2023-2024 *FIRST®* Tech Challenge

Basic 'Bot Guide for TETRIX- Part 1

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Revision History		
Revision	**Date**	**Description**
1	6/28/2023	Initial Release

Contents

FOR INSPIRATION & RECOGNITION OF SCIENCE & TECHNOLOGY

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. Participants and alumni of *FIRST* programs gain access to education and career discovery opportunities, connections to exclusive scholarships and employers, and a place in the *FIRST* community for life. To learn more about *FIRST*® Tech Challenge and other *FIRST*® Programs, visit www.firstinspires.org.

Gracious Professionalism®

FIRST® uses this term to describe our programs' intent.

Gracious Professionalism® is a way of doing things that encourages high-quality work, emphasizes the value of others, and respects individuals and the community.

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

Introduction to this Guide

About this Guide
The Basic 'Bot Guide is intended for teams looking for a step-by-step instructional guide to learn how to build a basic chassis and structure of the robot. Each season there is a new release of this guide, previously called the "Push Bot Guide", this version the **Basic 'Bot Guide for TETRIX Part 1** has been created to use 2021-2022 season's TETRIX kit of parts.

Parts
- TETRIX FTC Competition Set
  - Tools included with the TETRIX FTC Competition Set
- Electronics Modules and Sensors set
- Control & Communication Set 1 or 2
  - (Optional) Only the tools included in the FTC Competition Set will be needed to build the chassis. The screws and nuts are a standard size and having more tools may allow more students to participate at the same time.
  - (Optional) A ruler is not needed to build this robot, but it is necessary to make sure that the robot is competition ready

Tips and Tricks
- Organize and separate out all of the parts you will need to build the drivetrain before you get started.
- Keep extra parts in separate bags for use later or as replacements.
- Make sure that set screws are installed in every axle hub, motor hub, and axle collar.
- Refer to the legend provided in the Kit of Parts, if any parts are unfamiliar.
- Make sure that all assemblies areperpendicular (90° angles). It is hard to drive a crooked robot straight!
- The drive wheels are powered by two DC motors located on the back of the robot, which are relatively heavy. This weight is needed to help the wheels grip the surface better.
- Omni wheels should be located on the front of the robot, which allows the robot to turn more easily. The omni wheels' rollers slide sideways with very little friction.
- Unless otherwise noted, the top image in each step shows the necessary parts; the lower image shows the completed assembly.
- Place all completed sub assemblies aside in a plastic container.

Computer Aided Design (CAD)
- The drawings in this document were generated using Creo Parametric Computer Aided Design (CAD) software.
  - By designing on the computer first with CAD, the design can be tested to ensure everything will work together before actual construction.
- The Creo software is available for free to FIRST teams for use in designing robots. The CAD drawings color code the screws to help identify them (see table below).

CAD Coloring Legend

Pitsco Part Number		Part	Color
39098		5/16" socket head cap screw	red
39094		keps nut	blue
39111		3/8" button head cap screw	green
39097		1/2" socket head cap screw	yellow
39195		motor mount screw	orange

Frame

Step 1: Build the Left Rail
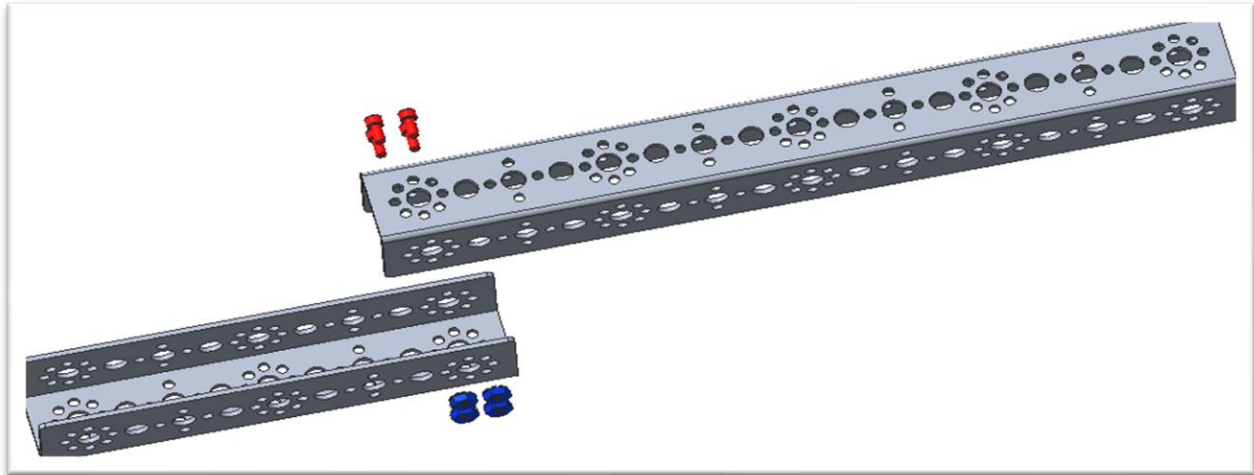
Figure 1- Unassembled view
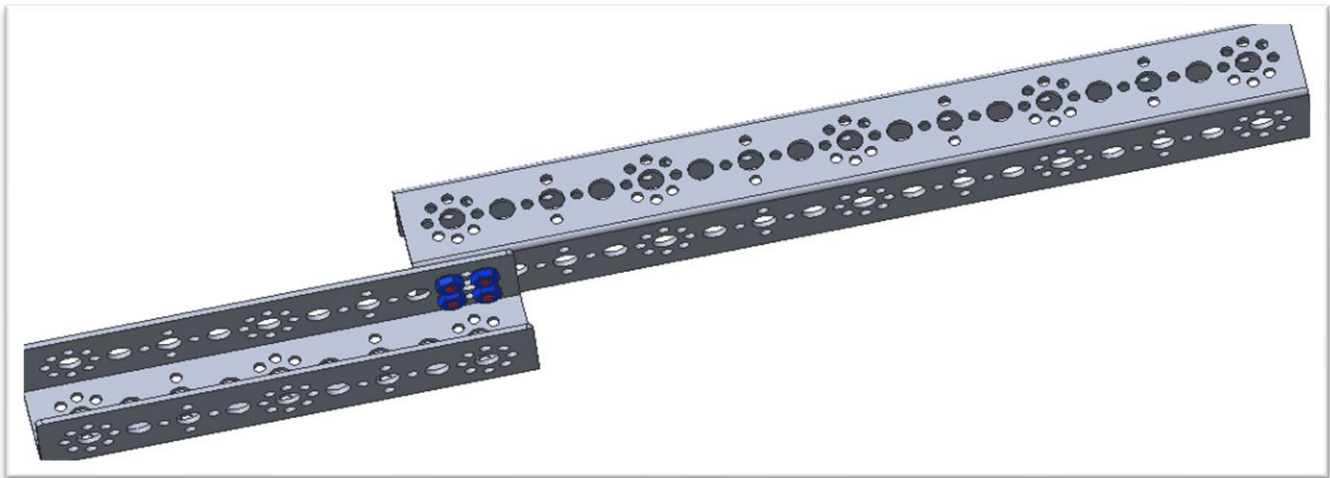
Figure 2- Assembled view

Step 2: Build the Right Rail
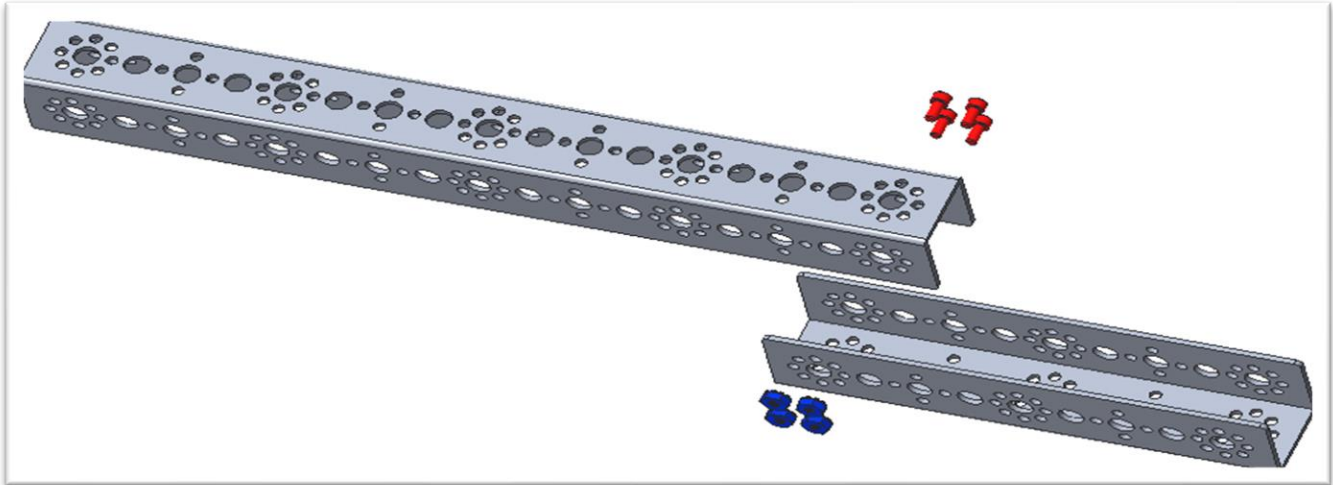
Figure 3- Unassembled view
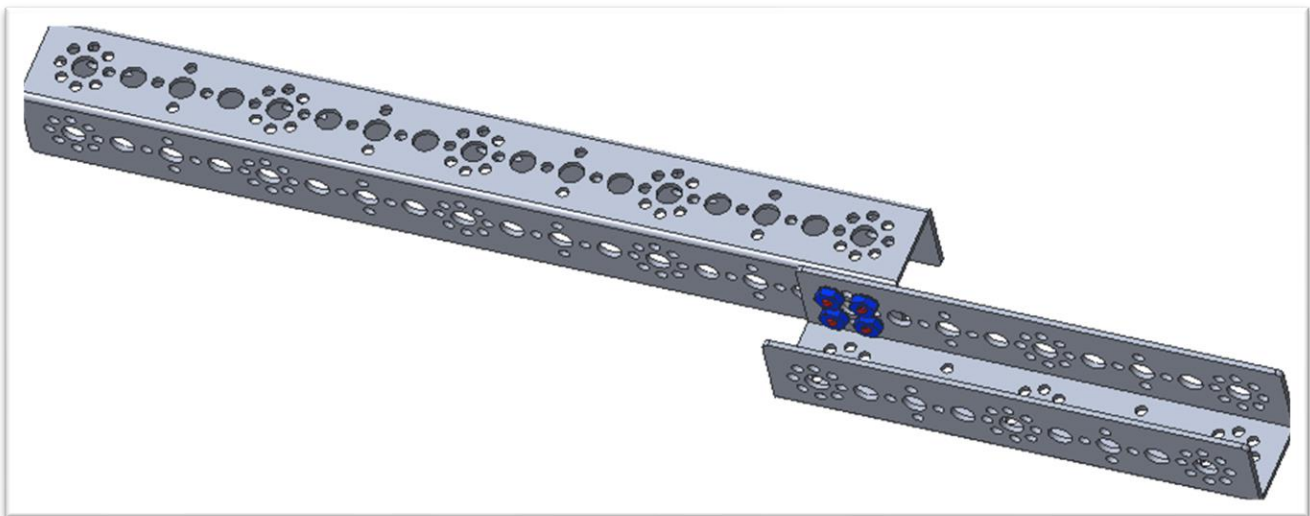
Figure 4- Assembled View

Step 3: Connect the Left and Right Rails
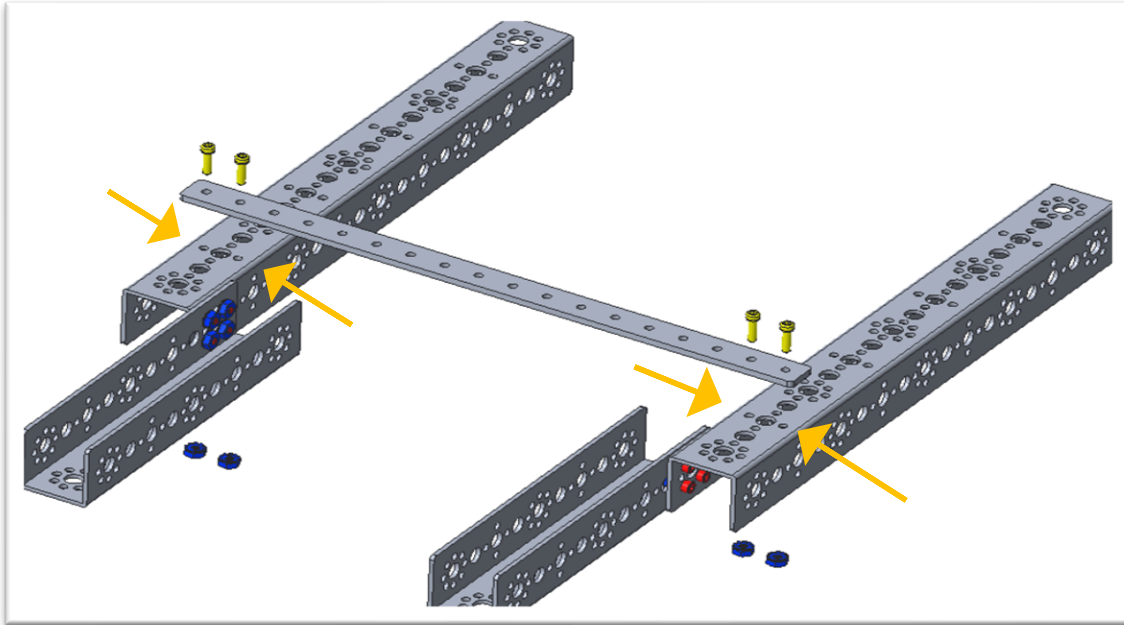
Figure 5- Unassembled view
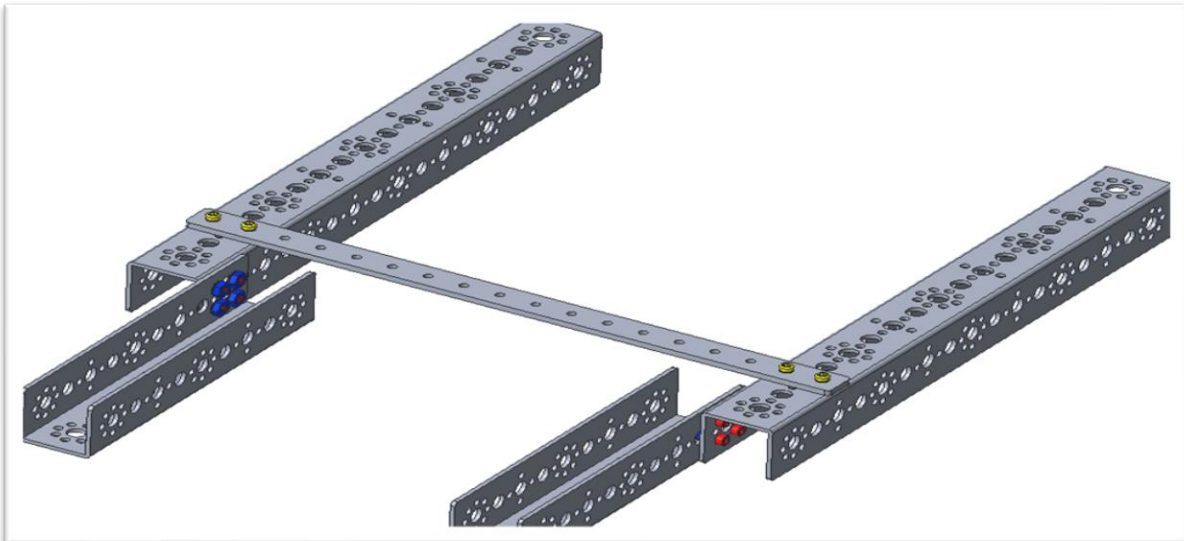
Figure 6- Assembled View

Step 4: Add Structural Support Brackets

Figure 7- Unassembled view

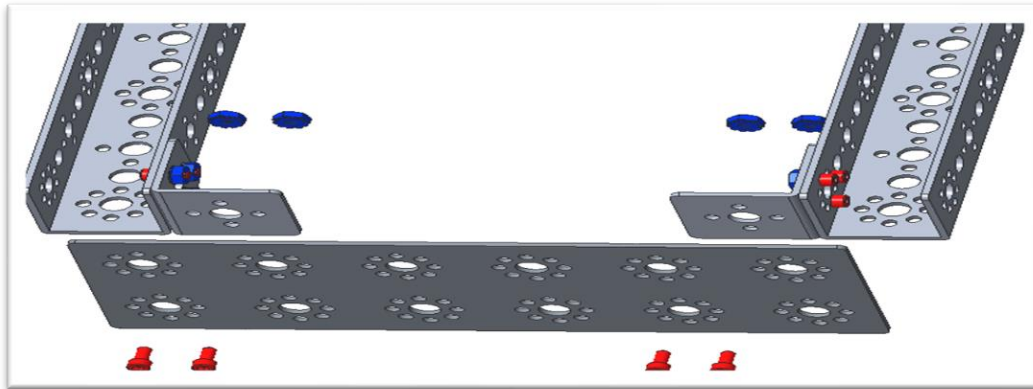*Figure 8- Assembled view*

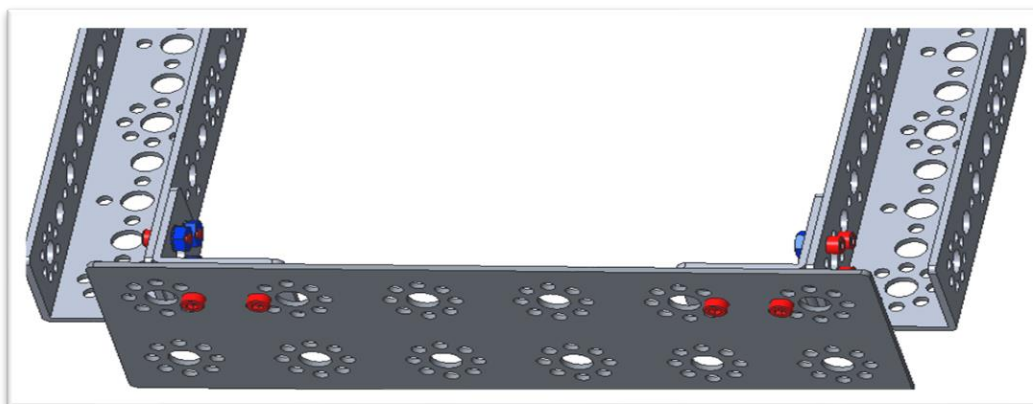## Step 5: Add the Structural Support Plate

Figure 9- Unassembled view

Figure 10- Assembled view

Helpful Hints

- Make sure that all pieces are correctly alignedby looking at the robot from above and ensuring the left and right rails are parallel and the cross braces form right angles with them.
- Once the frame is square, make sure that all the frame's bolts are tight. It is hard to drive a crooked robot straight!

Step 6: Build Left Electronics Plate

Figure 11- Unassembled View
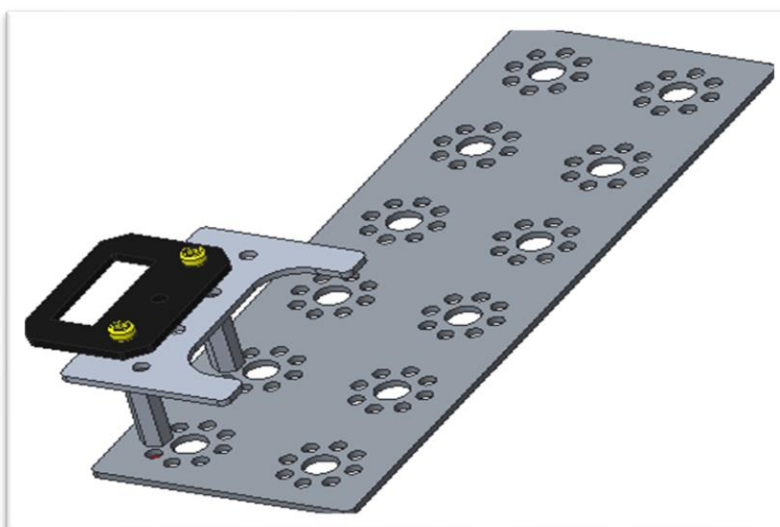
Figure 12- Assembled view
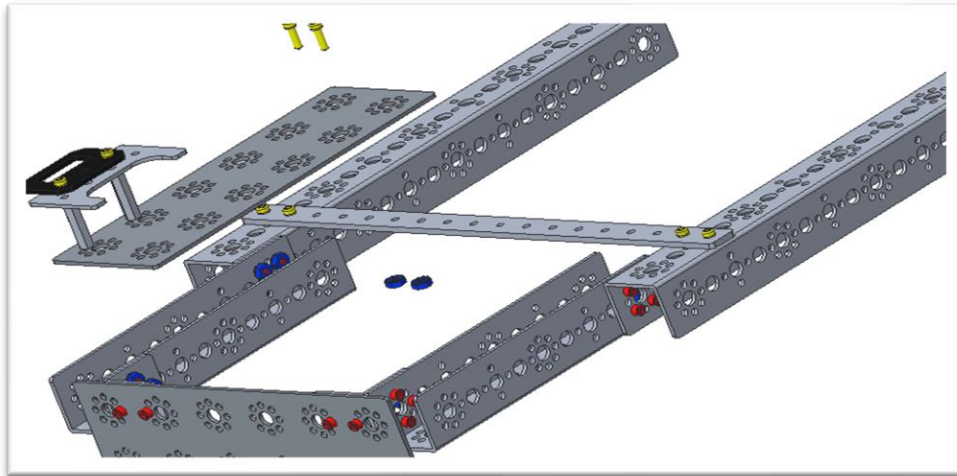
Step 7: Attach Left Electronics Plate to Frame

Figure 13- Unassembled view

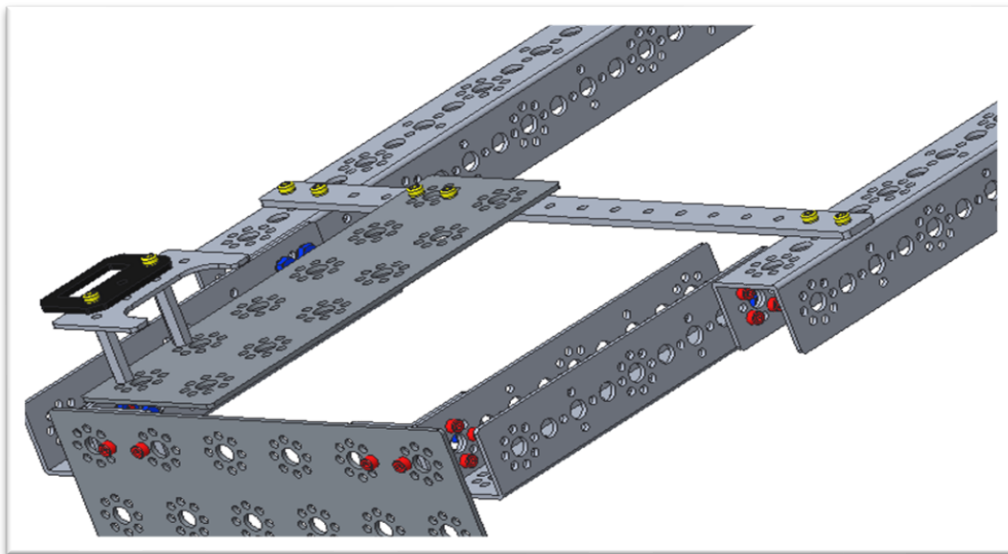
Figure 14- Assembled view

Helpful Hint

- The plate does NOT attach to the frame at the clip/structural support plate.

Step 8: Build Right Electronics Plate

Figure 15- Unassembled view
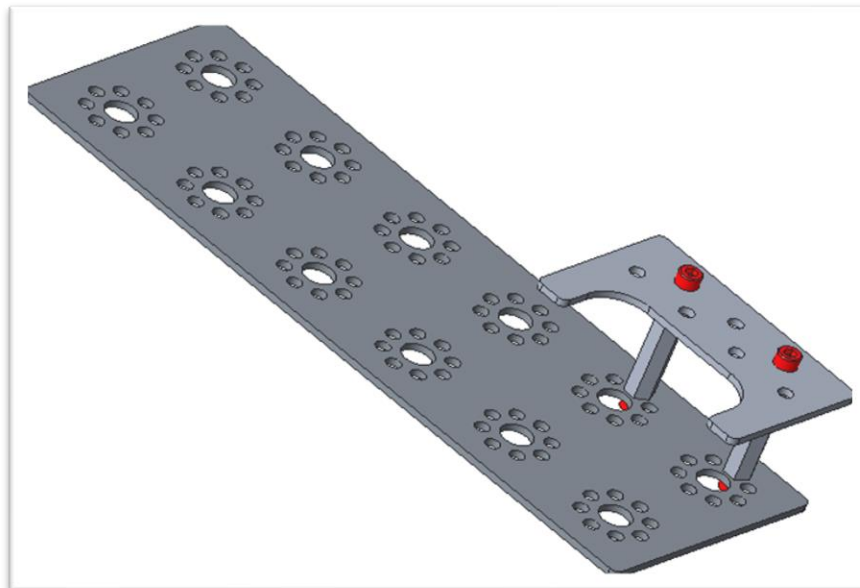
Figure 16- Assembled view

Step 9: Attach Right Electronics Plate to Frame

Figure 17- Unassembled view
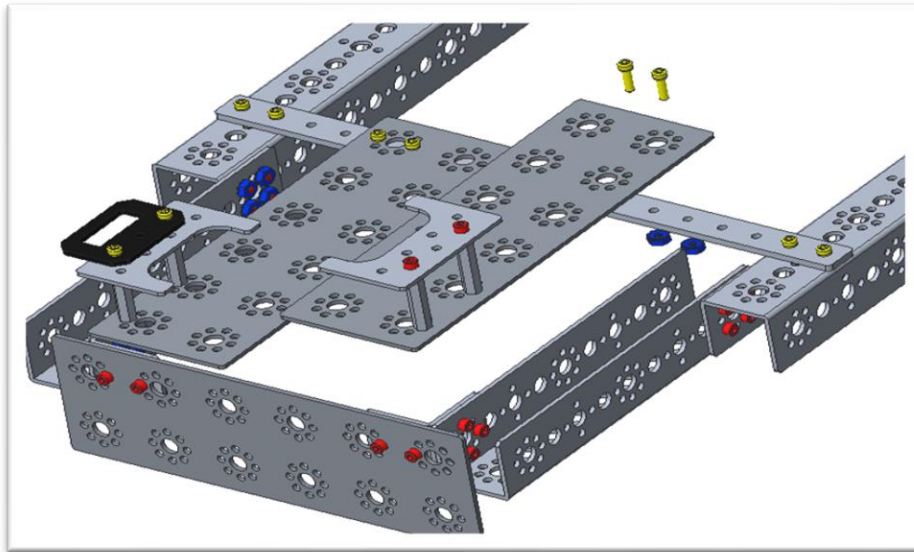

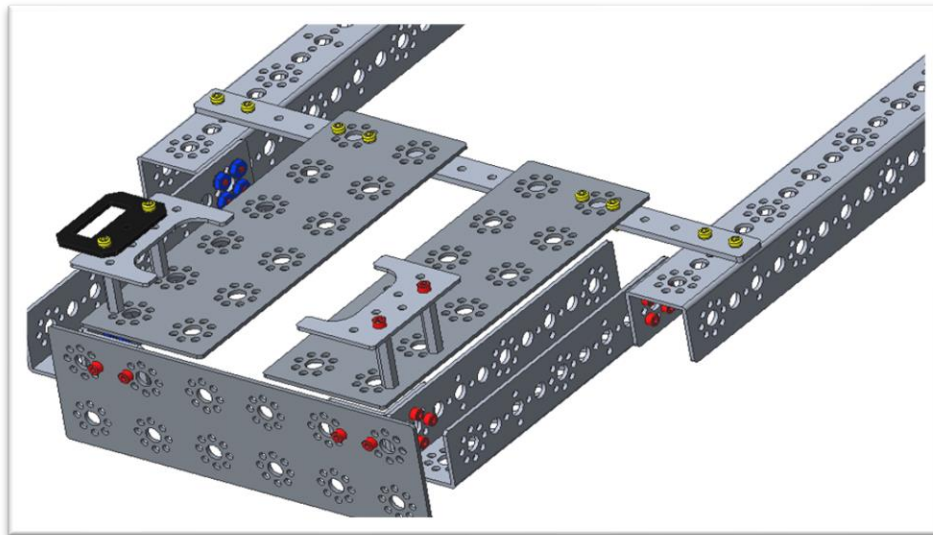*Figure 18- Assembled view*

Helpful Hint

- The plate does NOT attach to the frame at the clip/structural support plate.

Drive Motors and Drive Wheels

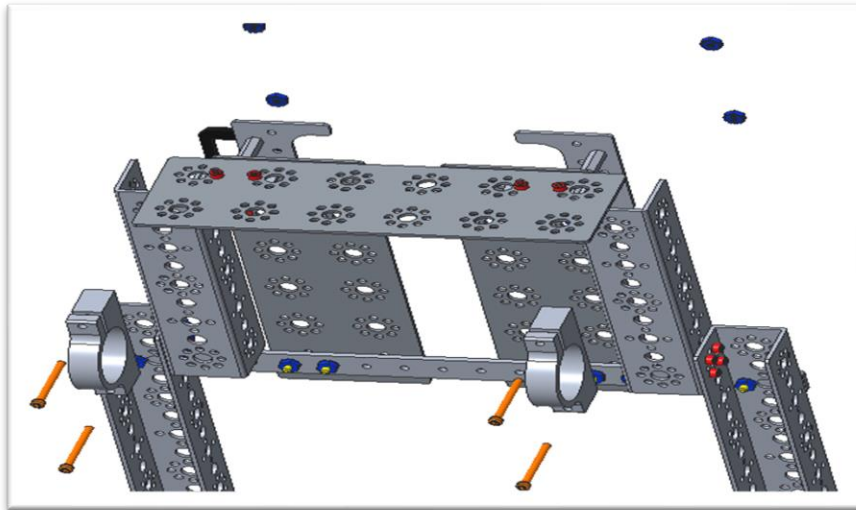## *Step 1: Add Drive Wheel Motor Mounts*
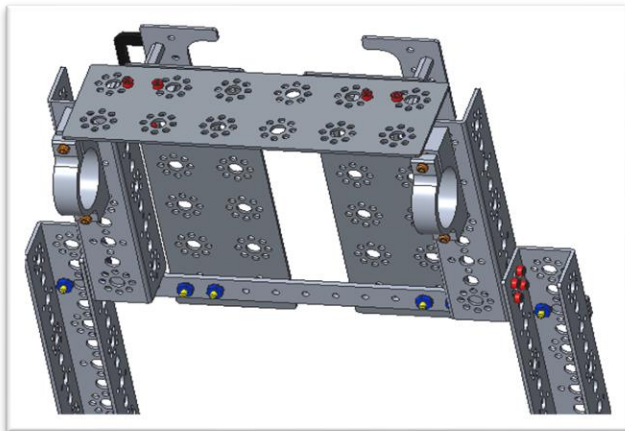
Figure 19- Unassembled View

Figure 20- Assembled View from below the robot

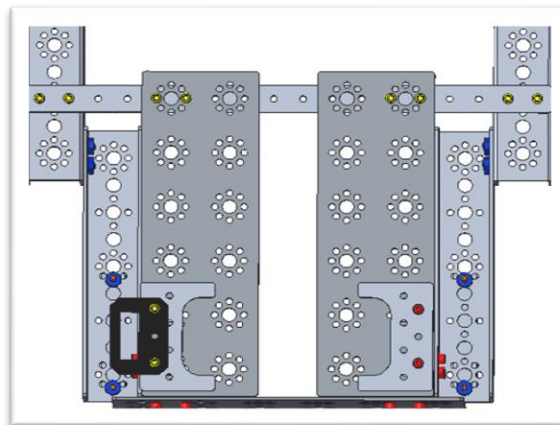*Figure 21- Assembled view from above the robot*

Helpful Hint

- Do not tighten the motor mount bolts that control the clamp (i.e., the gap on one side of the mount) until the motors have been inserted (next step). When this bolt is tightened, the motors cannot be inserted into the mount.

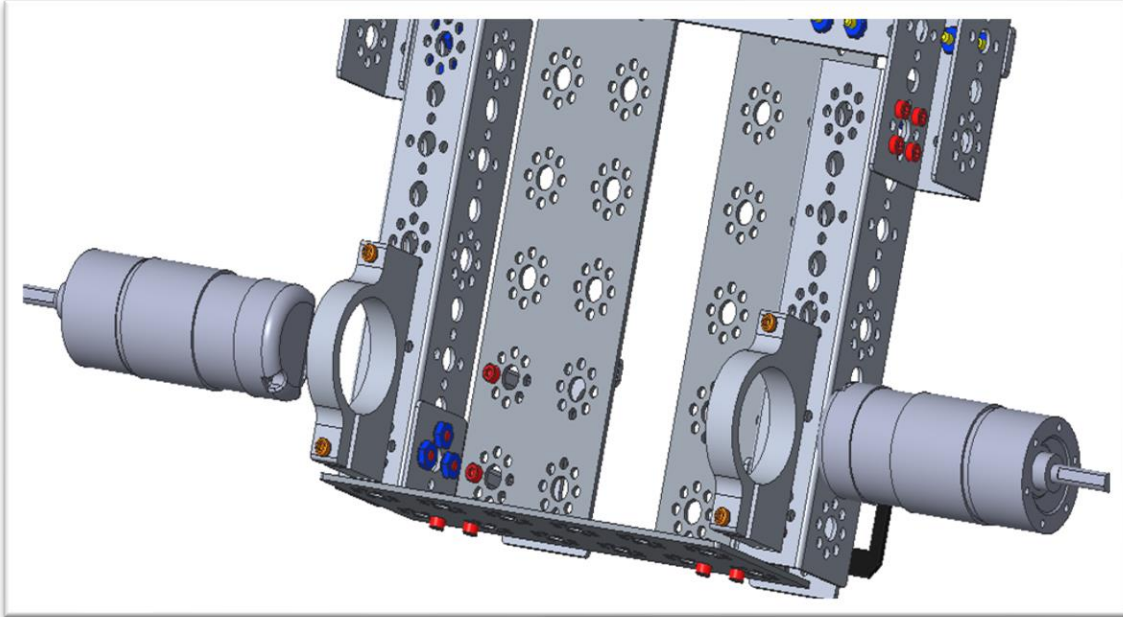## *Step 2: Add Drive Motors*

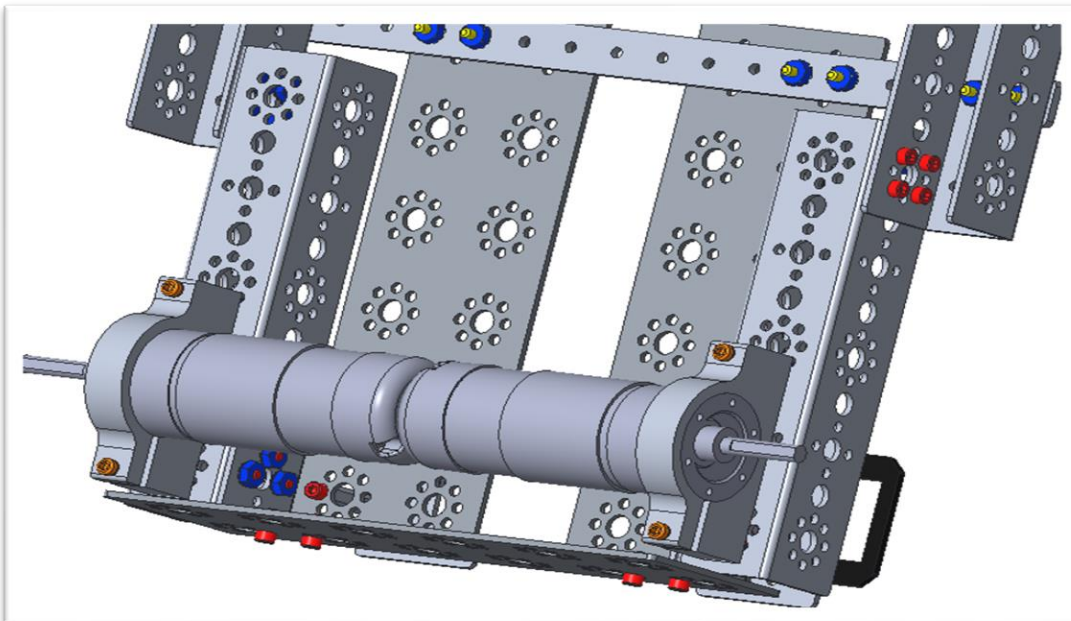*Figure 22- Unassembled view*

Figure 23- Assembled View

Step 3: Secure Drive Motors
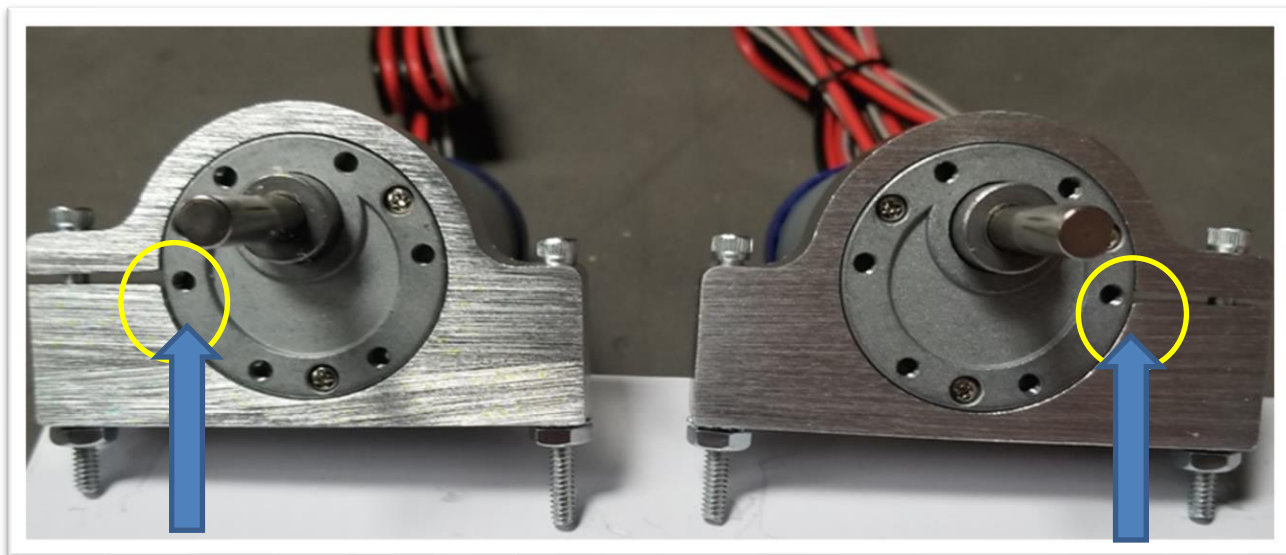
Figure 24- Real view
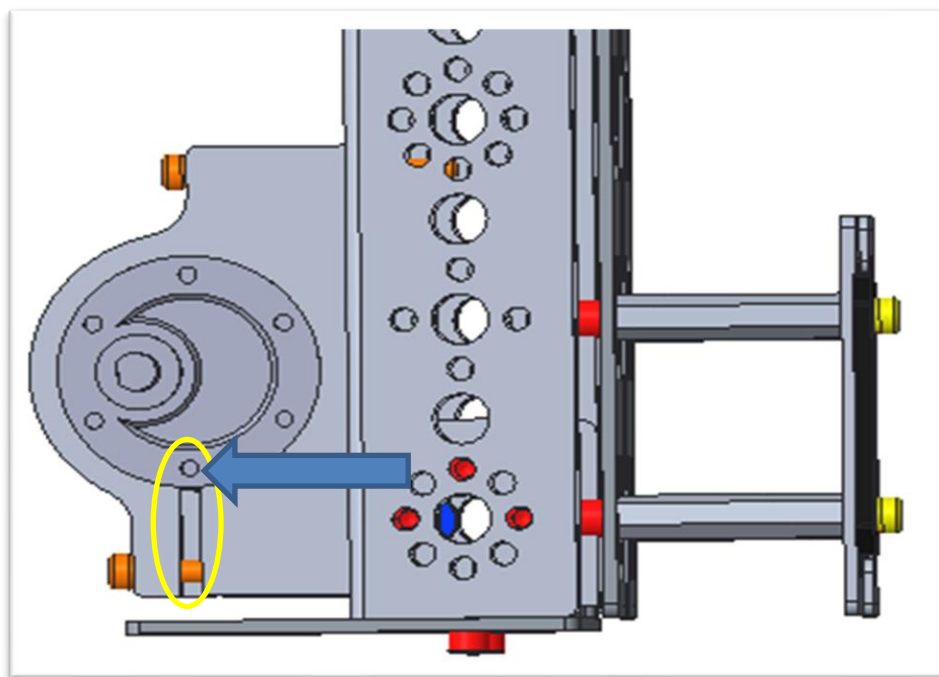
Figure 25-Left rail motor view highlighting the axle mounted away from frame

Helpful Hint

- Tighten the motor mount bolt so that the motor will not rotate.

Step 4: Secure Drive Motor Wires
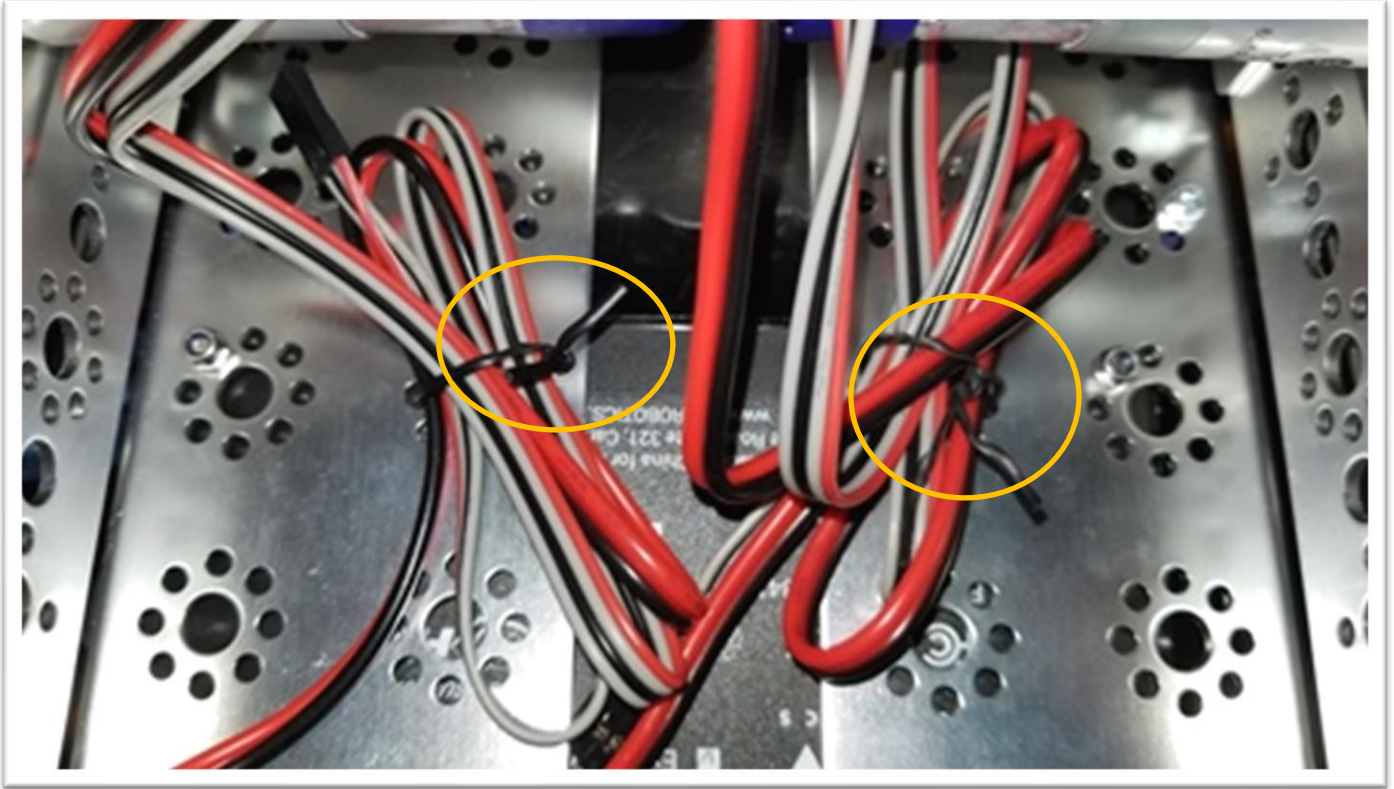
Figure 26- Secured drive motor wires

Helpful Hint
- Use the plastic-coated wire tie that holds the loops of motor wire together to secure the wires to the electronics plate

Step 5: Add Motor Hubs
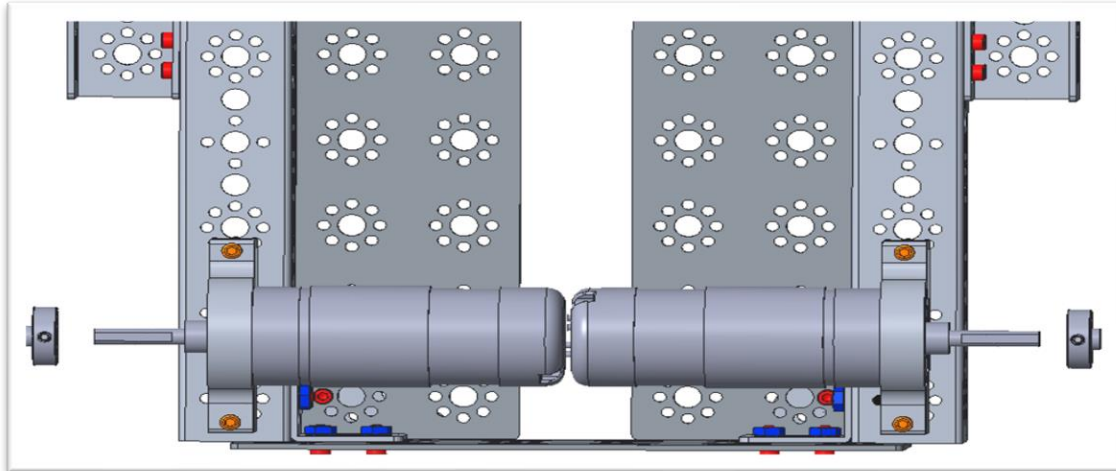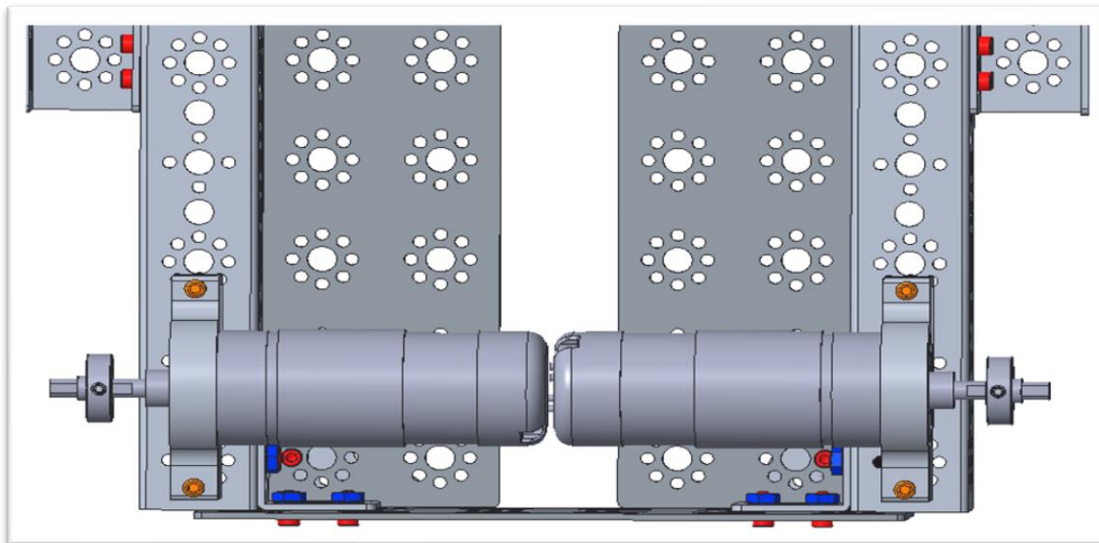
Figure 27- Unassembled view

Figure 28- Assembled view

Helpful Hint

- Install the hubs 10 mm from the outside end (the end furthest from the motor) of the axle.

Step 6: Add Drive Wheels
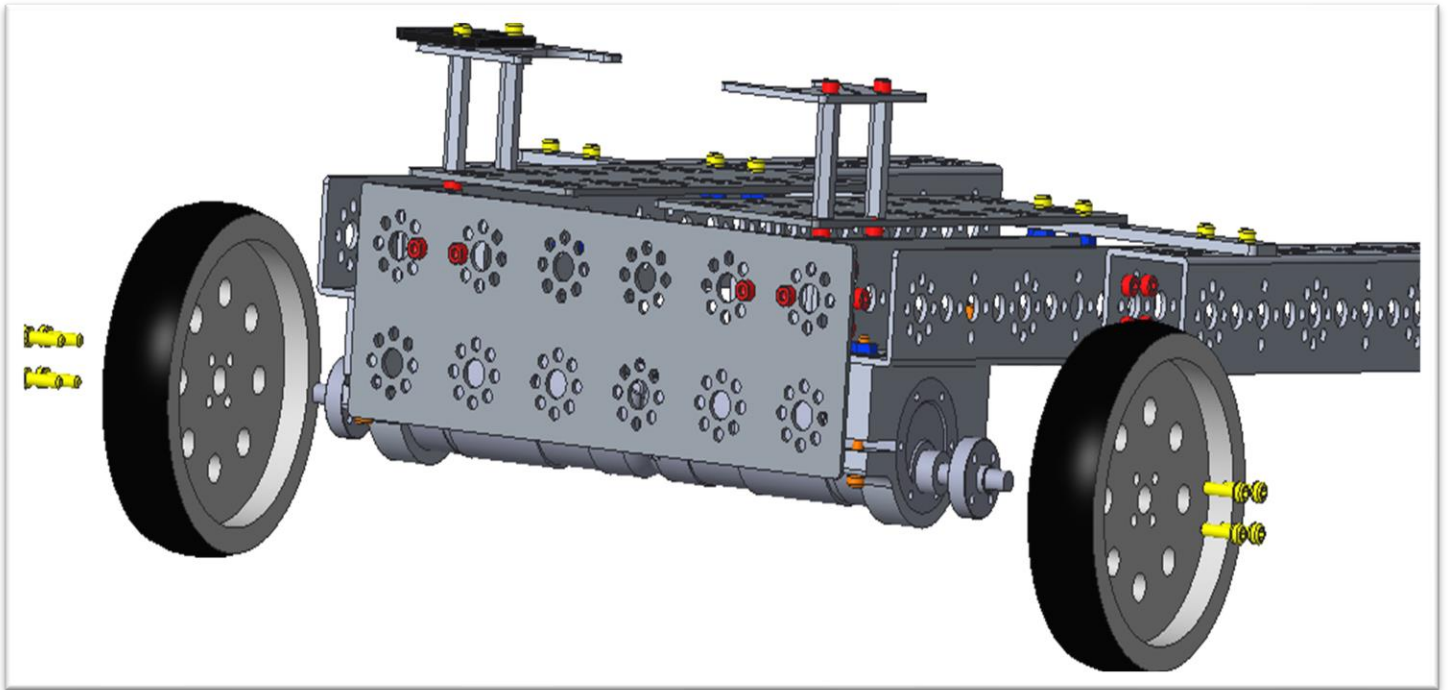
Figure 29- unassembled view
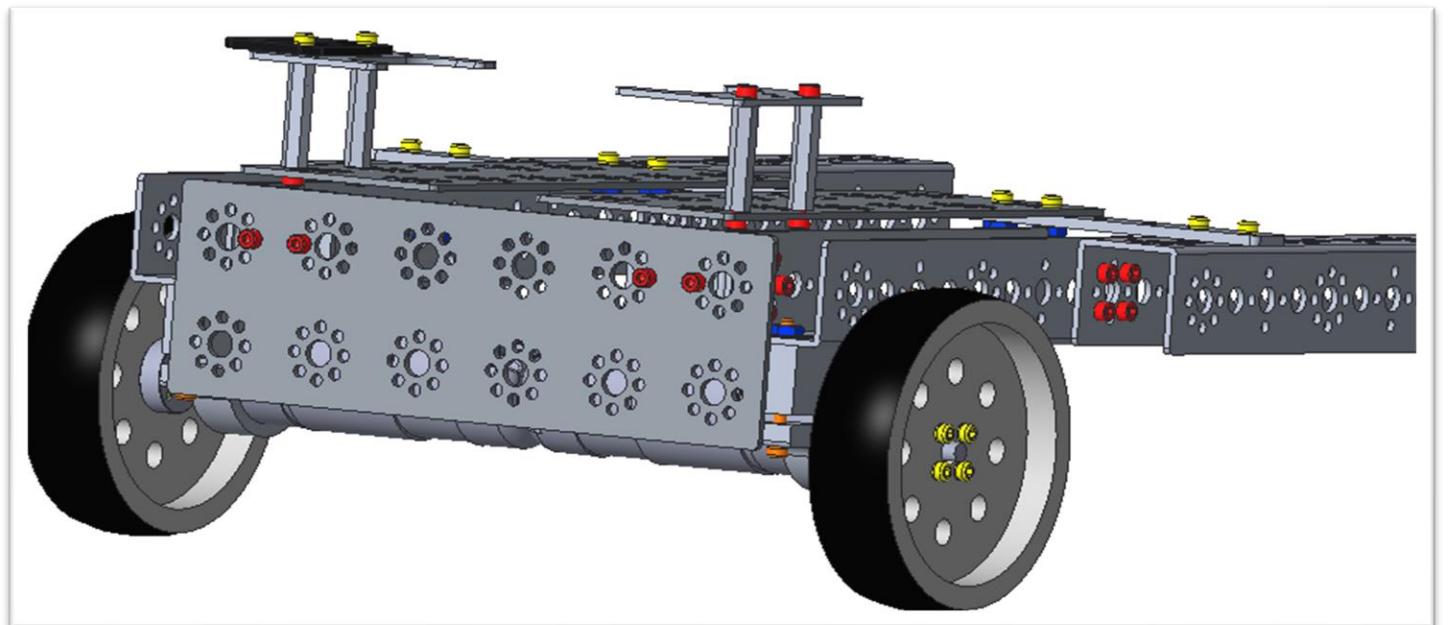
Figure 30- Assembled view

Caster Wheels

Step 1: Build the Omni Wheel Assembly x2

Figure 31-Unassembled view of one wheel assembly (Make two of these)

Figure 32- Assembled view 1   *Figure 33- Assembled view 2*

Helpful Hints
- Assemble according to the instructions that come in the omni wheel pack.
- The screws on one wheel are in opposite holes from the screws on the opposite side wheel

Step 2: Add Bronze Bushings to the Omni Wheel Assemblies
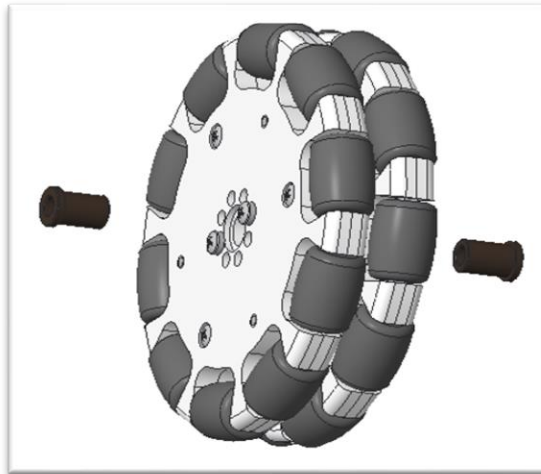
Figure 34- Unassembled view from a single wheel assembly (Make two of these)
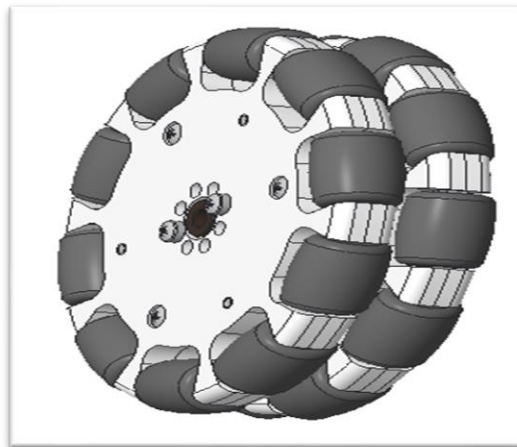
Figure 35- Assembled view

Helpful Hints
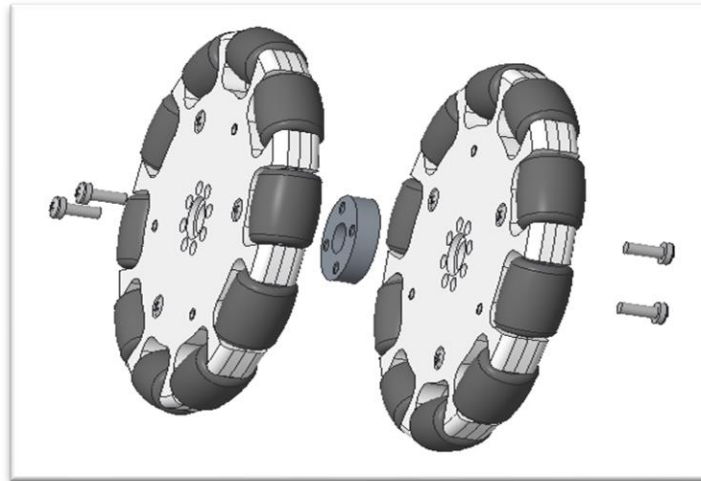- To make it easier to insert the bronze brushings, secure an axle collar onto the axle. Slide a bronze bushing down the axle. Slide the omni wheel down the axle and press it against the axle collar.
- A video showing a gear mounted to an axle is available that shows this trick.
    - Visit: https://www.facebook.com/322705934572847/videos/506108019565970/

Step 3: Add the Omni Wheel Assemblies to the Frame Chassis
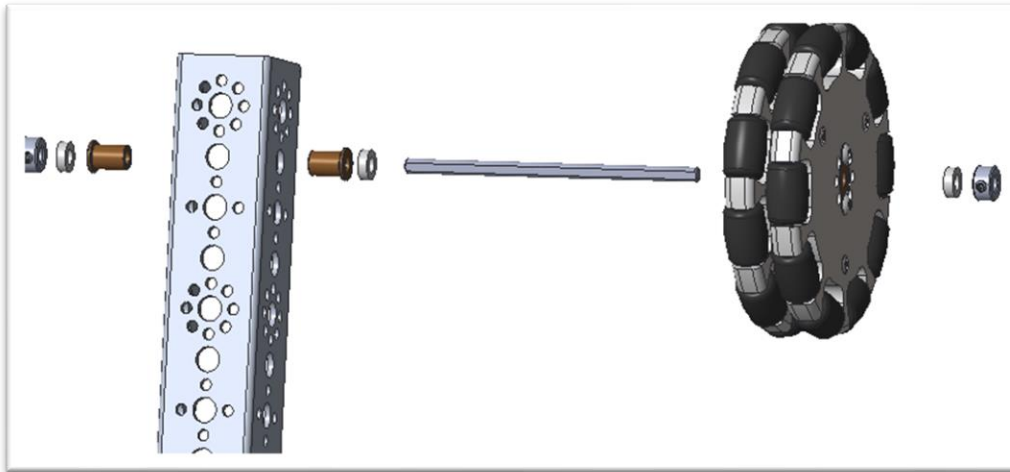
Figure 36- Unassembled view of left wheel assembly
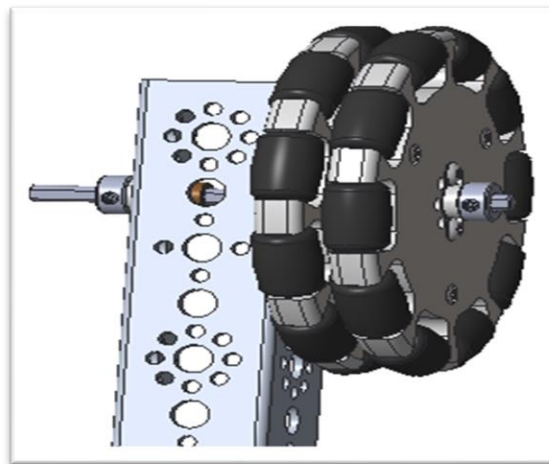
Figure 37- Assembled view of left wheel assembly.

Helpful Hint

- Order from the outside in: axle set collar, 1/8" axle spacer, omni wheel assembly, 1/8" axle spacer, 11 mm bronze bushing, channel, 11 mm bronze bushing, 3/8" spacer, axle set collar
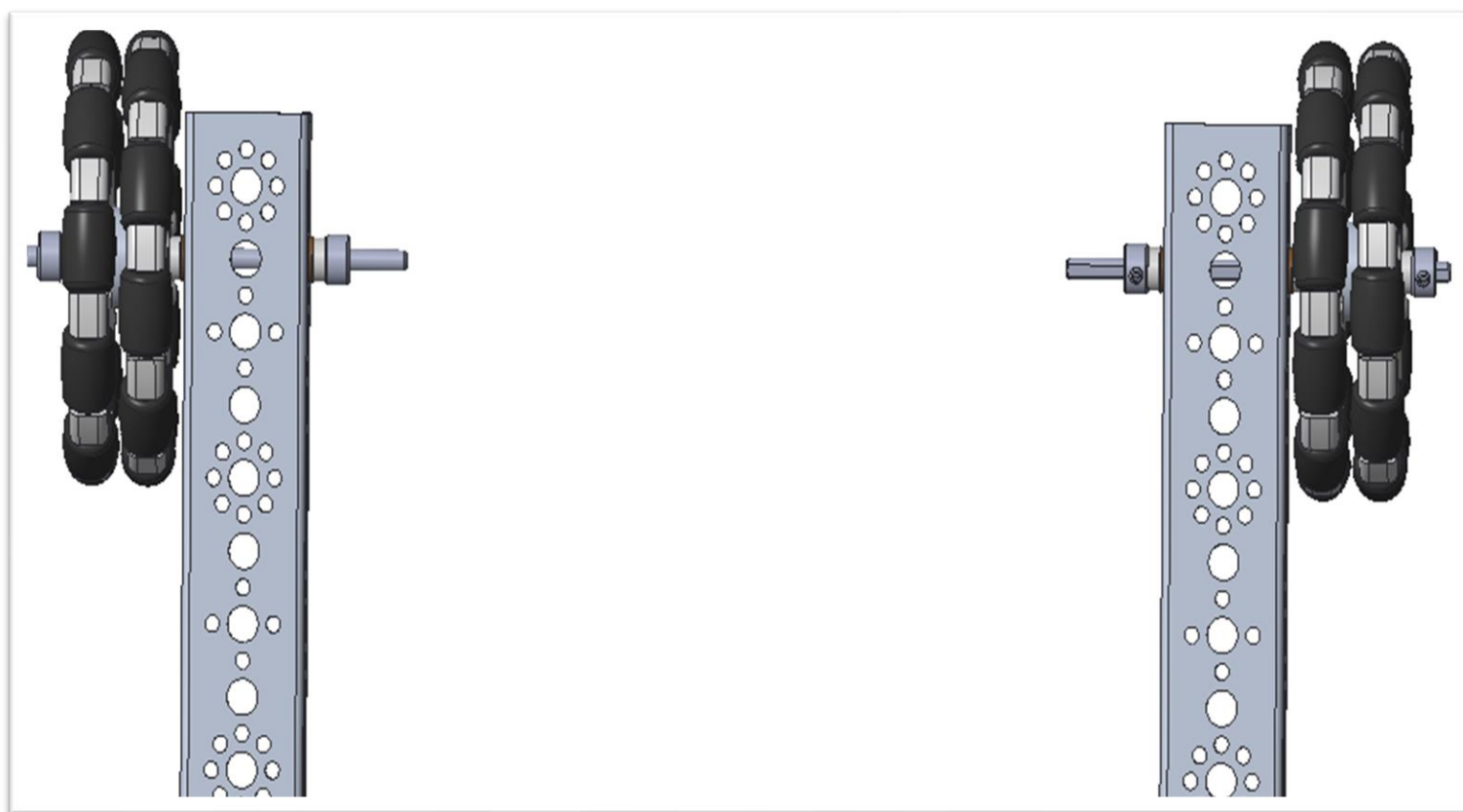
Figure 38- Both wheels fully assembled from above

Control Hub

Step 1: Add the REV Robotics Control Hub
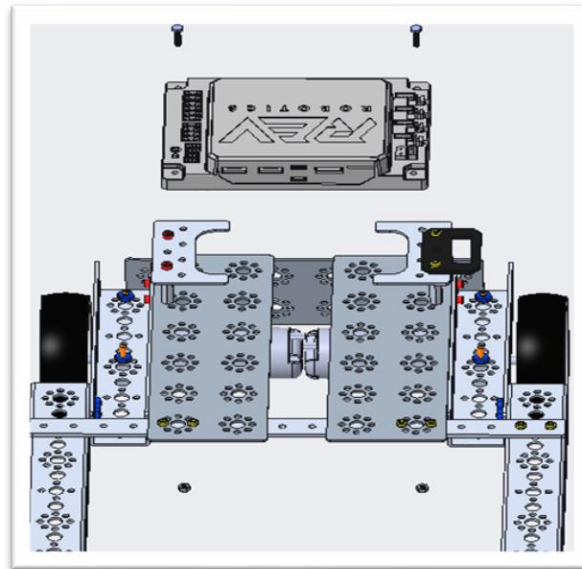
Figure 39- Unassembled view
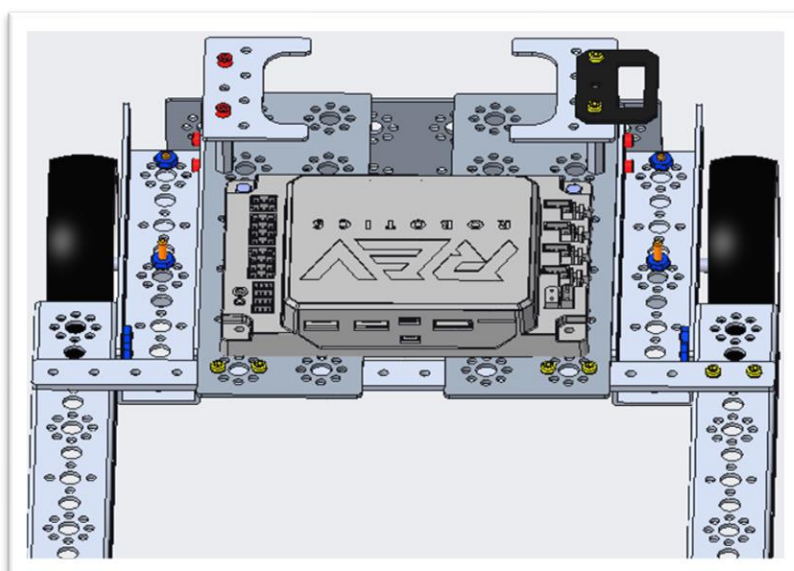
Figure 40- Assembled view 1
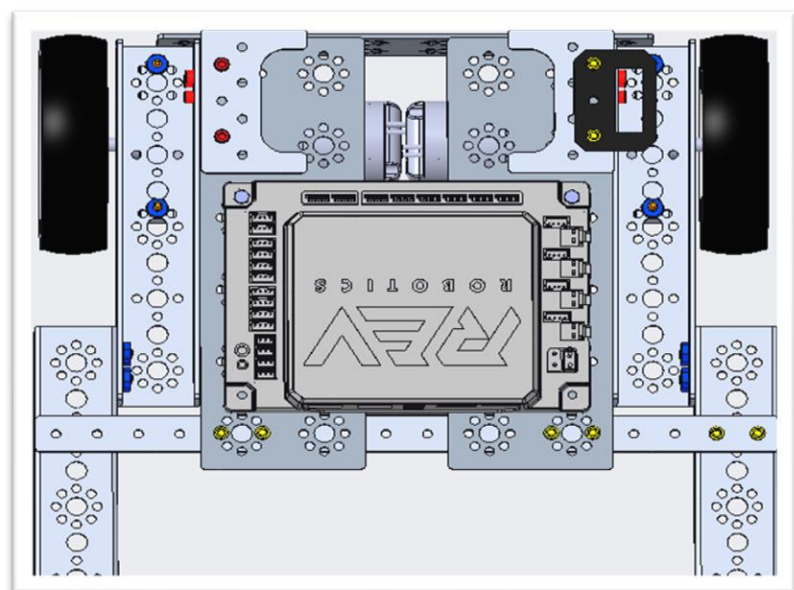
Figure 41- Assembled view 2

Step 2: Add the Left Drive Motor Power Cable

Figure 42- Top view

Step 3: Add the Right Drive Motor Power Cable
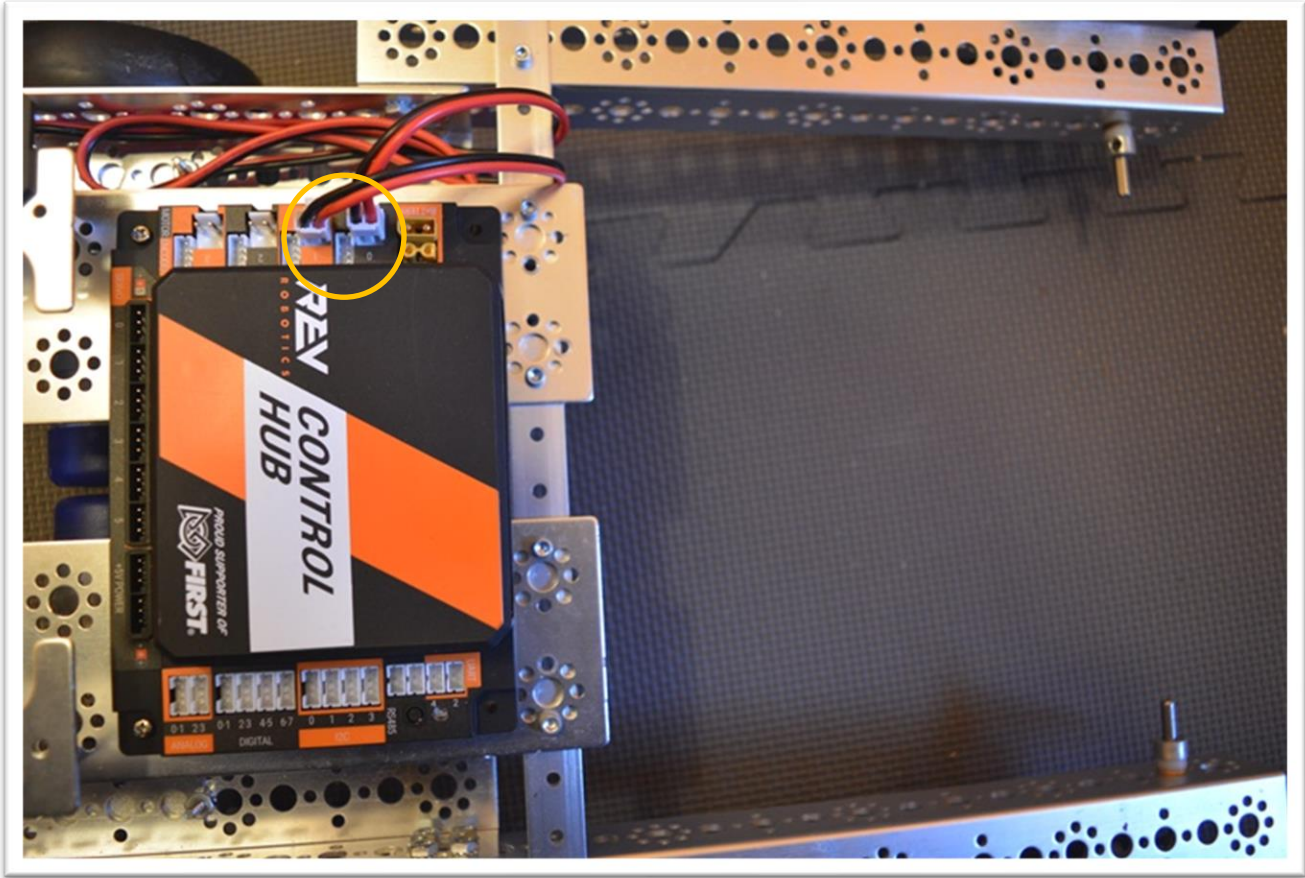
Power Switch

Step 1: Add the Switch
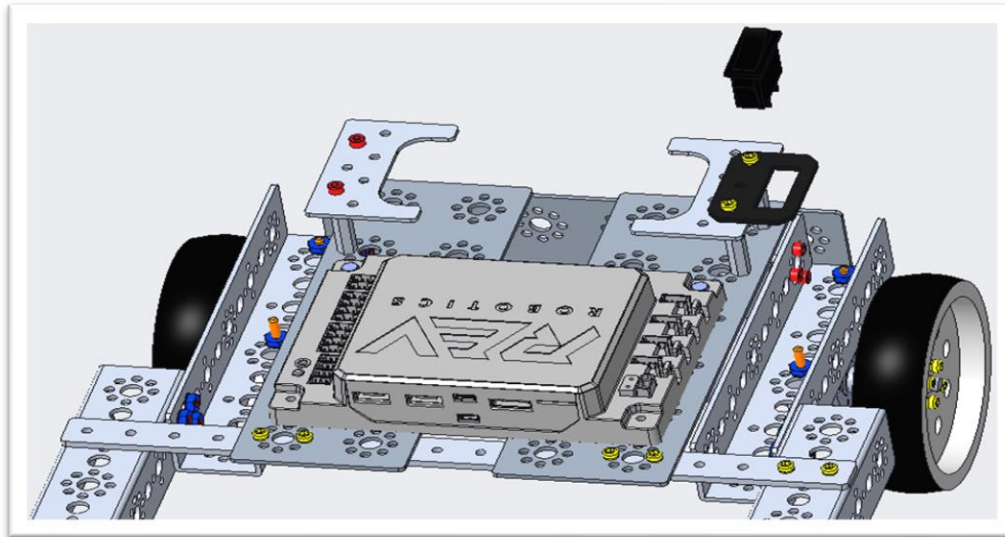
Figure 43- Unassembled view
(The wires attached to the switch are not shown in this image)
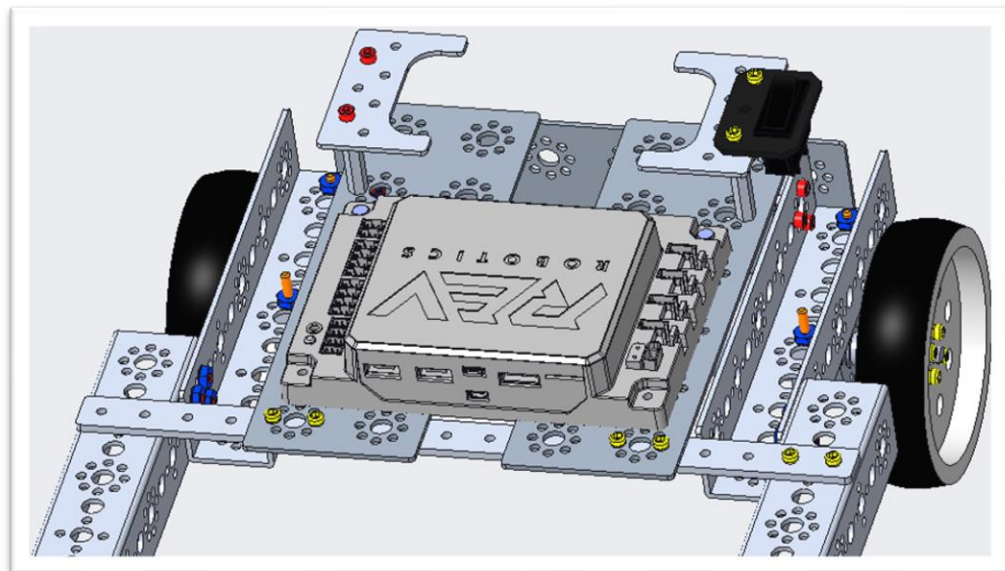
Figure 44- Assembled view
(The wires attached to the switch are not shown in this image)

Step 2: Connect the Switch to the Motor and Sensor Controller
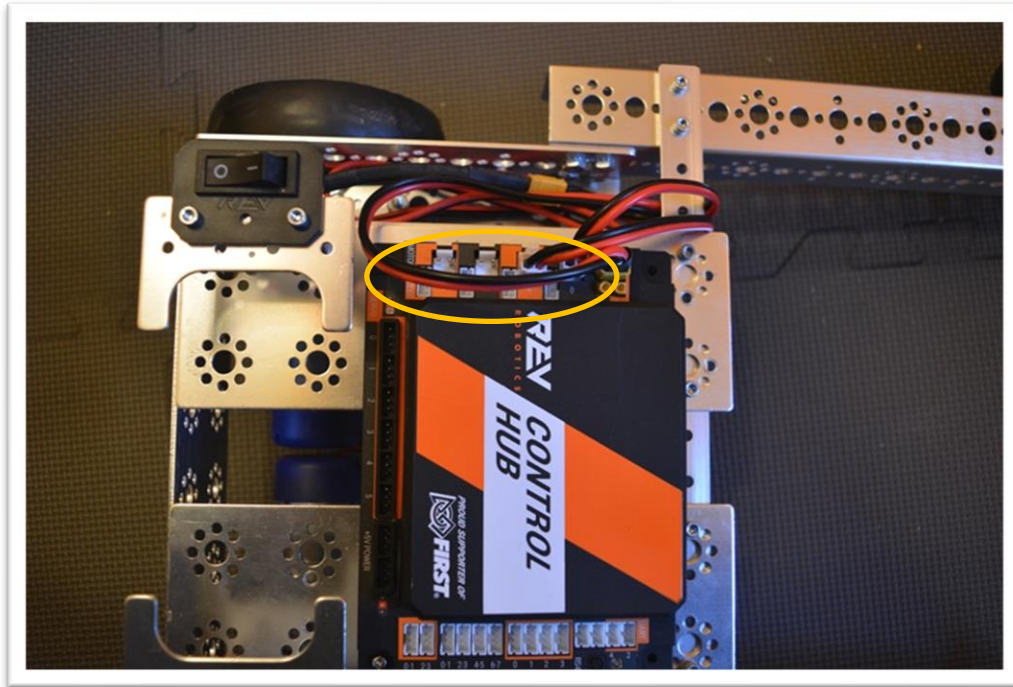
Figure 45- Unassembled view
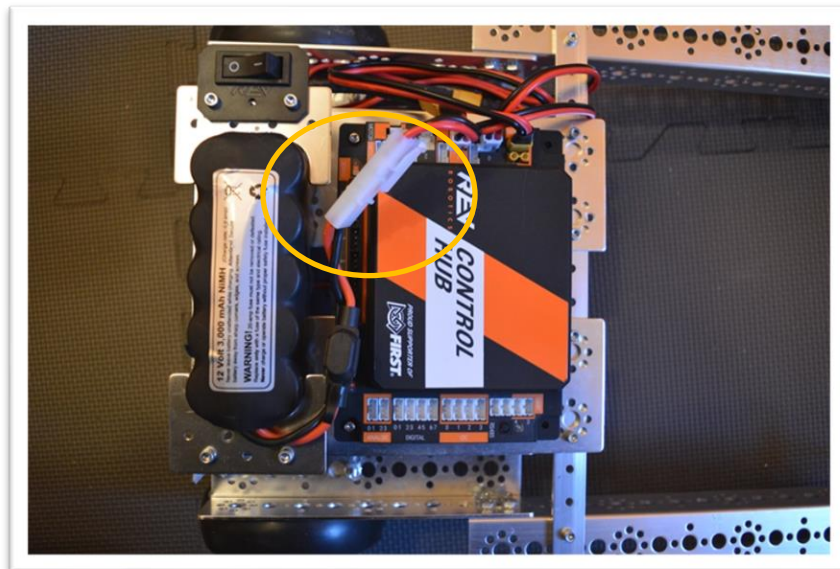
Figure 46- Assembled view

Battery

Step 1: Add the Battery
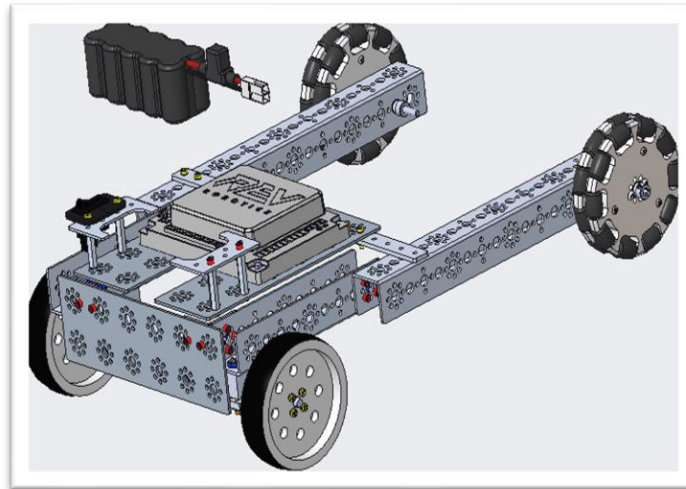
Figure 47- Unassembled view
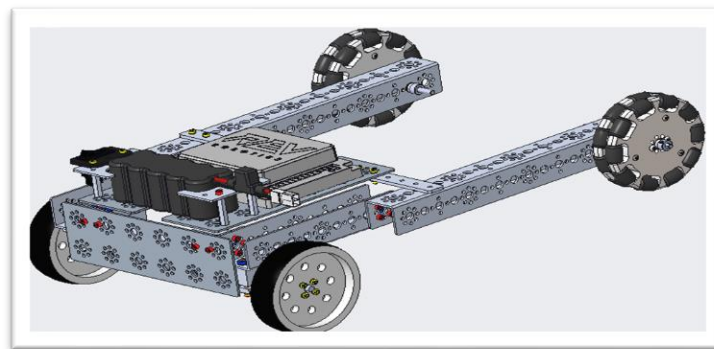
Figure 48- Assembled view

Step 2: Connect the Battery to the Switch
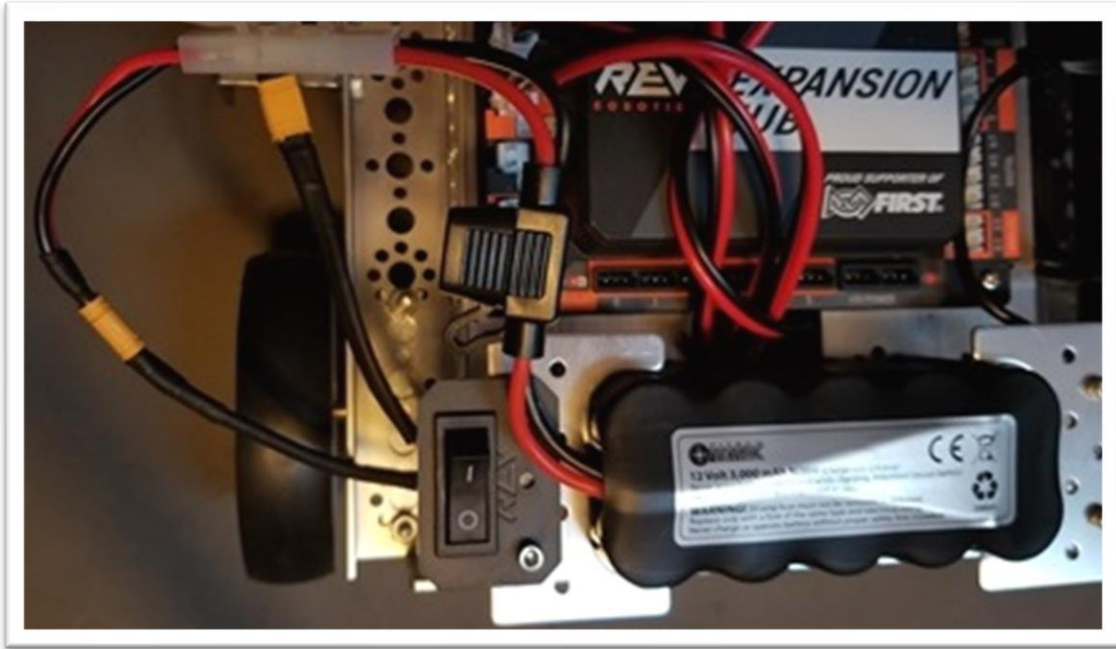
Figure 49- Top view

<u>Helpful Hints</u>

- It is recommended that the battery be secured in the holder using a zip tie or some other mechanism to prevent it from being separated from the robot during competition.
- Standard 4-inch zip ties should be purchased for securing wires to the chassis.
- Electrical tape can be used to secure motor wires to the motor.
- Longer zip ties or Velcro straps can be used to keep the battery from falling out of the robot in case it tips over.

Make sure that axle hub, motor hub, and axle collar set screws are installed, so that the screw is on the flat side of the axle, which will prevent assemblies from spinning on the axle.

Final Steps

What's Next?

- You have now constructed the frame of your Basic 'Bot, however, programming will be needed to make the robot functional.
- Testing should be done to determine whether anything needs to be changed or optimized for the season's game rules. Testing will also show whether more cables need to be secured or re-routed.
- Check the game rules for all the applicable stickers.
- Make sure to also go over the robot checklists:
    - Robot Self-Inspection Checklist
    - Robot Reliability Checklist

Resources

Visit the FIRST website for programming resources, robot building resources, more instructions and game rules.

The robot can be even better with armature. Watch for the release (later in the season) of the Basic 'Bot Armature Guide by visiting our website (https://www.firstinspires.org/resource-library/ftc/robot-building-resources).

Appendix A – Resources

Game Forum Q&A

https://ftc-qa.firstinspires.org/

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.

Volunteer Forum

Volunteers can request access to role specific volunteer forums by emailing FTCTrainingSupport@firstinspires.org. You will receive access to the forum thread specific to your role.

FIRST Tech Challenge Game Manuals

Part 1 and 2 - https://www.firstinspires.org/resource-library/ftc/game-and-season-info

FIRST Headquarters Pre-Event Support

Phone: 603-666-3906
Mon – Fri
8:30am – 5:00pm
Email: Firsttechchallenge@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 firsttechchallenge@firstinspires.org. Thank you!