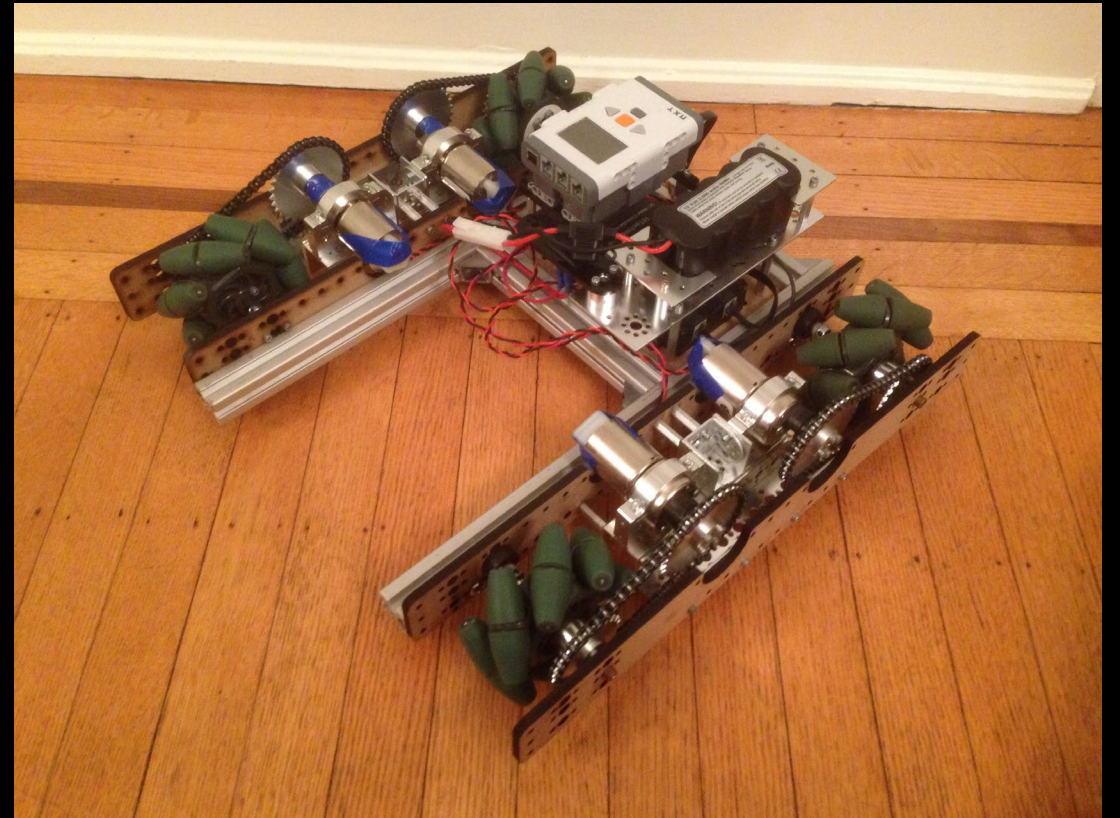
There are tons of wheel types and wheel brands from which to choose:

- All-Terrain
- Banebots
- Colson
- Omni
- Rev Traction Wheels
- Mecanum Wheels



# Wheel Configurations

- Place Some Types of Wheels at Corners of Chassis
- Inset Other Wheels
- Protect Your Wheels



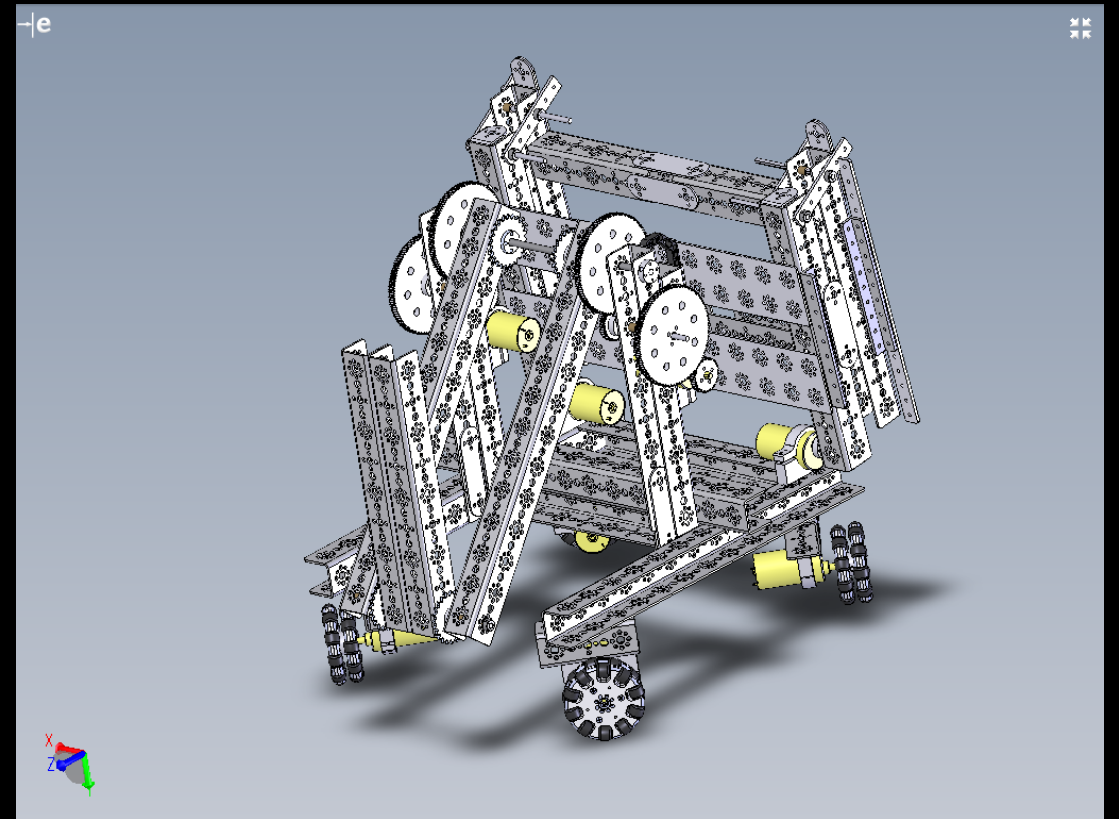
# Lifting System Ideas

- Arms
- Linear Slides
- Scissor Lifts
- Rack & Pinion Systems



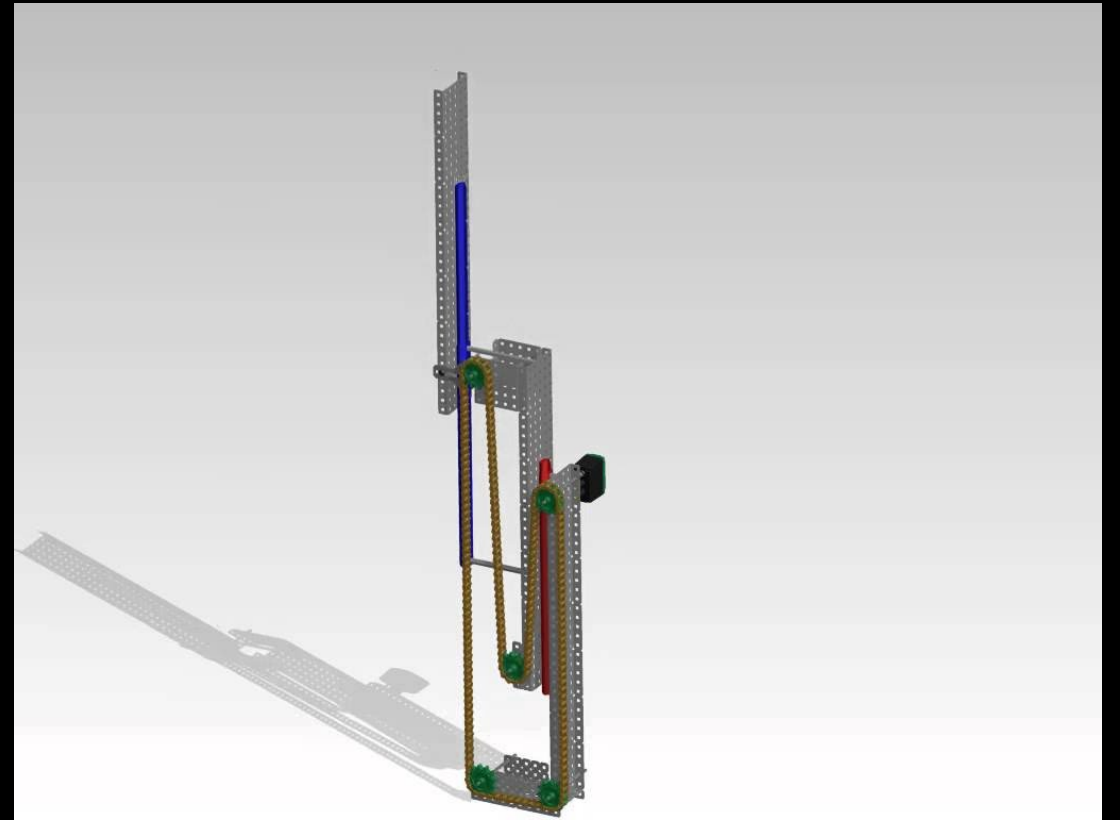
# Lifting Systems - Arms

- Can feature 1, 2 or 3 Joints
- Pluses
- Minuses



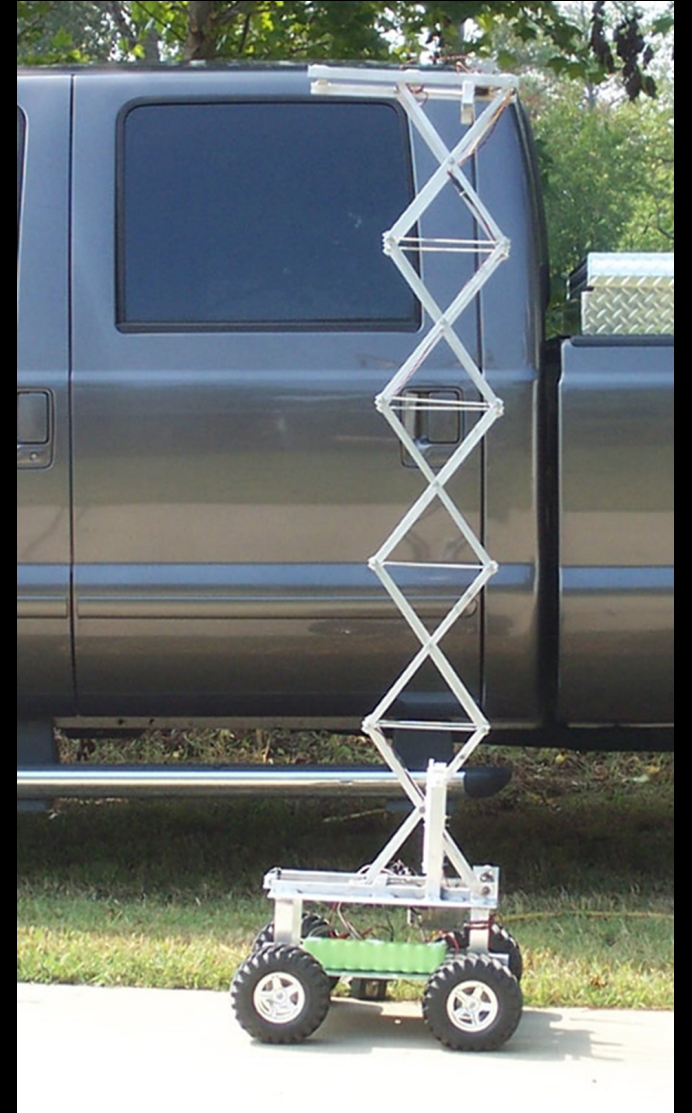
# Lifting Systems – Linear Slides

- Nested Rails Lifted by a String or Wire Attached to a Spool & Powered by a Motor
- Pluses
- Minuses
- A Variety of Materials
  - 80/20
  - Gobilda
  - Rev Robotics
  - Drawer Slides
  - And, More



# Lifting Systems – Scissor Lifts

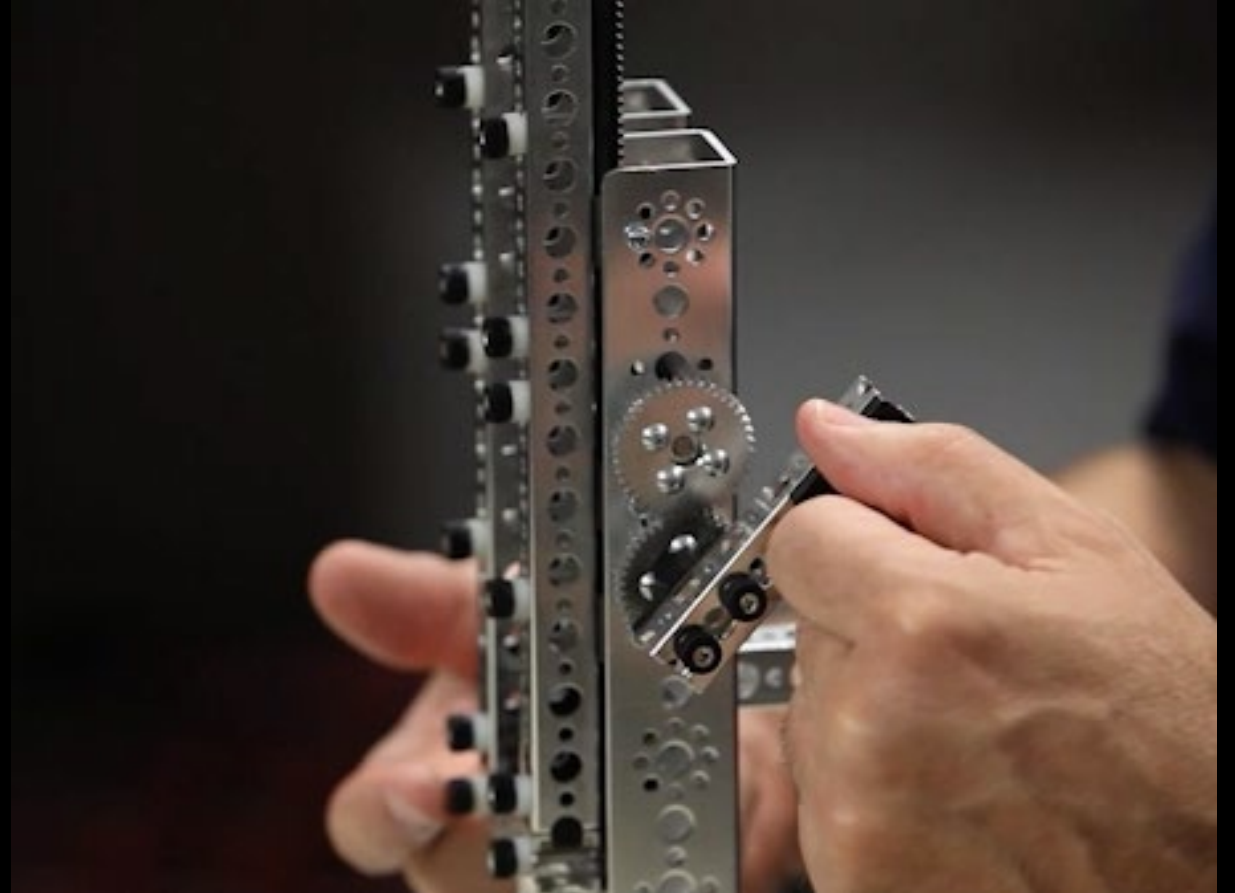
- A platform mounted on folding arms that collapse and extend in a scissor-fashion.
- Pluses
- Minuses





# Lifting Systems – Rack & Pinion

- A Type Of Linear Actuator That Uses A Pair of Gears to Convert Rotational Motion Into Linear Motion
- Pluses
- Minuses



# Manipulation Systems

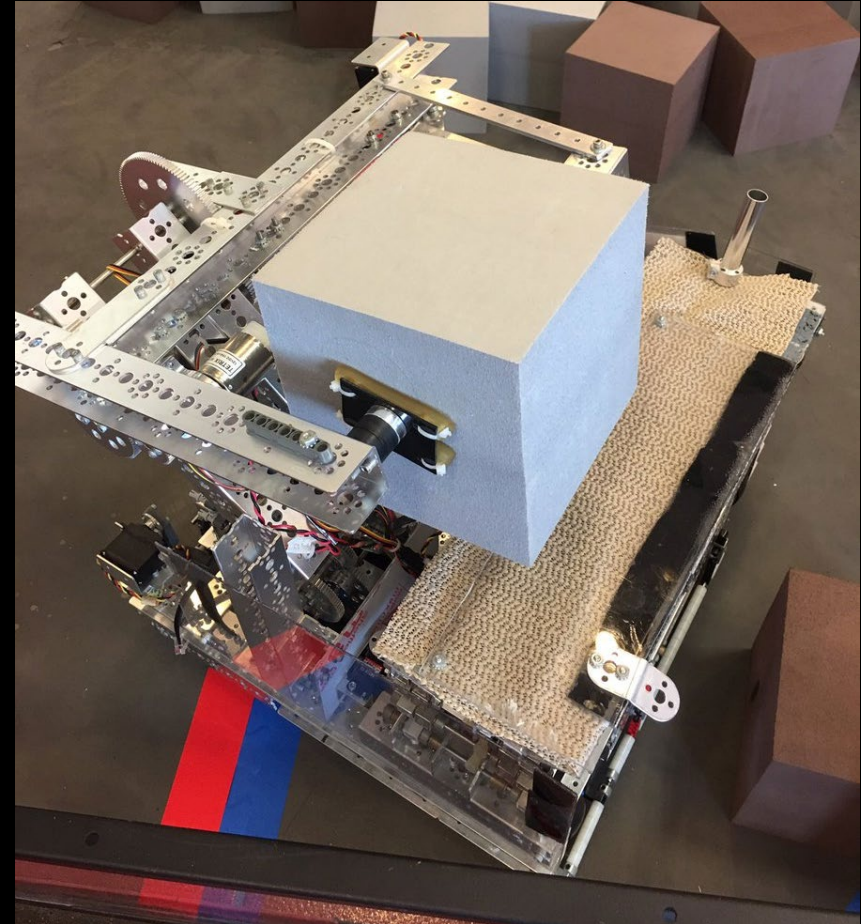
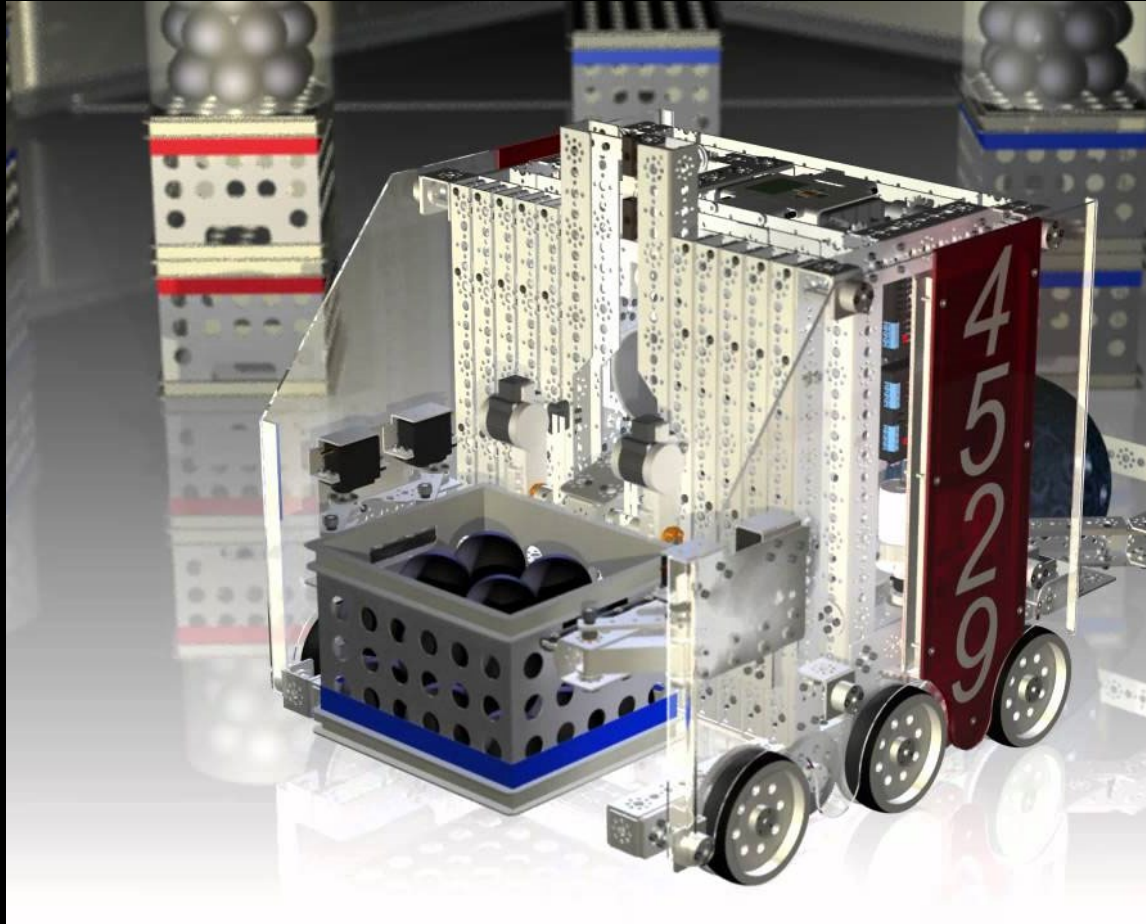
- Chopstick-Like Grips
- Slide Rail Grips
- Top Jaw Grips
- Roller Grips
- Finger-Like Grips



# Manipulators - Chopstick-Like Grips



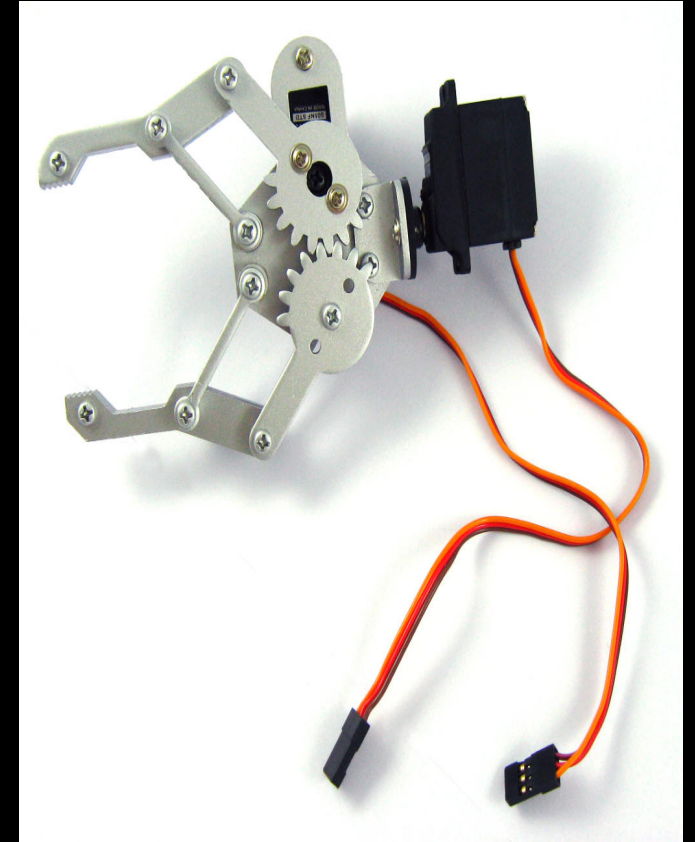
# Manipulators – Two Pad Grips



# Manipulators - Roller Grips



# Manipulators - Finger-Like Grips



# Manipulators – Overhead Grips



# To Develop This Functionality

- Divide & Conquer
- Prototype Fast
- Perfect Assemblies Before Moving On to Other Functionality





# Important Base Skills

Making the Build Easier & Better



# Invest in Reliability

- Follow the Reliability Checklist
- Monitor Your Battery
- Mitigate Static Discharge



# More Building Tips

- Set Screws
  - May Become the Bane of Your Existence
    - The Tetrax Ones are Made of Soft Metal
    - Use McMaster Carr Set Screws Instead
    - Set Screws Fail Often
  - Should Tighten Them After Every Round When You Must Use Them
  - Should Avoid Them When You Can



# More Building Tips

- Lexan is Your Friend – It Cuts Beautifully
- Plexiglas is NOT – It Cracks & Shatters
- Use Lexan for:
  - Side Walls
  - Electronics Mounts
  - Hood Shields
  - Hinged Doors
  - And More!



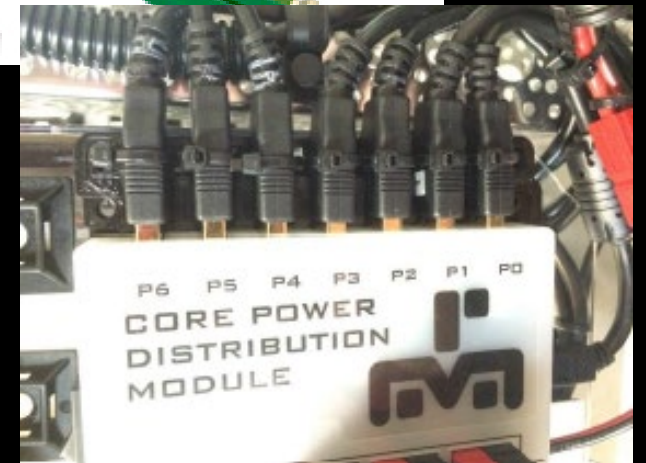
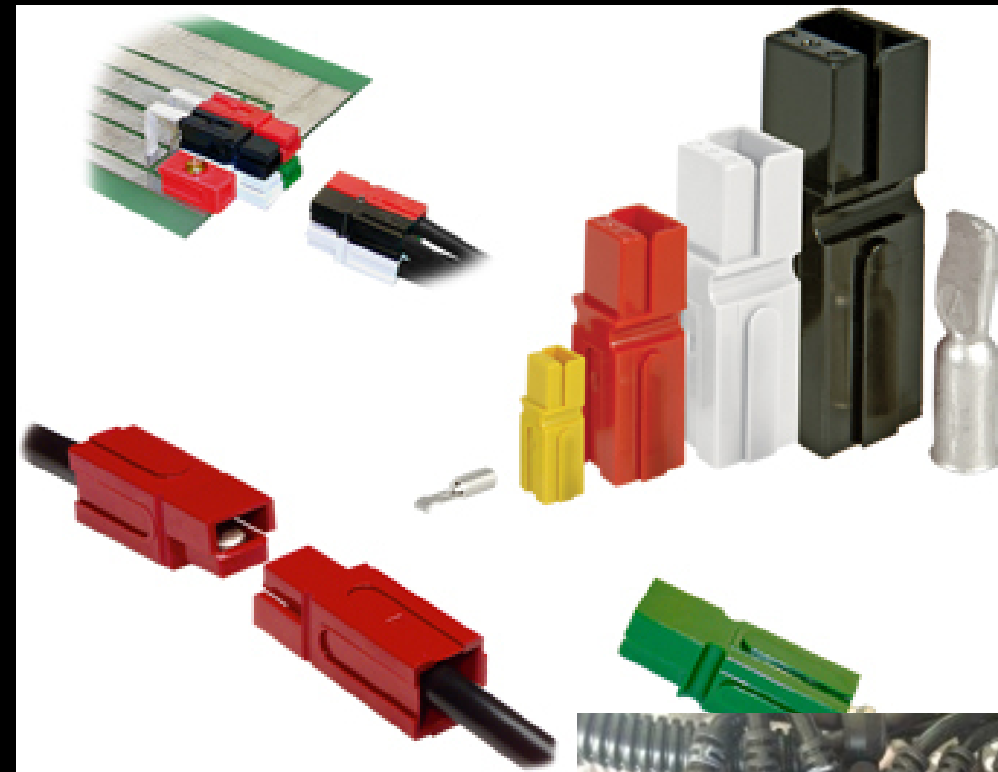
# More Building Tips

- Servo City Servo Blocks Are the Bomb!
  - Unlike the Tetrax Blocks Which Are Weak
  - The Servo City Blocks Reduce Strain on the Servos
  - And, Prevent Failures
  - Note: You Will Need Adapters to Attach Them to Tetrax Parts



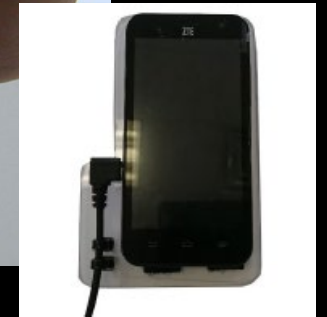
# More Building Tips

- Wiring
  - Protect Wires with Walls, Conduit, Sleeves
  - Keep Wires Away from Moving Parts
  - And, Use PowerPoles on Your Battery and Motor Wires + to Create Secure Connections
  - More Tips



# More Building Tips

- The Micro USB to the Phones
  - A Significant Failure Point
  - Buy The Best You Can Find
  - Avoid Holding by the Cord and/or Dropping
  - Secure Cord



# Electrostatic Shock

- This is a HUGE issue.





# More Building Tips

- Sprockets & Chain
- Nut Drivers & T-Handle Hex Keys
- Loose Screws



# Resources

- For a List of:
  - Books
  - Websites
  - Curriculum
  - See our site:  
[LearnScienceAndMathClub.org](http://LearnScienceAndMathClub.org) > Resources > FTC
- Call us any time –  
Rebecca Kidwell, 816-914-3115  
[rkidwell@LearnScienceAndMathClub.org](mailto:rkidwell@LearnScienceAndMathClub.org)



Remember This:

Above All: Have Fun!

