



Training and
Support

2018-2019 *FIRST®* Tech Challenge

Basic Bot Guide for REV

ROVER RUCKUS



Presented By

Qualcomm

www.firstinspires.org

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Revision History		
Revision	Date	Description
1	07/22/2018	Initial Draft Complete
1.1	07/22/2018	Formatted into template, fixed formatting errors, added pictures, added visual aides
1.2	07/27/2018	Title changes, initial release

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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. To learn more about FIRST® Tech Challenge and other FIRST® Programs, visit www.firstinspires.org.

FIRST Core Values

We express the FIRST® philosophies of *Gracious Professionalism®* and *Coopertition®* through our Core Values:

- **Discovery:** We explore new skills and ideas.
- **Innovation:** We use creativity and persistence to solve problems.
- **Impact:** We apply what we learn to improve our world.
- **Inclusion:** We respect each other and embrace our differences.
- **Teamwork:** We are stronger when we work together.
- **Fun:** We enjoy and celebrate what we do!

NOTICE OF NON-DISCRIMINATION

For Inspiration and Recognition of Science and Technology (FIRST®) does not discriminate based on race, color, national origin, sex, disability, age, status as a veteran who served in the military, religion, gender, gender identity, or gender expression in its programs and activities.

Keep updated at: <http://www.firstinspires.org/about/legal-notices>.

Gracious Professionalism®

FIRST® uses this term to describe our programs' intent and *Gracious Professionalism®* is not clearly defined for a reason. It has different meanings 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.
- Gracious Professionals make valued contributions in a way that is pleasing to others and to themselves.

In the end, *Gracious Professionalism®* is part of everyday life. When professionals use their knowledge graciously and individuals act with integrity and sensitivity, everyone wins, and society benefits.

Watch Dr. Woodie Flowers explain *Gracious Professionalism* in this [short video](#).

Introduction to the Guide

Introduction

The Basic Bot Guide is designed to be a resource for teams looking for step-by-step instructional for building the basic chassis and structure needed in a FIRST Tech Challenge competition. There are multiple versions of this guide, previously called the “Push Bot Guide”, this version the **Basic Bot Guide for REV** has been created to use the new and differing parts in the 2018-2019 season’s REV kit of parts.

Parts

- Rev FTC Competition Set

Gracious Professionalism® - “Doing your best work while treating others with respect and kindness - It's what makes FIRST, first.”

- 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

- Secure the screws/nuts just enough, so parts do not slide/move relative to each other. Overtightening the screws will damage the aluminum extrusions.
- 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 are square. It is hard to drive a crooked robot straight!
- The drive wheels are powered by two DC motors, which are relatively heavy. The drive wheels are on the back of the robot, because that is where the most weight is. This weight is needed to help the wheels grip the surface better.
- Omni wheels are on the front of the robot, which allows the robot to turn more easily. The omni wheels can slide sideways with very little friction due to the rollers.
- Unless otherwise noted, the top image in each step shows the necessary parts; the lower image shows the completed assembly.

Construction

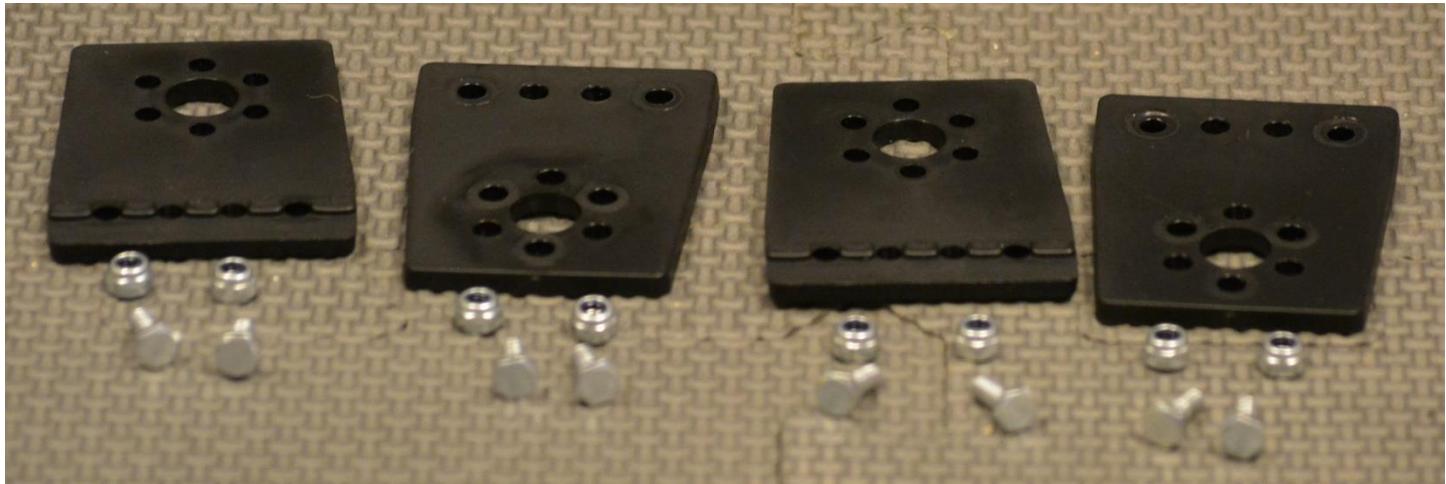
Drive Assemblies and Frame

Step 1: Build Drive Brackets

REV-41-1303 – Bracket, Motion (4)

REV-41-1361 – Nut, Locking, M3 (8)

REV-41-1359 – Screw, Hex Cap, M3, 8mm (8)



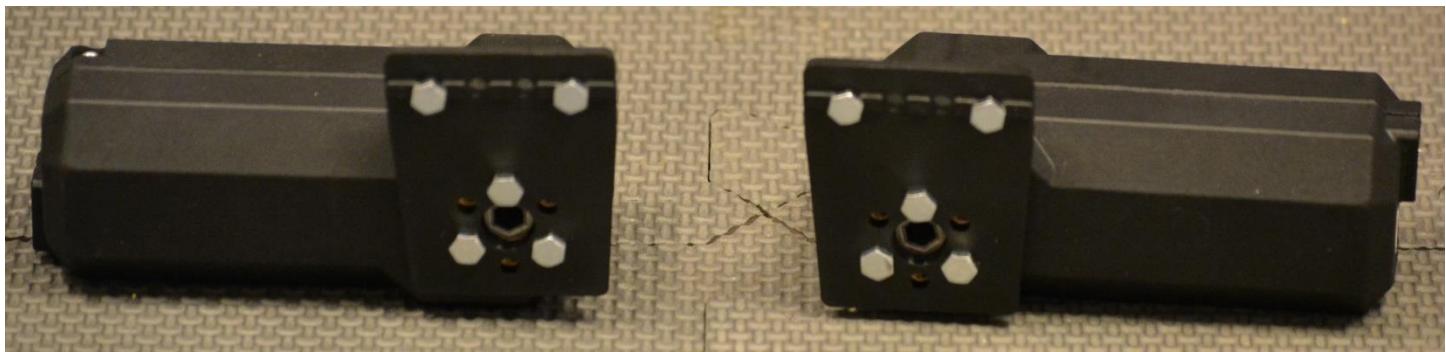
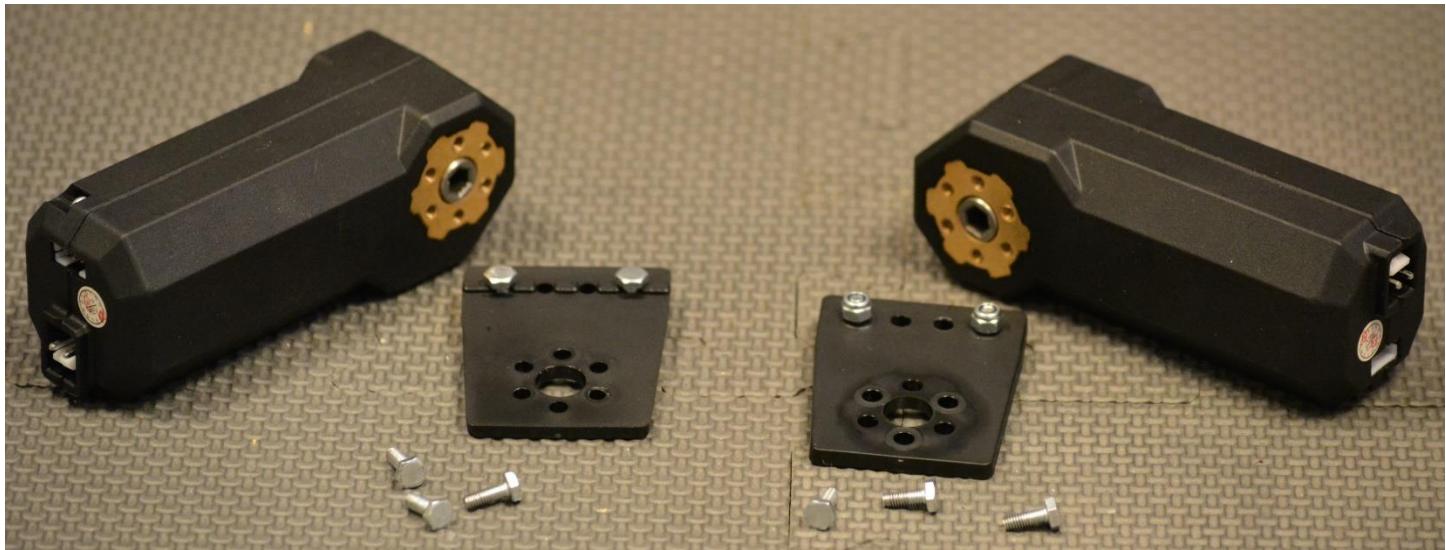
Tighten the nuts onto the screws just until it's difficult to turn them; do not overtighten them. The screw heads will need to slide along the center of an extrusion in a later step.

Step 2: Build Motor Assemblies

REV-41-1300 – Core Hex Motor w/cables¹ (2 in total)

Drive Bracket Assemblies² (1 per motor; 2 in total)

REV-41-1359 – Screw, Hex Cap, M3, 8mm (3 per motor; 6 in total)



Make sure that the brackets are facing the correct direction; the alignment ribs should be on the side away from the motor.

Motor directions are reversed – the power plug of the motor pictured on the left is on the bottom; the plug of the motor on the right is on the top.

¹ Do not plug cables into the motors at this time

² Use only two of the assemblies from step 1

Step 3: Build the Right and Left Rail

REV-41-1432 – Extrusion, 420mm, 90-90 degree (1 per side; 2 in total)

Motor Assemblies (1 per side; 2 in total – from step 2)

Drive Bracket assemblies (1 per side; 2 in total –the two remaining from step 1)

REV-41-1324 – Spacer, 3mm (3 per side; 6 in total)

REV-41-1327 – Shaft Collar (1 per side; 2 in total)

REV-41-1326 – Bearing, Through Bore, Short (1 per side; 2 in total)

REV-41-1347 – Shaft, 5mm Hex, 75mm (1 per side; 2 in total)

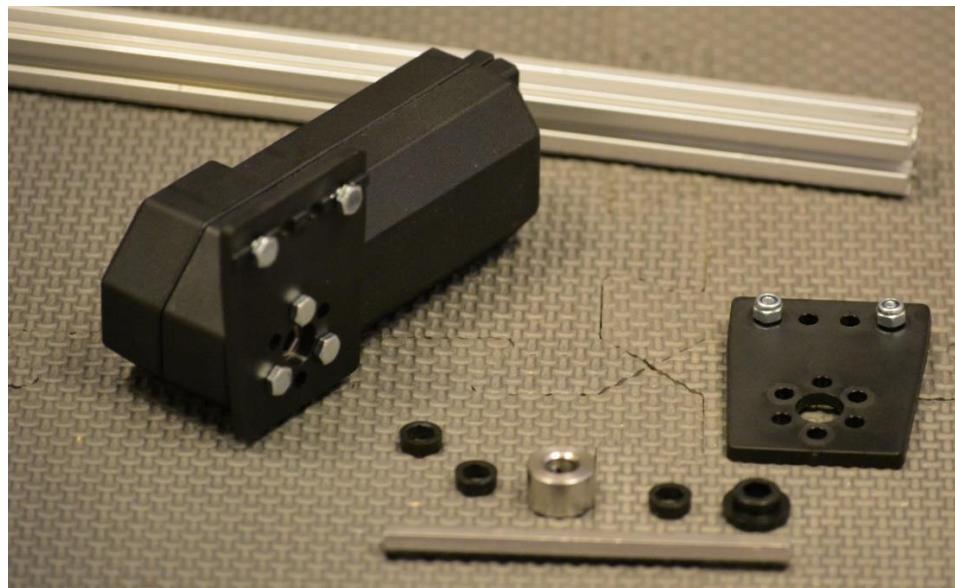
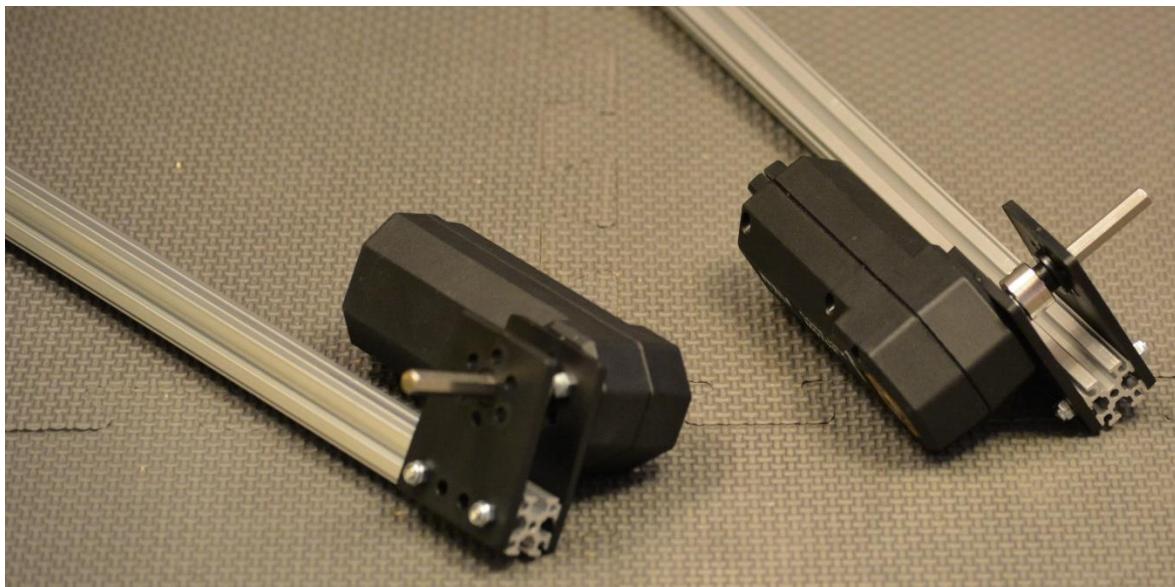


Figure 1 The image above shows only the right rail. Duplicate the number of parts for the left rail.



Slide the head of the screws down the center of the extrusions. The brackets should be flush with the end of the extrusions.

Order from the outside in: bracket, bearing, spacer, collar, two spacers, bracket with attached motor

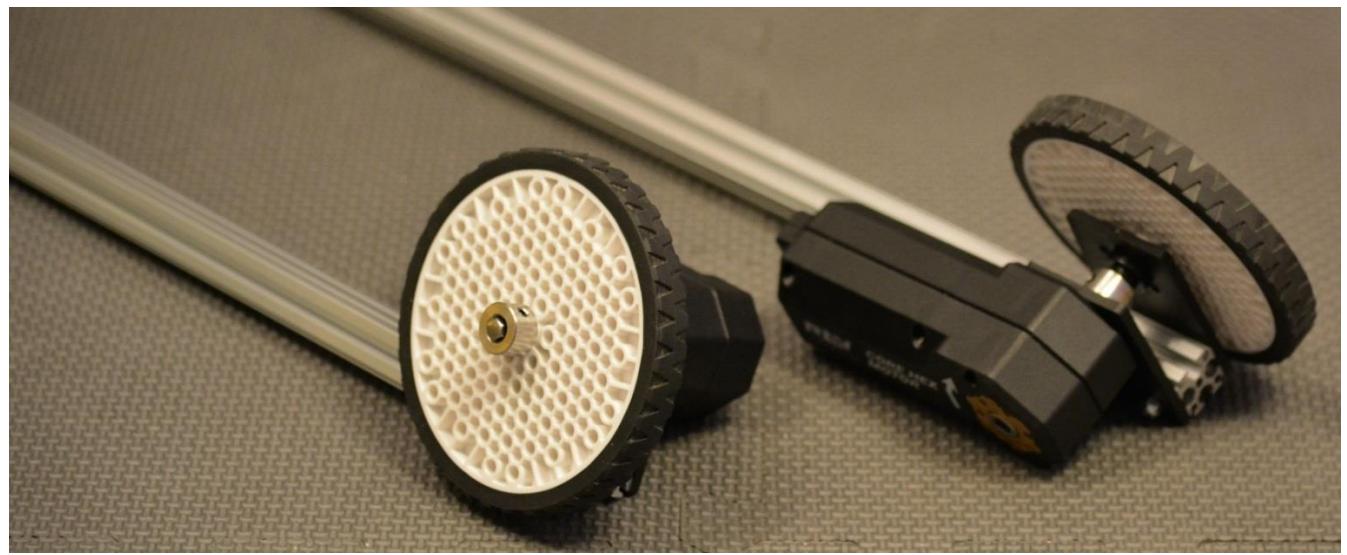
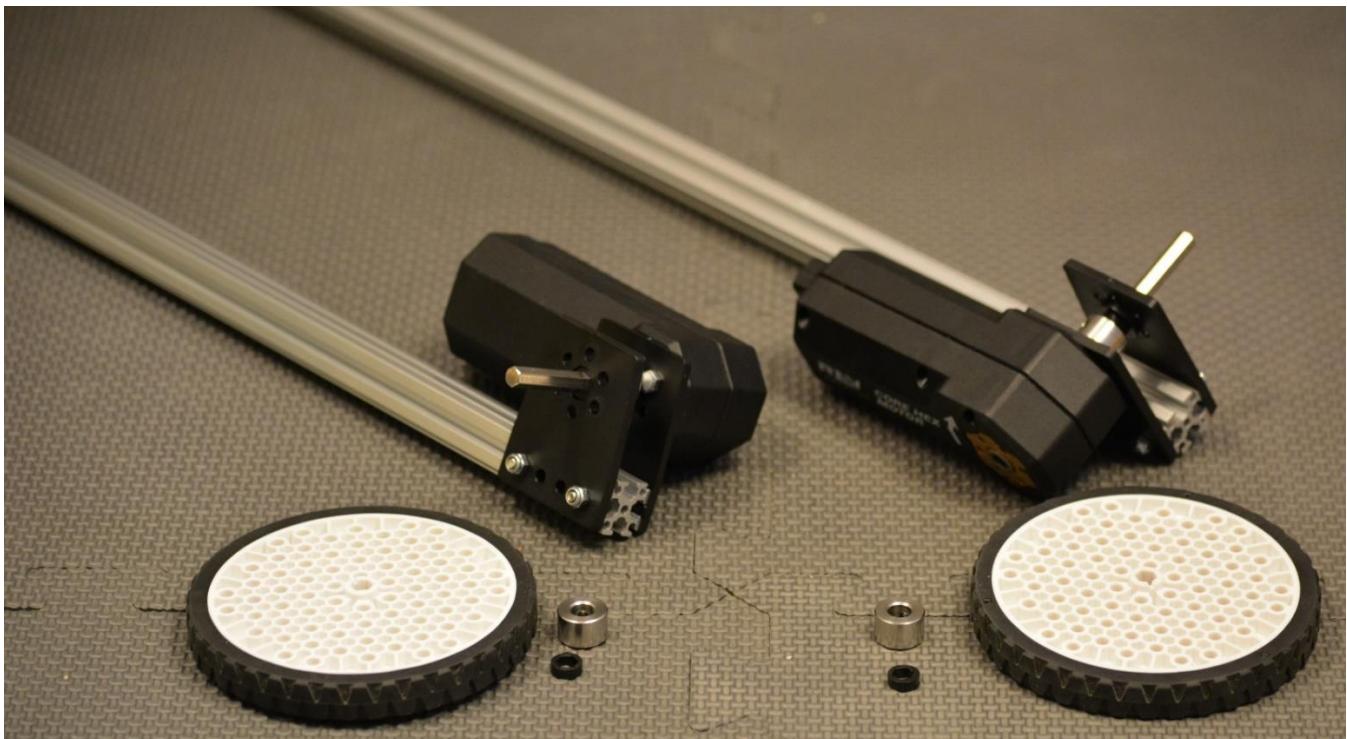
Step 4: Add Drive Wheels

Rail Assemblies (1 per side; 2 in total) *from step 3

REV-41-1354 – Wheel, Traction 90mm (1 per side; 2 in total)

REV-41-1327 – Shaft Collar (1 per side; 2 in total)

REV-41-1324 – Spacer, 3mm (1 per side; 2 in total)



Order from the outside in: collar, wheel, spacer, rail assembly.

Make sure that the wheels do not rub the nuts. If they do, then revisit previous steps to make sure the construction is accurate.

Adjust axle length, so it is flush with the collar.

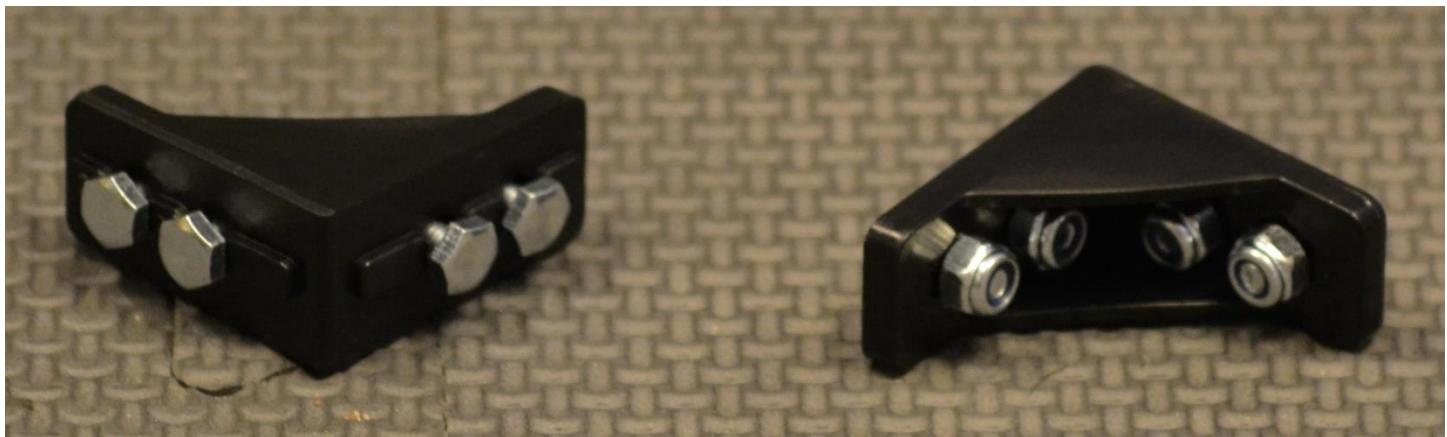
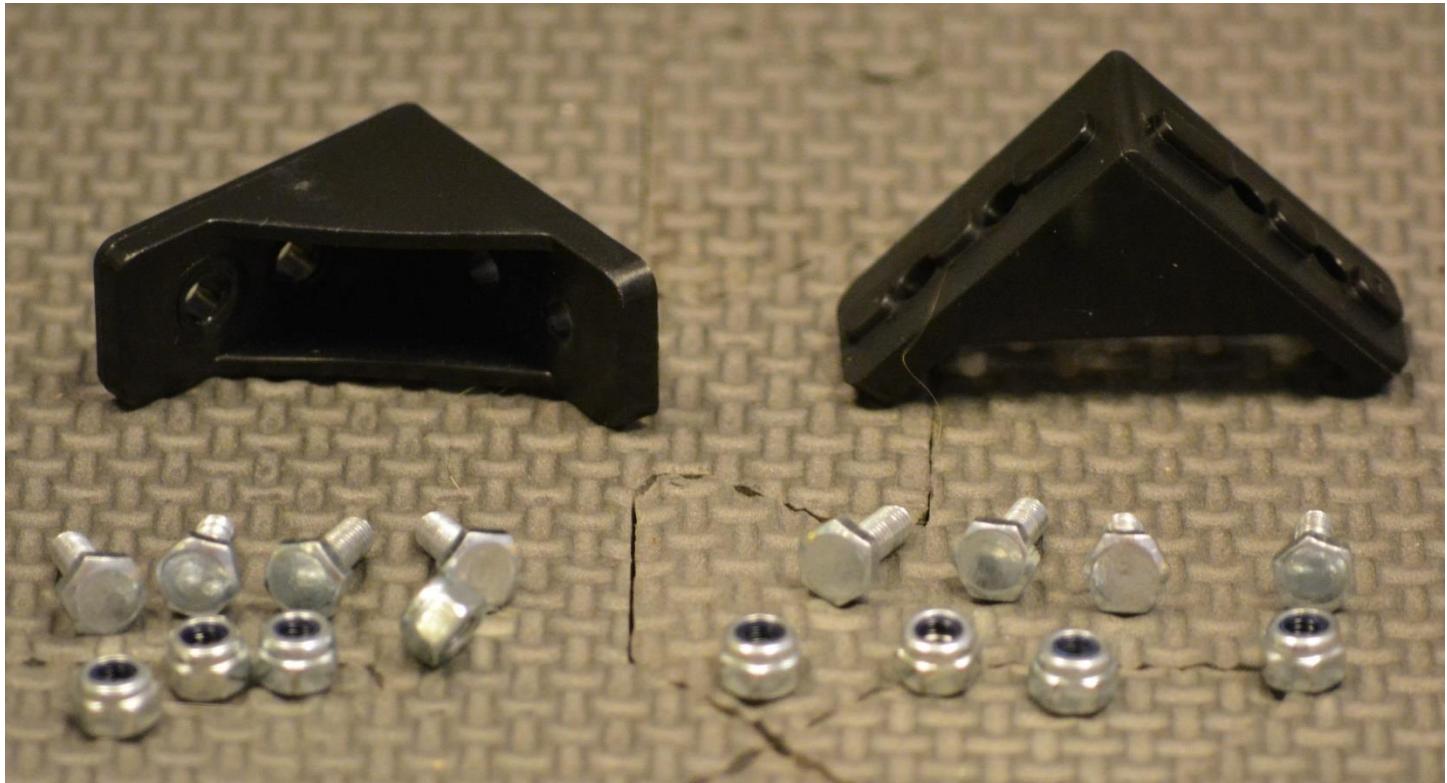
Back Support Beam

Step 1: Add Screws to Corner Brackets

REV-41-1320 – Bracket, Inside Corner (2)

REV-41-1359 – Screw, Hex Cap, M3, 8mm (8)

REV-41-1361 – Nut, Locking, M3 (8)



Screw the nuts onto the screws just until it's difficult to turn them; do not overtighten! The screw heads will need to slide along the center of an extrusion in a later step.

Step 2: Add Corner Brackets to Beam

REV-41-1431 – Extrusion, 225mm, 90-90 Degree (1)

Corner Bracket Assemblies (2 - from step 1)



Slide the head of the screws down the center of the extrusion.

Step 3: Add Floating Screws to Beam

Back Support Assembly (1 - from step 2)

REV-41-1359 – Screw, Hex Cap, M3, 8mm (2)

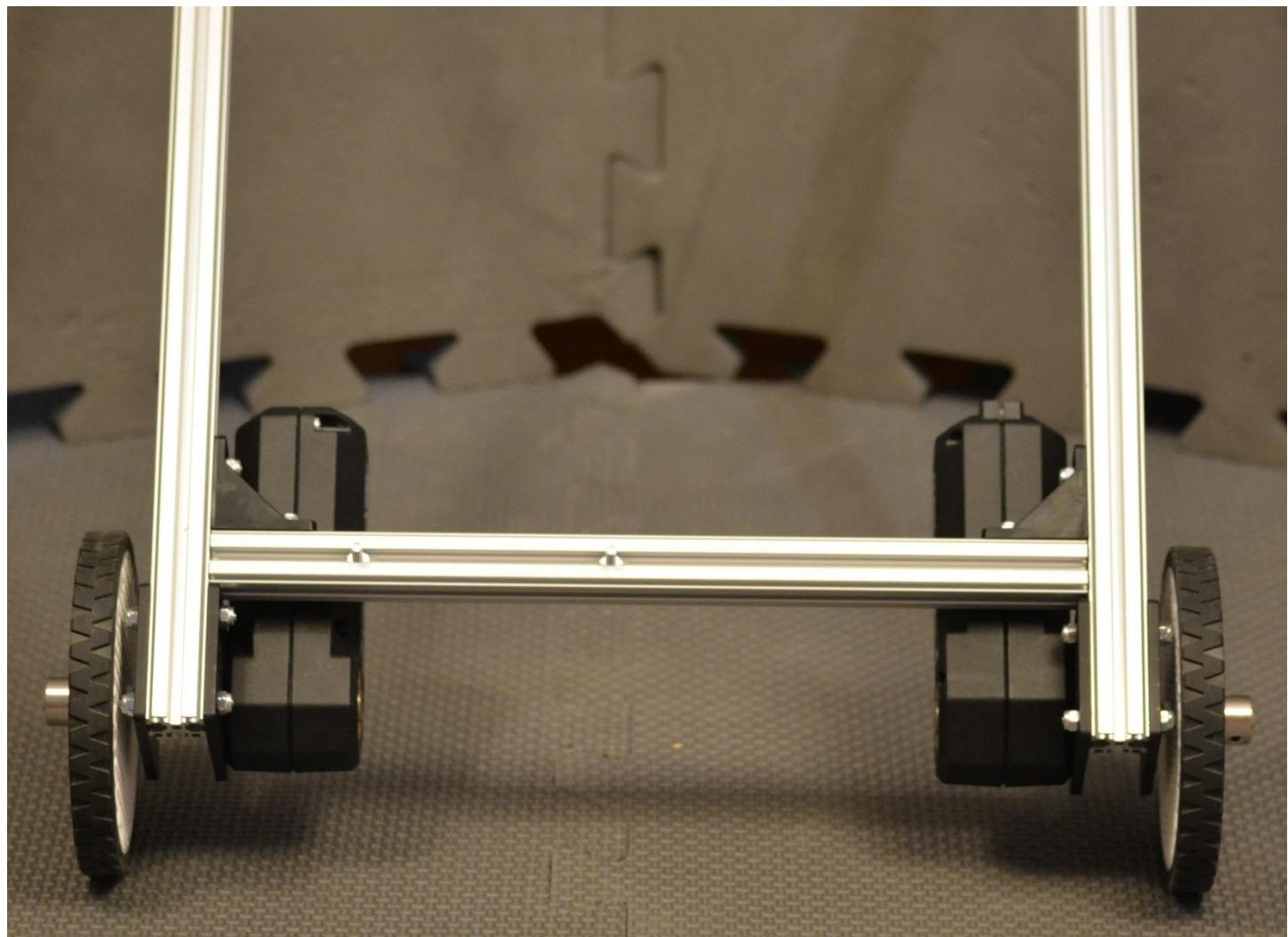


The two 8mm screws are loaded onto what will become the top face of the beam.

Step 4: Add Back Support Beam

Chassis (from Drive Assemblies and Frame, step 4)

Back Support Beam Assembly (from the previous step)



The beam should touch the drive wheel brackets.

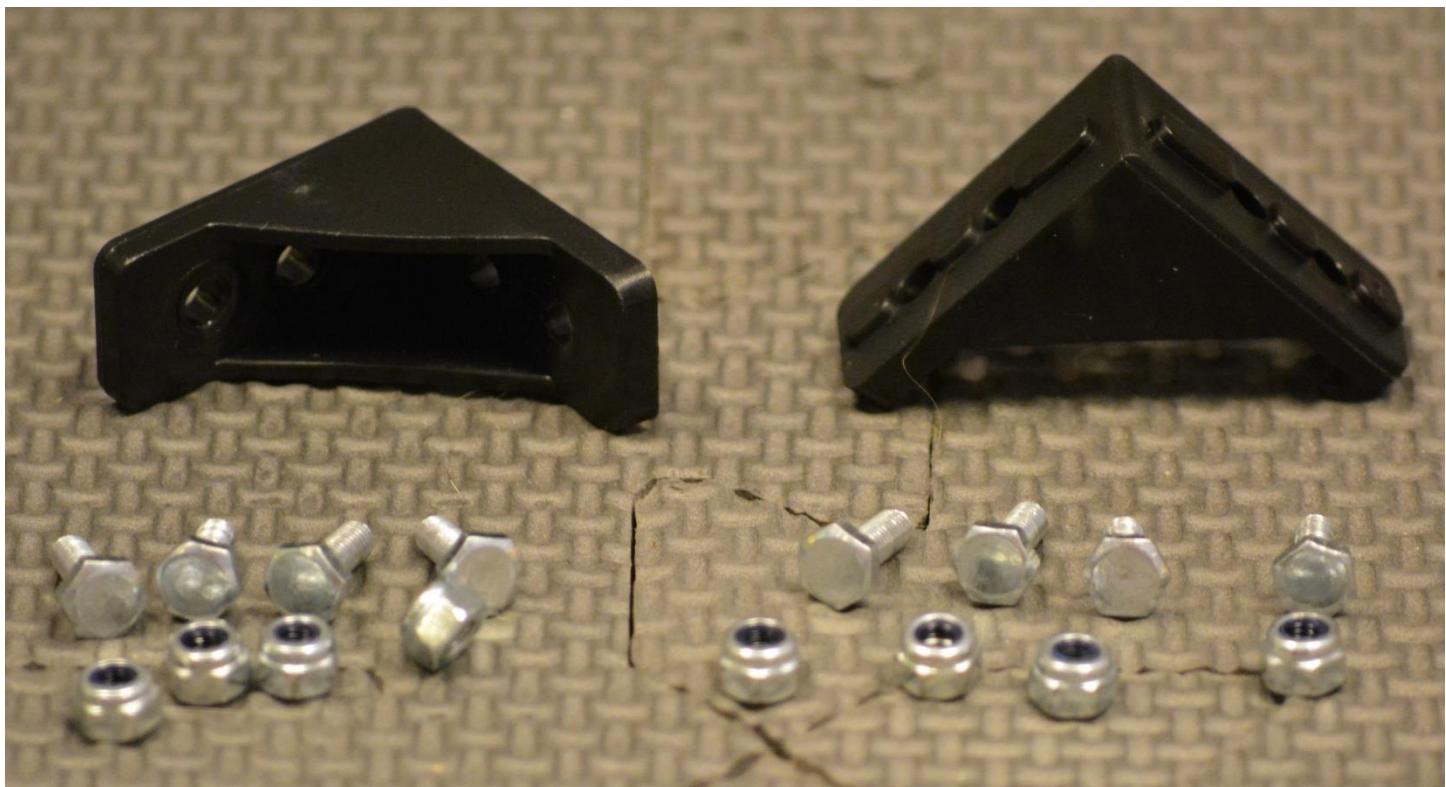
Front Support Beam

Step 1: Add Screws to Corner Brackets

REV-41-1320 – Bracket, Inside Corner (2)

REV-41-1359 – Screw, Hex Cap, M3, 8mm (8)

REV-41-1361 – Nut, Locking, M3 (8)



Screw the nuts onto the screws just until it's difficult to turn them; just so that the nuts don't fall off. The screw heads will need to slide along the center of an extrusion in a later step.

Step 2: Add Corner Brackets to Beam

REV-41-1431 – Extrusion, 225mm, 90-90 Degree (1)

Corner Bracket Assemblies (2 - from step 1)

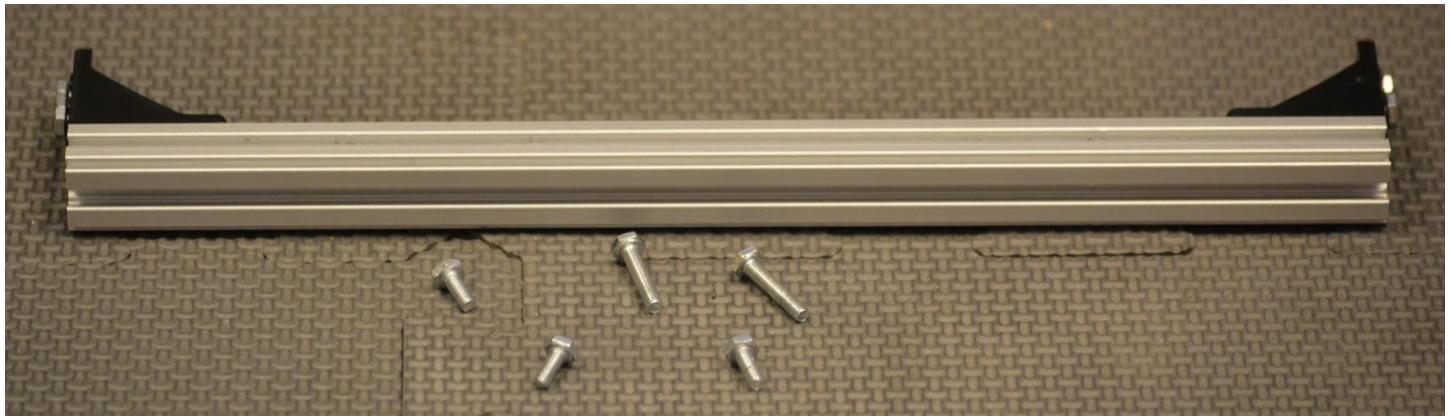


Step 3: Add Floating Screws to Beam

Front Beam Assembly (1 - from step 2)

REV-41-1359 – Screw, Hex Cap, M3, 8mm (3)

REV-41-1360 – Screw, Hex Cap, M3, 16mm (2)

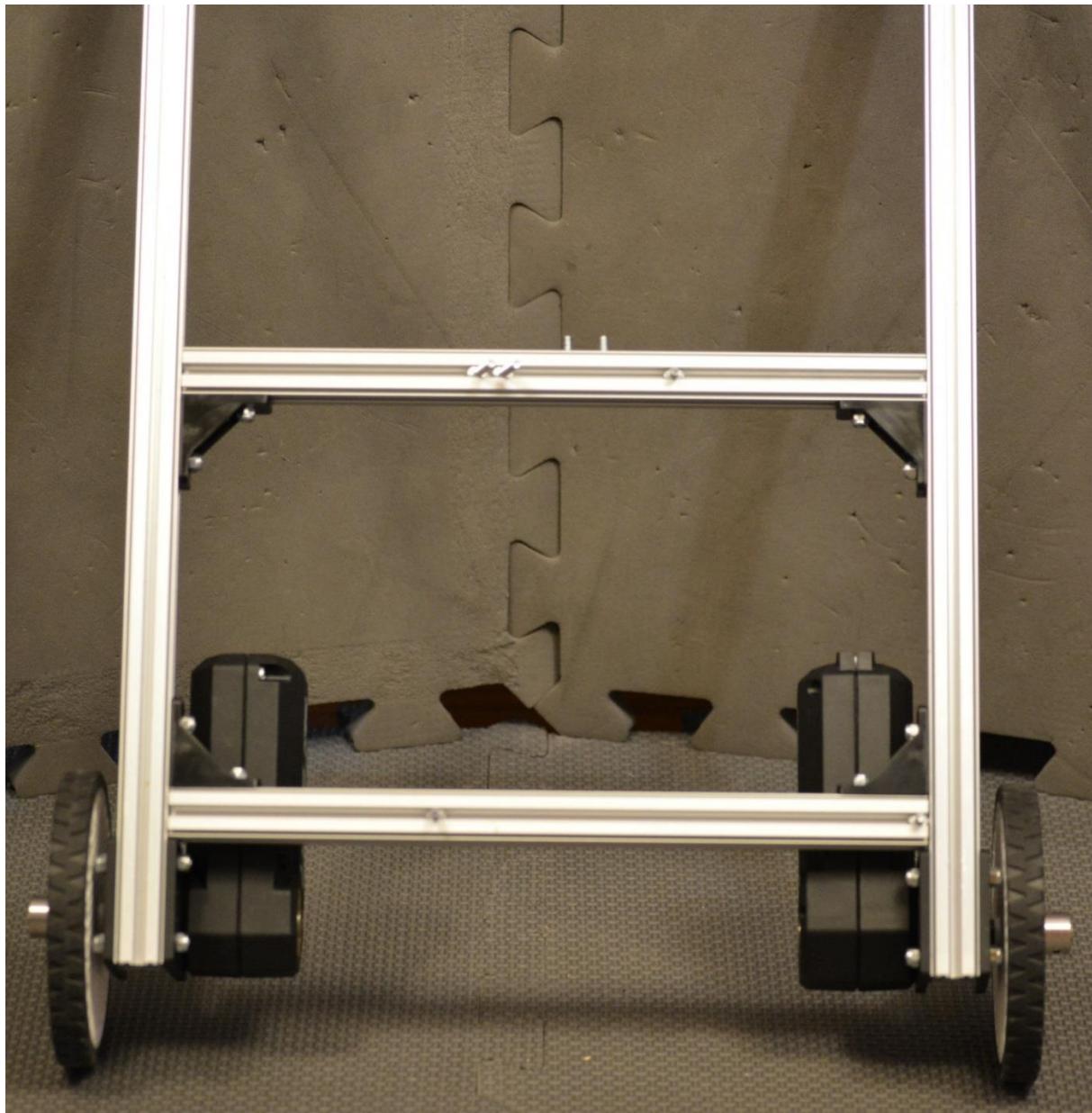
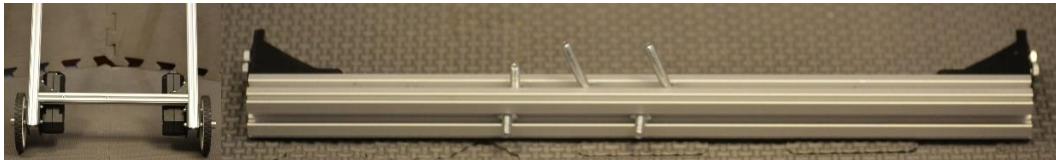


Two of the 8mm screws are loaded onto what will become the front face of the beam.

One of the 8mm and two of the 16mm screws are loaded onto what will become the top face of the beam.

Step 4: Add Front Support Beam

Chassis (from Back Support Beam, step 4)
Front Support beam assembly (1 - from step 3)

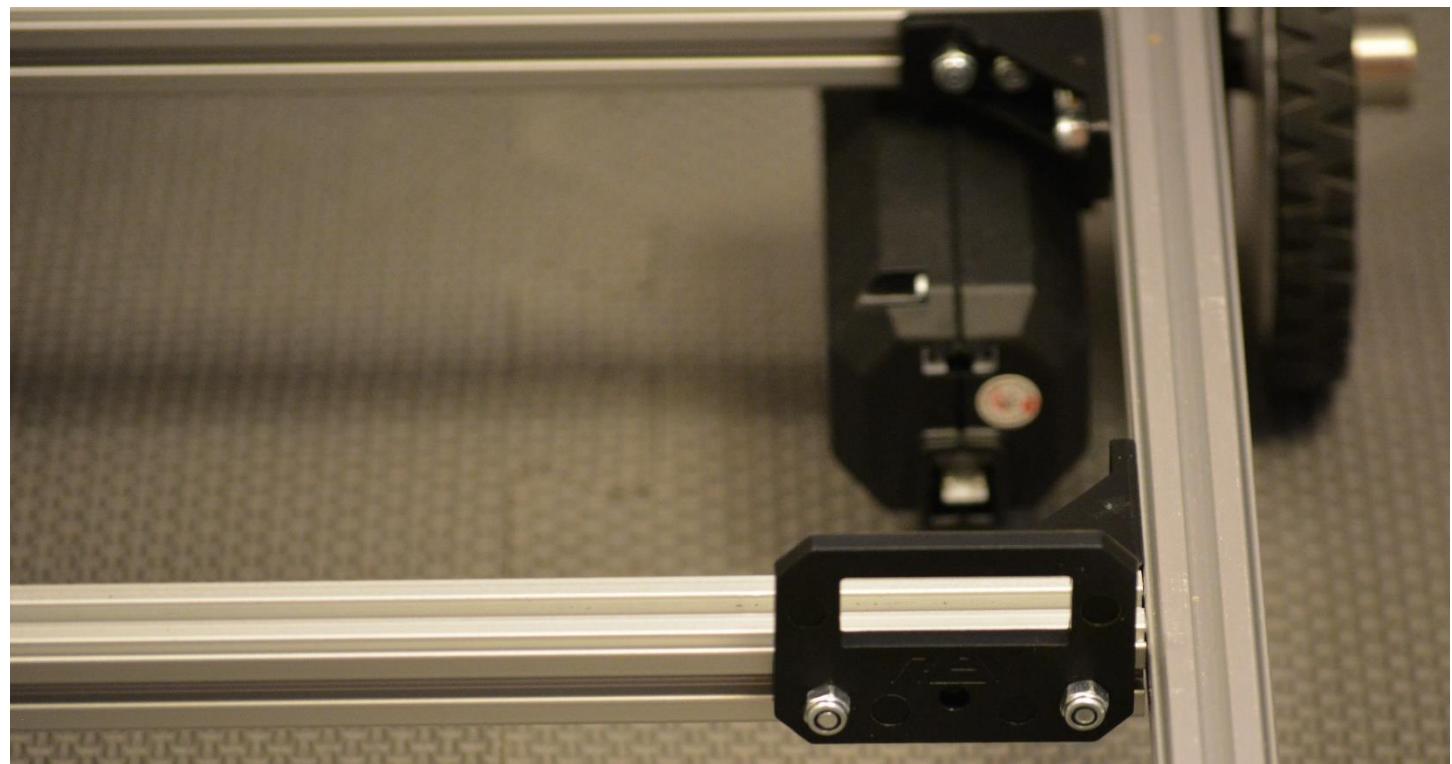
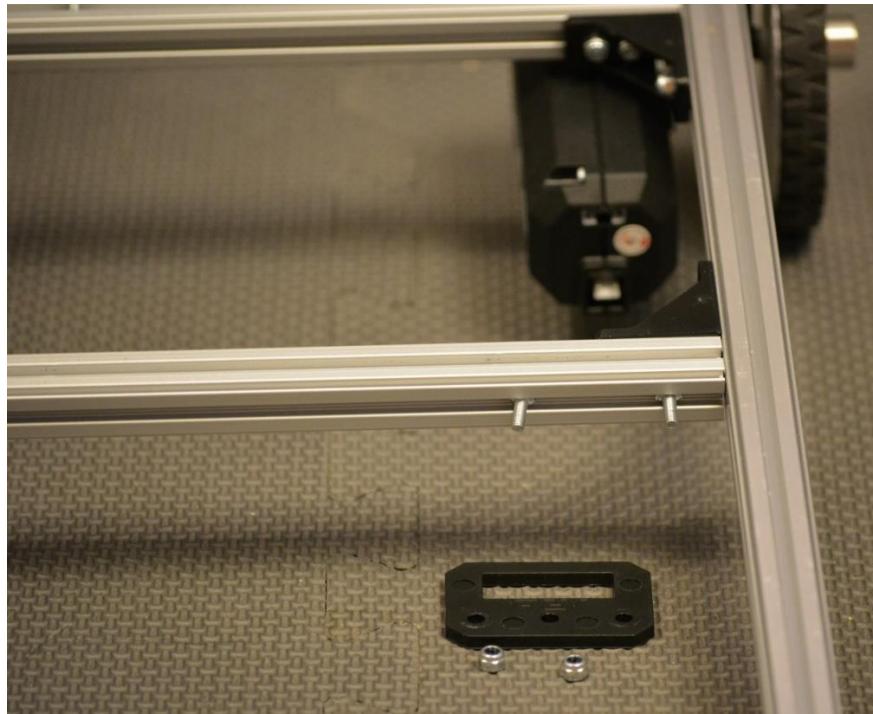


There should be 121mm between the back support beam and the front support beam (there will be 136mm center to center). If a ruler is not available, the position may need to be adjusted in a later step.

Step 5: Add Switch Bracket

Chassis

Switch Plate (part of REV-31-1387)
REV-41-1361 – Nut, Locking, M3 (2)



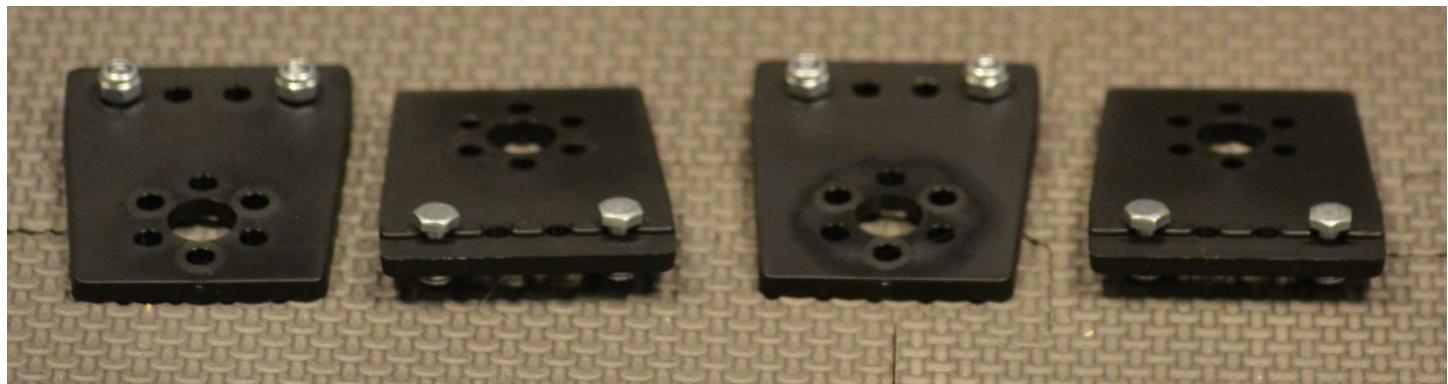
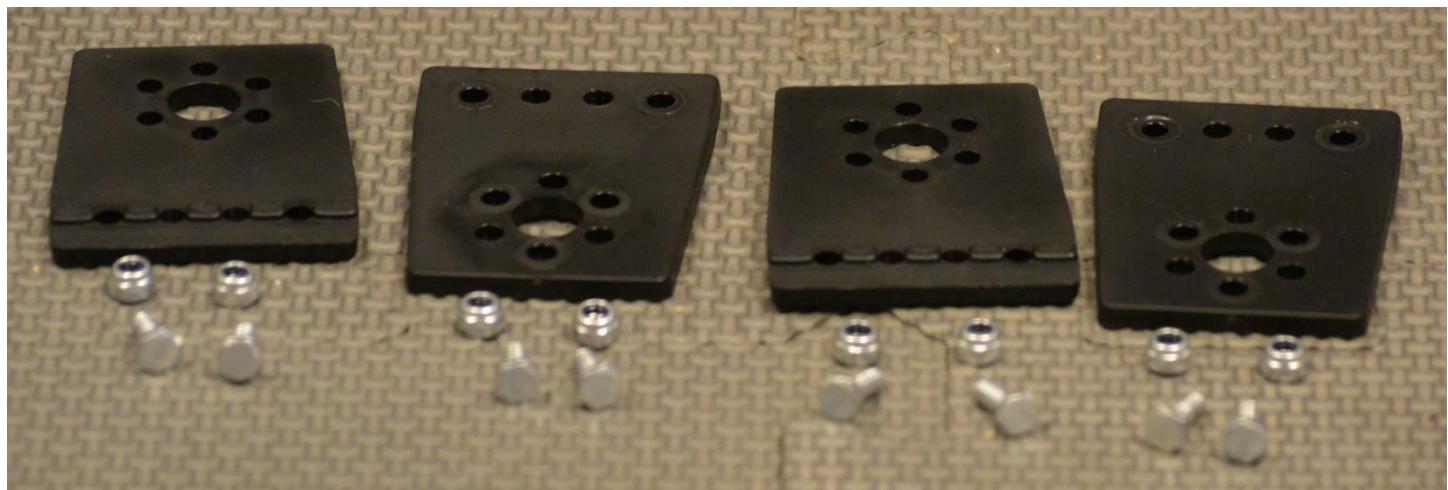
Caster Wheels

Step 1: Build Caster Brackets

REV-41-1303 – Bracket, Motion (2 per side, 4 total)

REV-41-1361 – Nut, Locking, M3 (2 per bracket, 4 per side, 8 total)

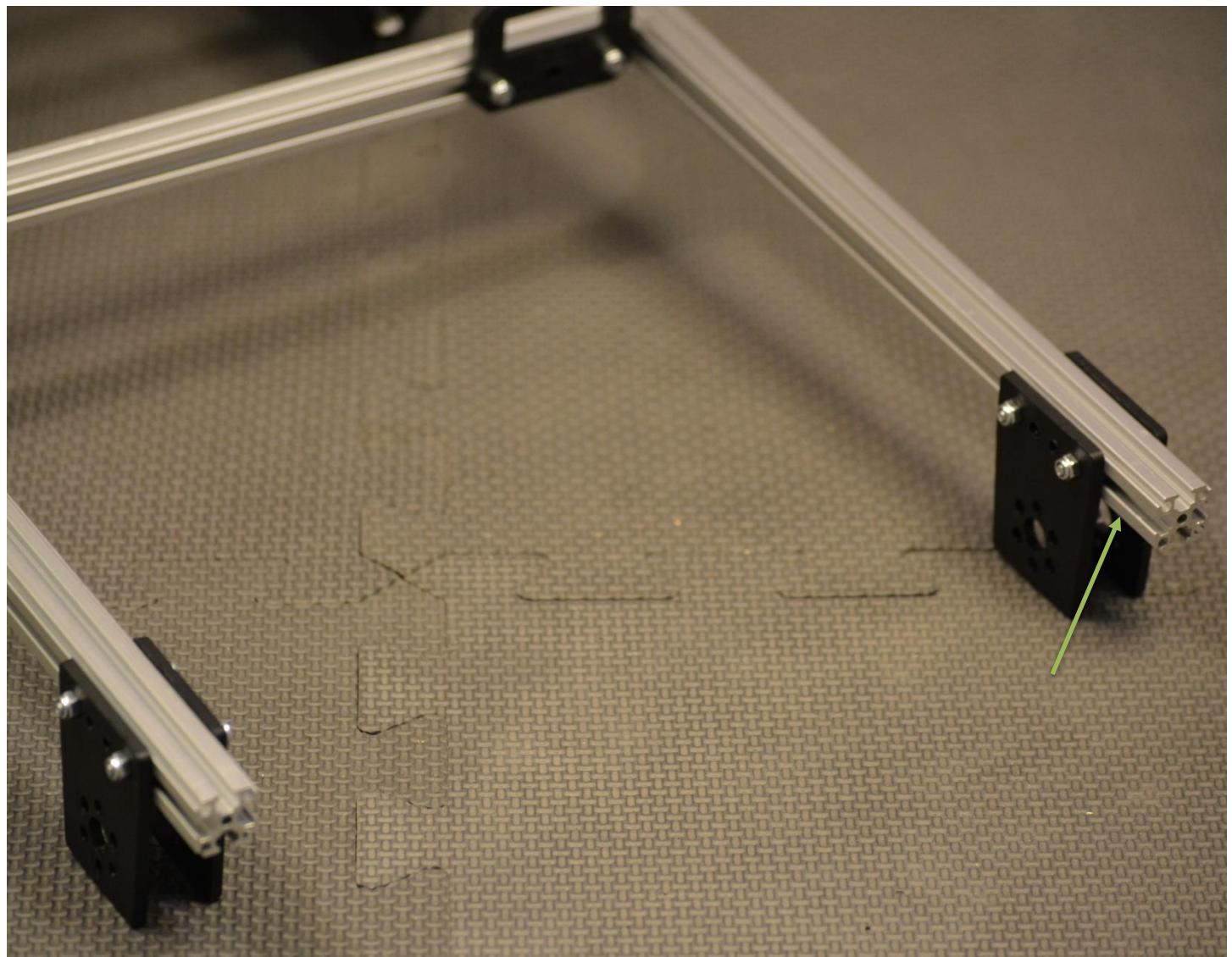
REV-41-1359 – Screw, Hex Cap, M3, 8mm (2 per bracket, 4 per side, 8 total)



Screw the nuts onto the screws just until it's difficult to turn them; do not overtighten because the screw heads will need to slide along the center of an extrusion in a later step.

Step 2: Add Caster Brackets to Chassis

Caster Bracket Assemblies (4 – from the previous step)



Brackets must be installed 2 cm from the end of the extrusion, if used for competition, to fit within the sizing cube. Ensure that the pair of brackets on the same extrusion are the same distance from the end of the extrusion or the wheels will not rotate properly.

Step 2: Add the Omni Wheels

REV-41-1327 – Shaft Collar (2 per side – 4 total)

REV-41-1326 – Bearing, Through Bore, Short (2 per side – 4 total)

REV-41-1323 – Spacer, 15mm (1 per side – 2 total)

REV-41-1324 – Spacer, 3mm (1 per side – 2 total)

REV-41-1347 – Shaft, 5mm Hex, 75mm (1 per side – 2 total)

REV-41-1190 – Wheel, Omni 90mm (1 per side – 2 total)

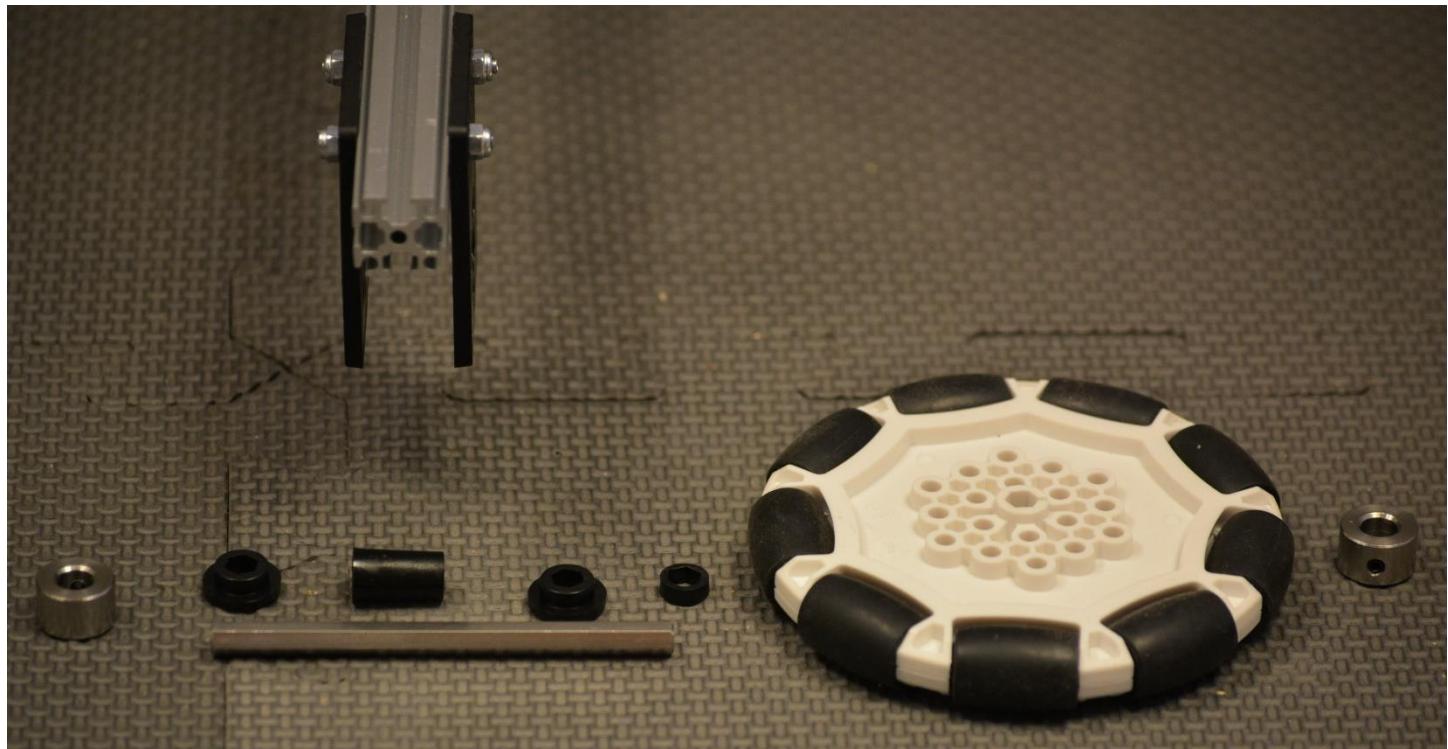


Figure 2 Only the left wheel is shown below. Make a mirror image for the right side.

[Continued on the next page, so detail can be seen more easily.]

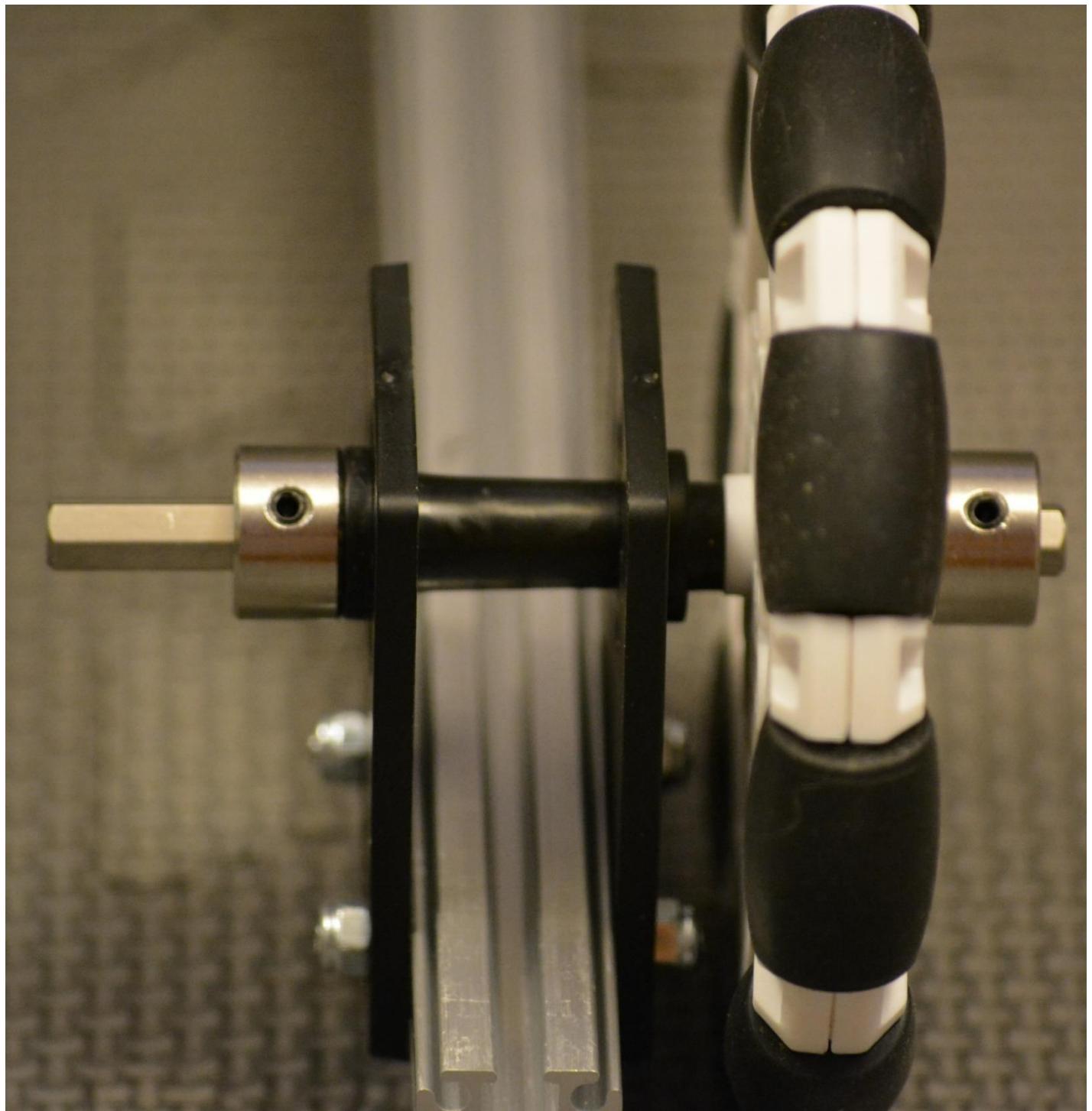


Figure 3 Above shows only the right wheel. The left wheel is a mirror image.

Order from the outside in: collar, omni wheel, 3mm spacer, bearing, bracket, 15mm spacer, bracket, bearing, collar. Adjust axle length, so it is flush with the collar.

[Continued on the next page, so detail can be seen more easily.]

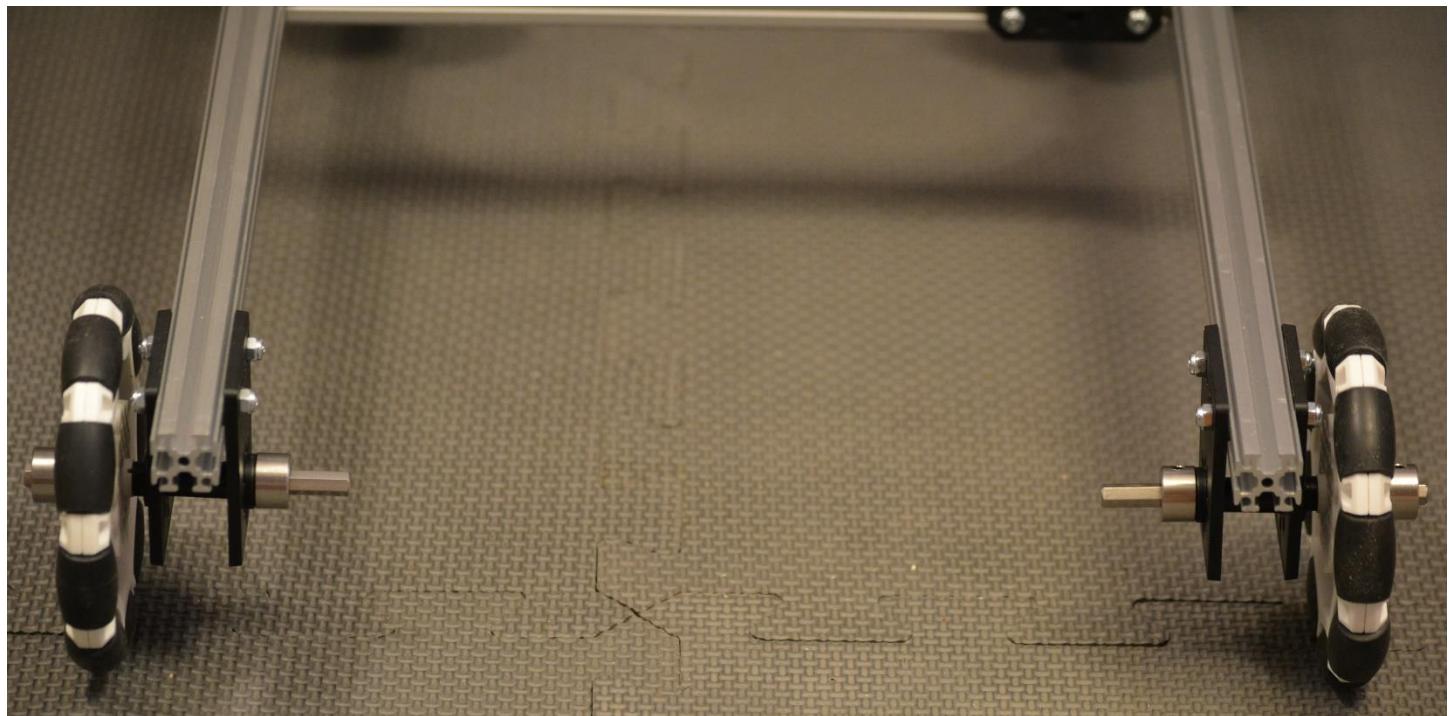


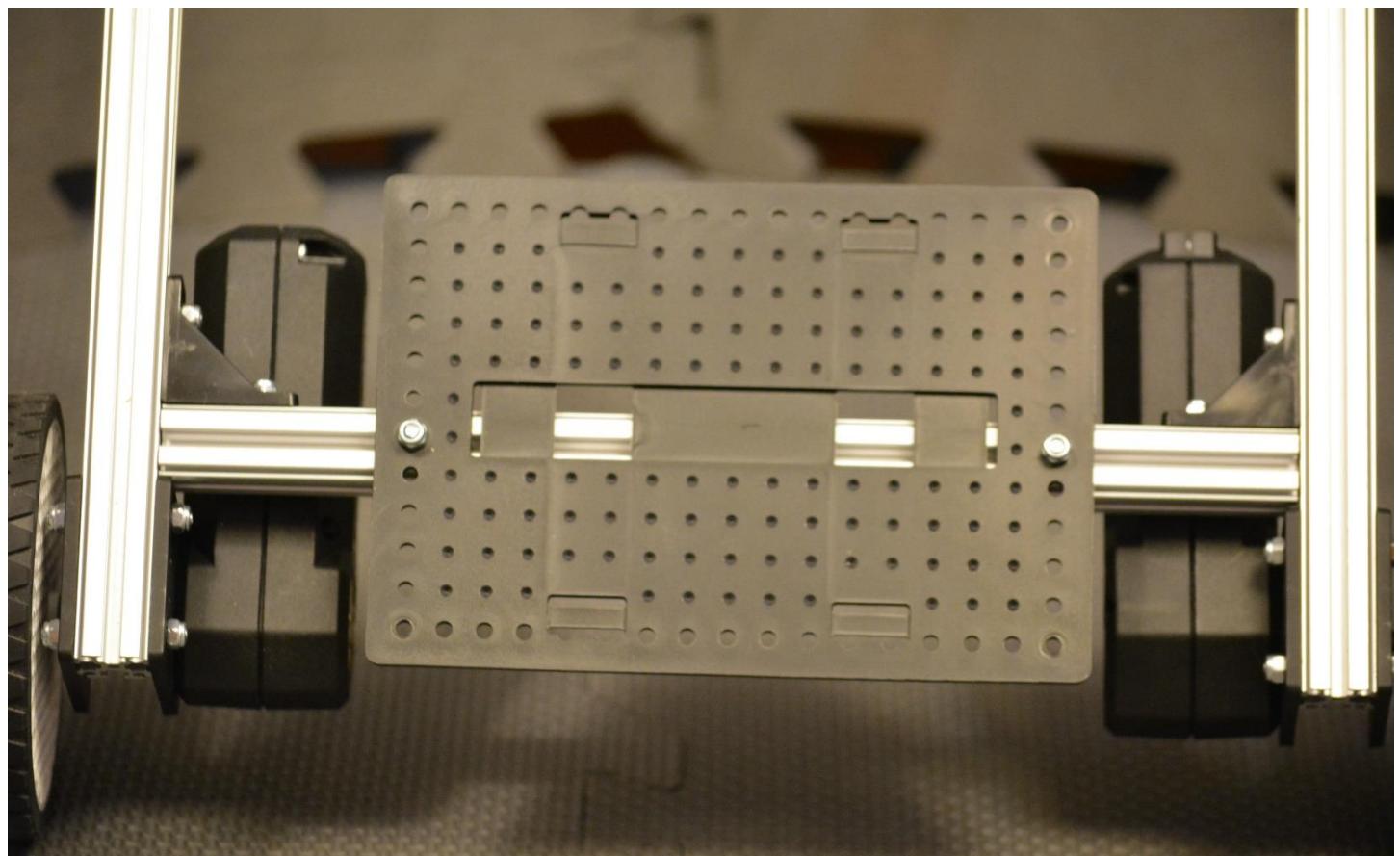
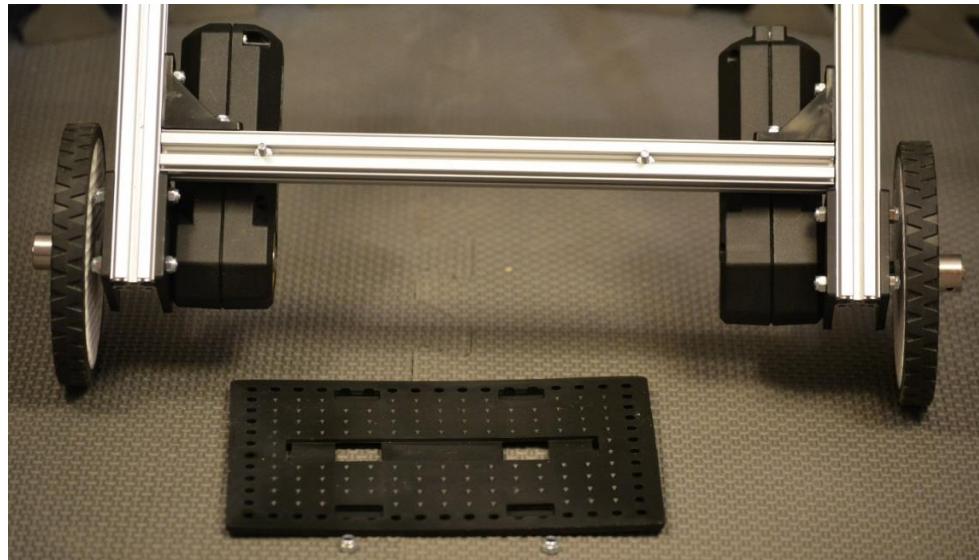
Figure 4 Above shows both wheels.

Motor and Sensor Controller

Step 1: Add the Support Plate

REV-41-1166 – Battery Holder Plate (1)

REV-41-1361 – Nut, Locking, M3 (2)



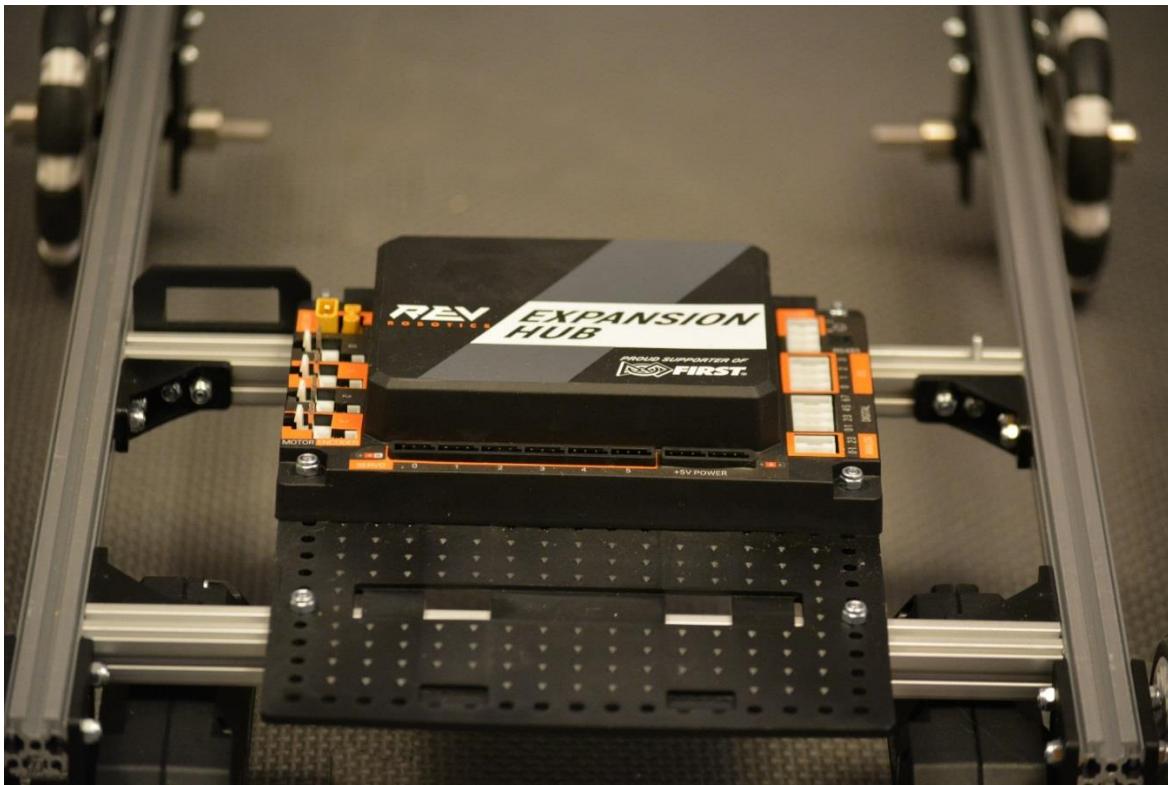
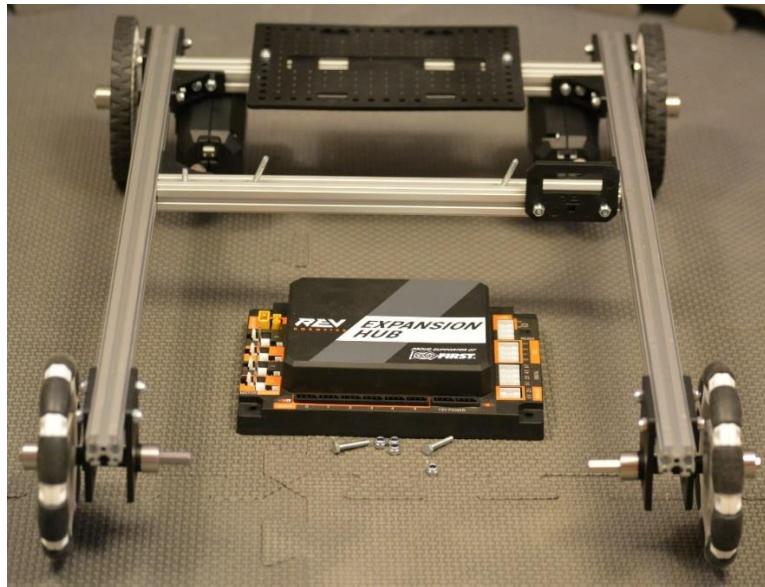
Center the plate on the extrusion.

Step 2: Add the Rev Robotics Expansion Hub

REV-31-1153 – Expansion Hub (1)

REV-41-1360 – Screw, Hex Cap, M3, 16mm (2) (two other screws are already in the extrusion from an earlier step)

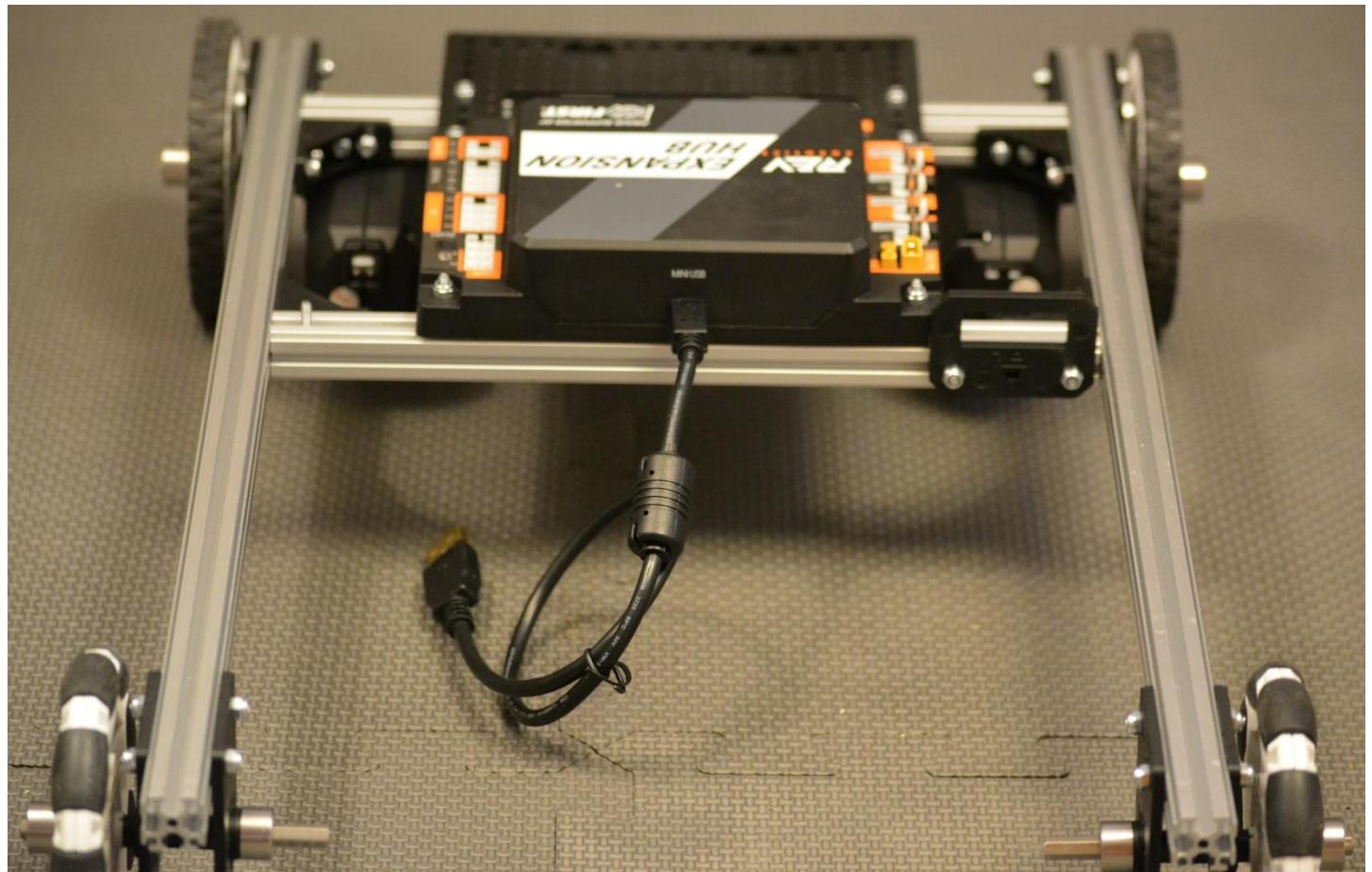
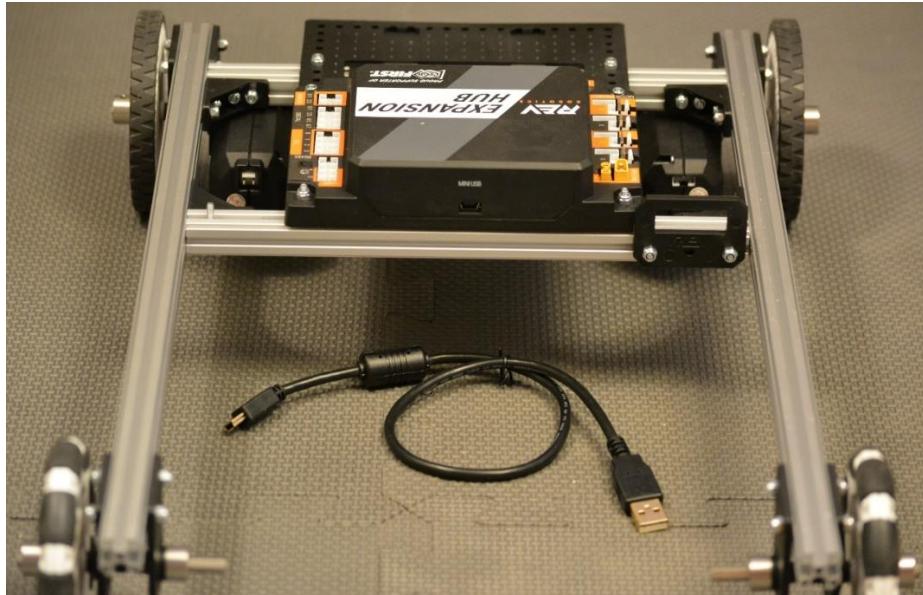
REV-41-1361 – Nut, Locking, M3 (4)



Reposition the front support beam, if necessary, to accomplish the proper spacing – the two floating screws on the front beam need to be at the corners of the expansion hub.

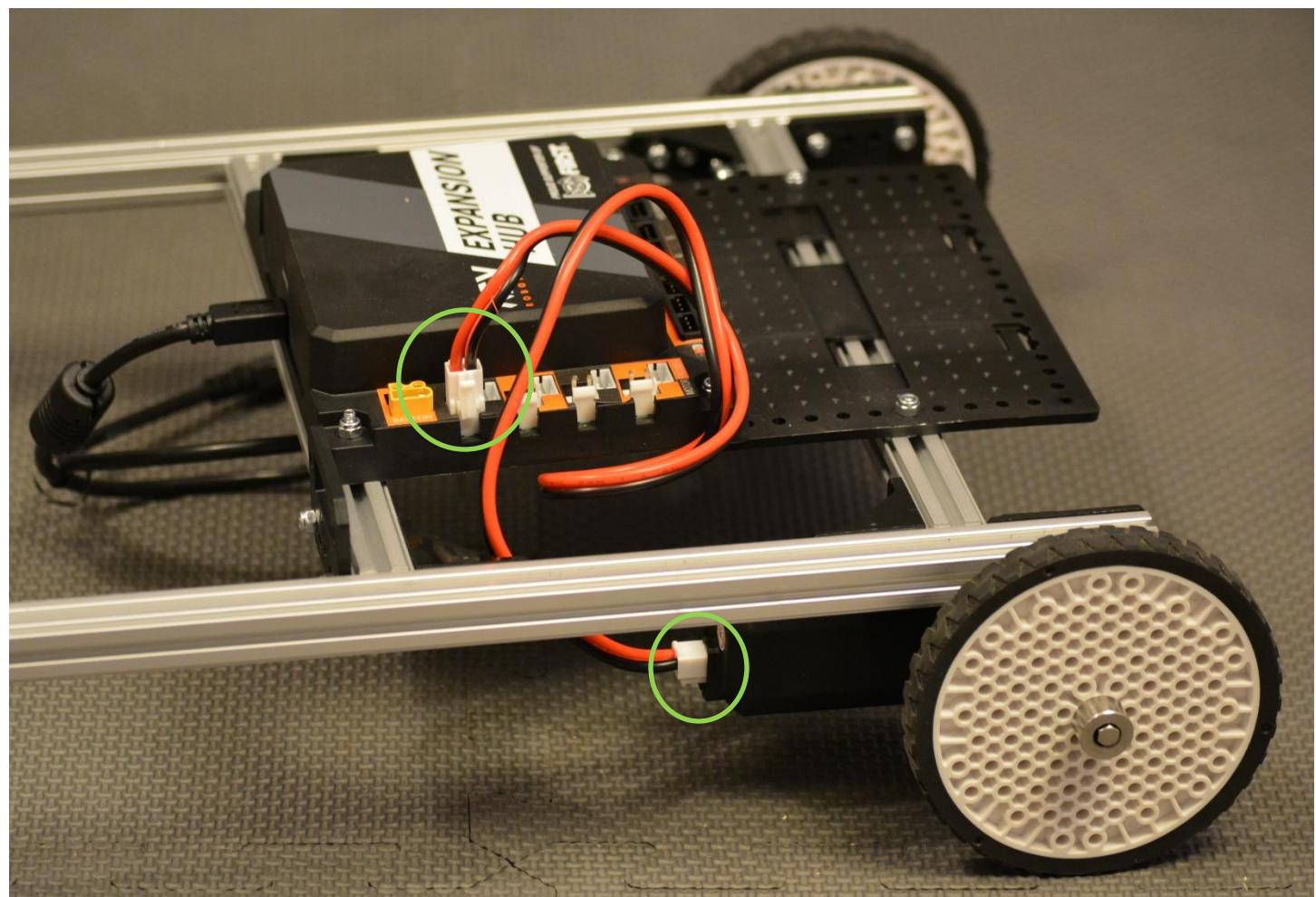
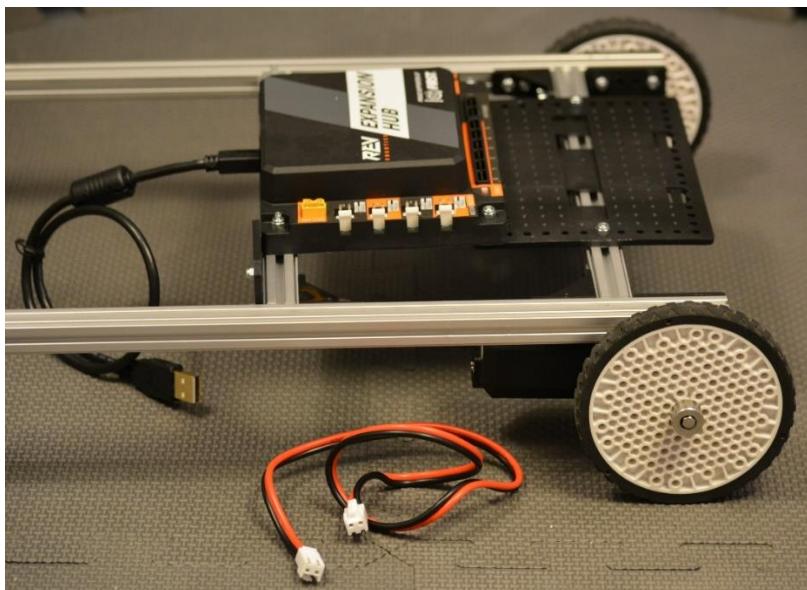
Step 3: Add the Expansion Hub to Phone Cable

5446 - Monoprice USB Cable (1)

**Plug the Mini USB plug into the Expansion Hub**

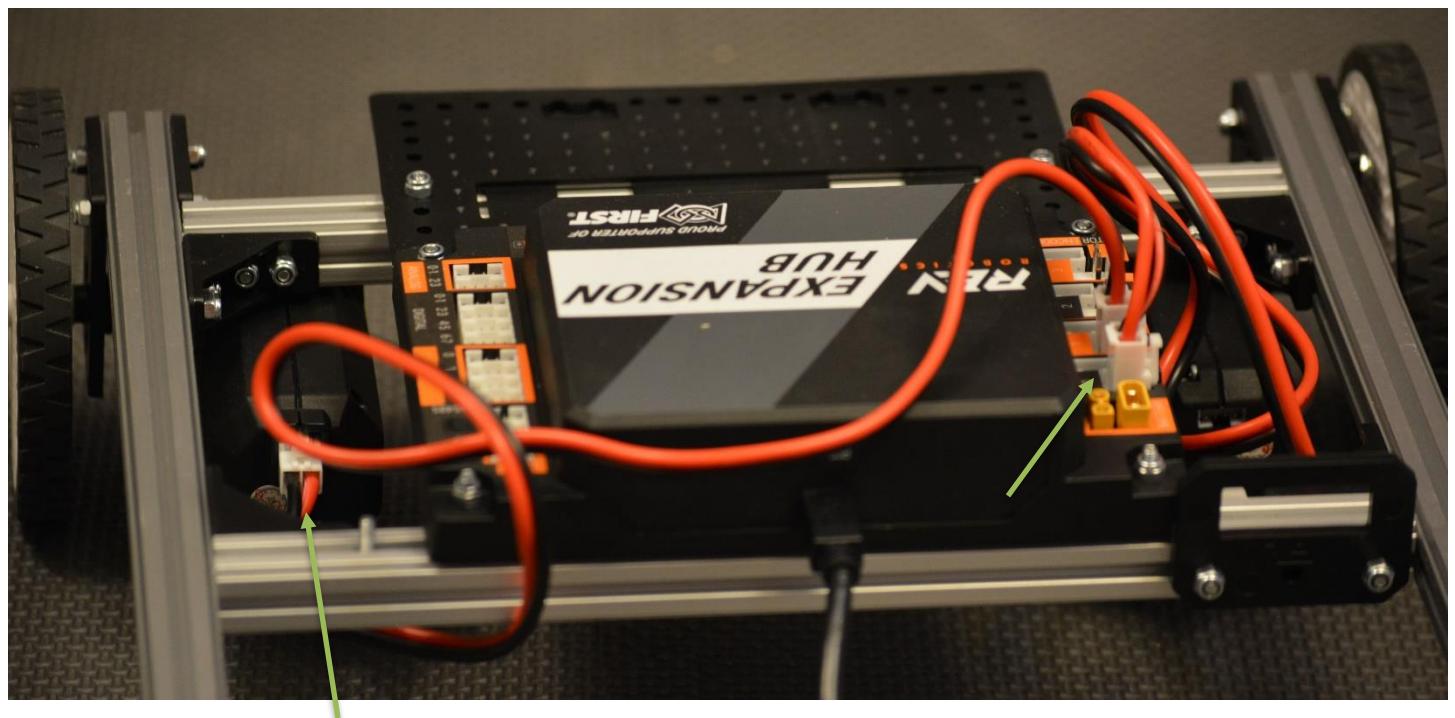
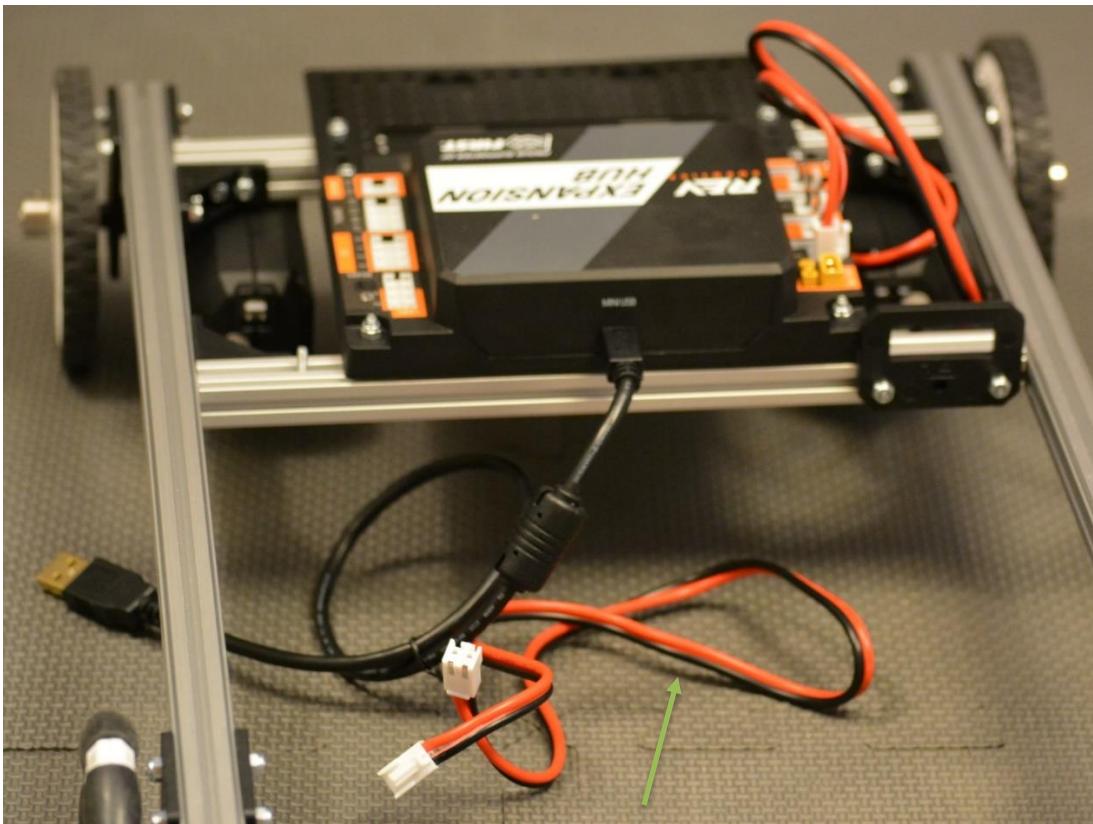
Step 4: Add the Left Drive Motor Power Cable

Motor Power Cable (1 – comes with the core hex motor – REV-41-1300)



Step 5: Add the Right Drive Motor Power Cable

Motor Power Cable (1 – comes with the core hex motor – REV-41-1300)



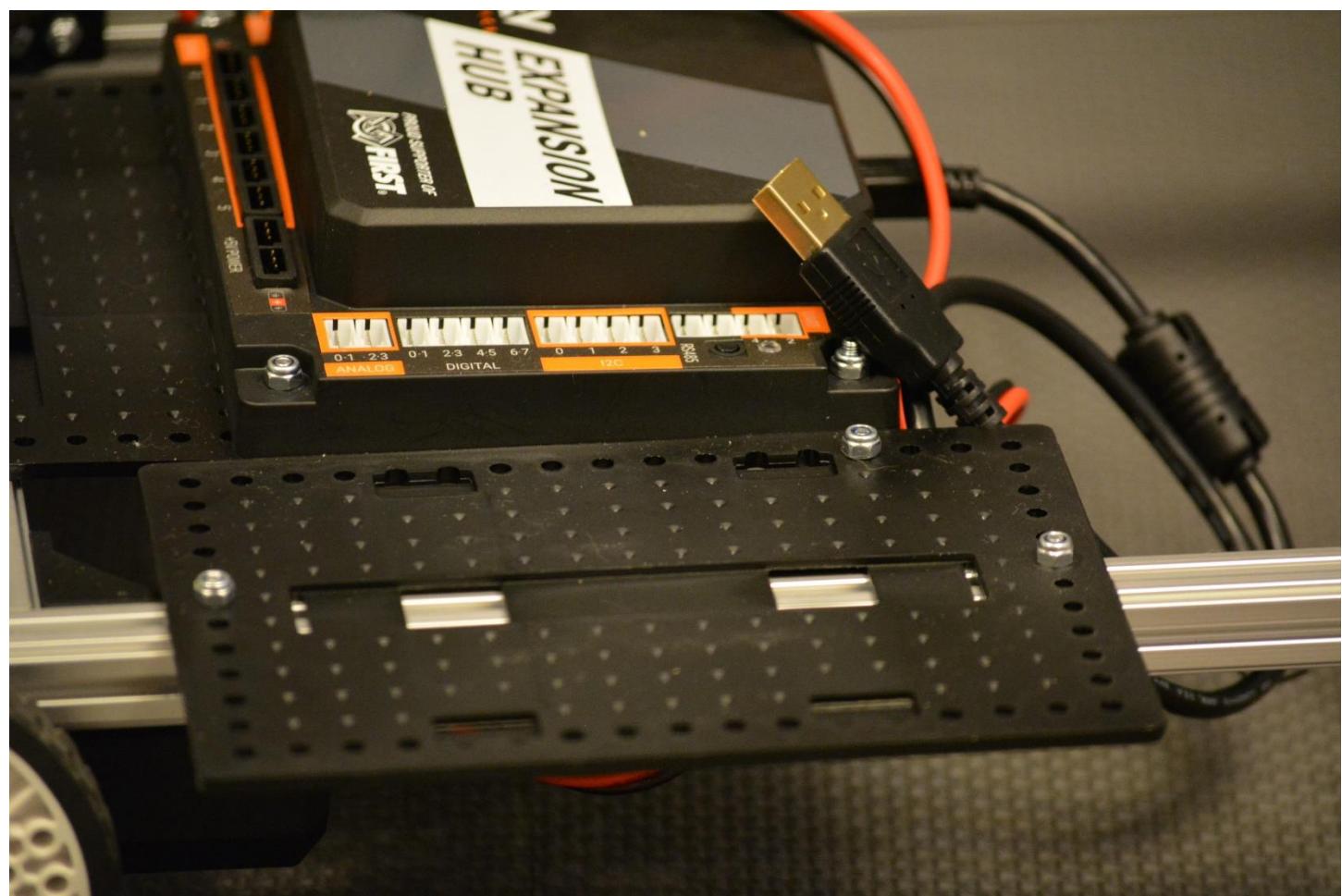
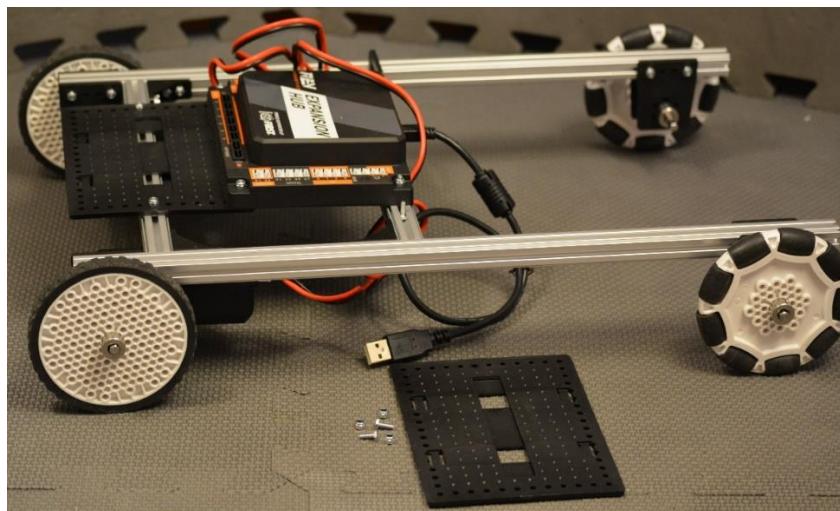
Robot Controller

Step 1: Add the Phone Support Plate

REV-41-1166 – Battery Holder Plate (1)

REV-41-1359 – Screw, Hex Cap, M3, 8mm (2) (a third screw is already in the extrusion from an earlier step)

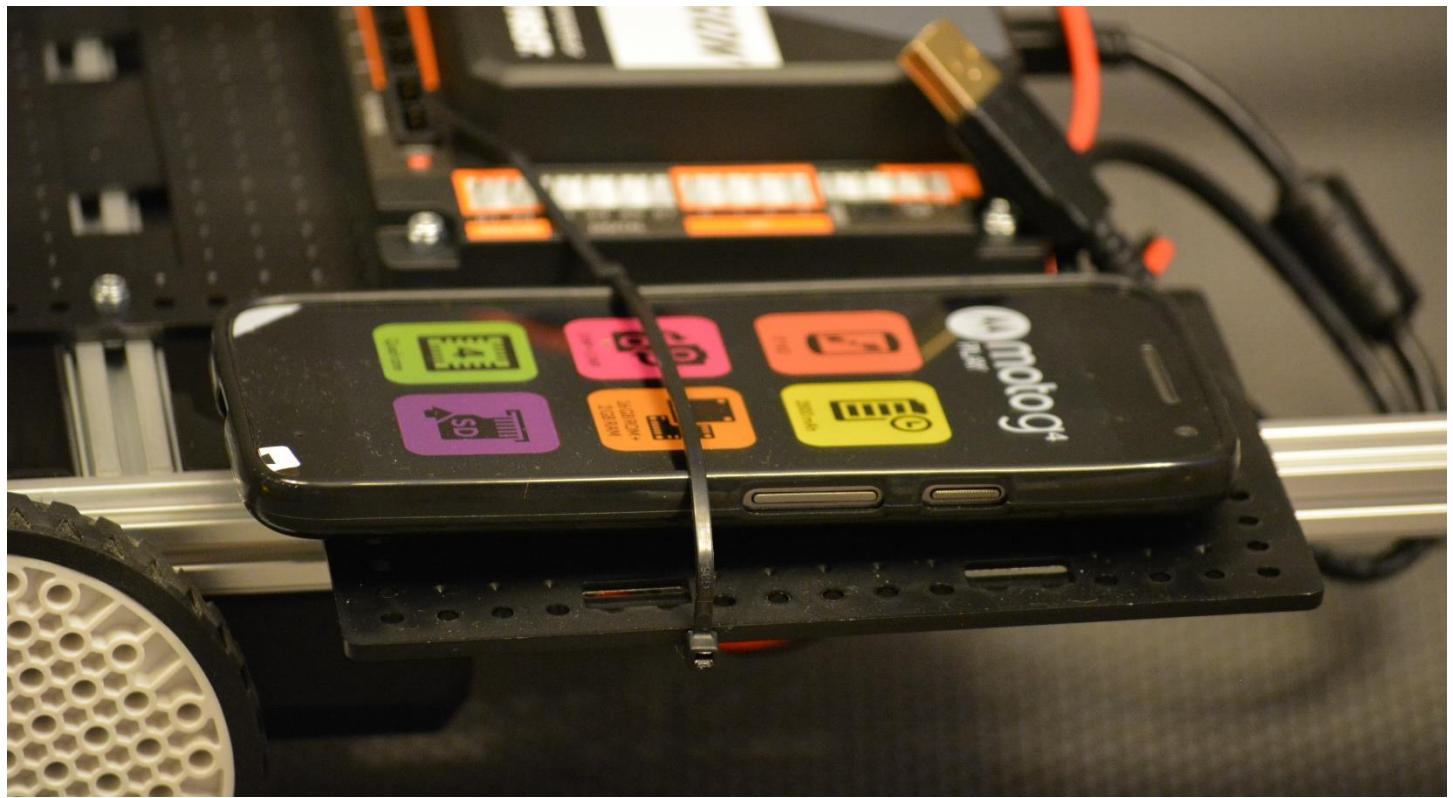
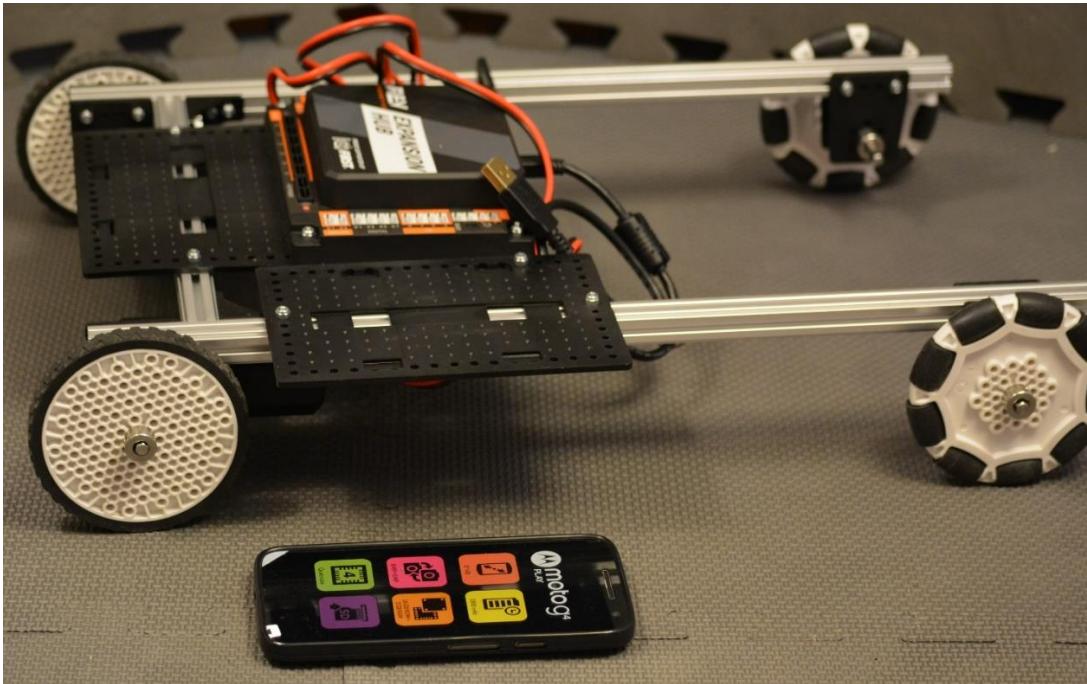
REV-41-1361 – Nut, Locking, M3 (3)



Step 2: Add the Robot Controller Cell Phone to the Holder

REV-41-1161 - Zip Tie, 160mm (2)

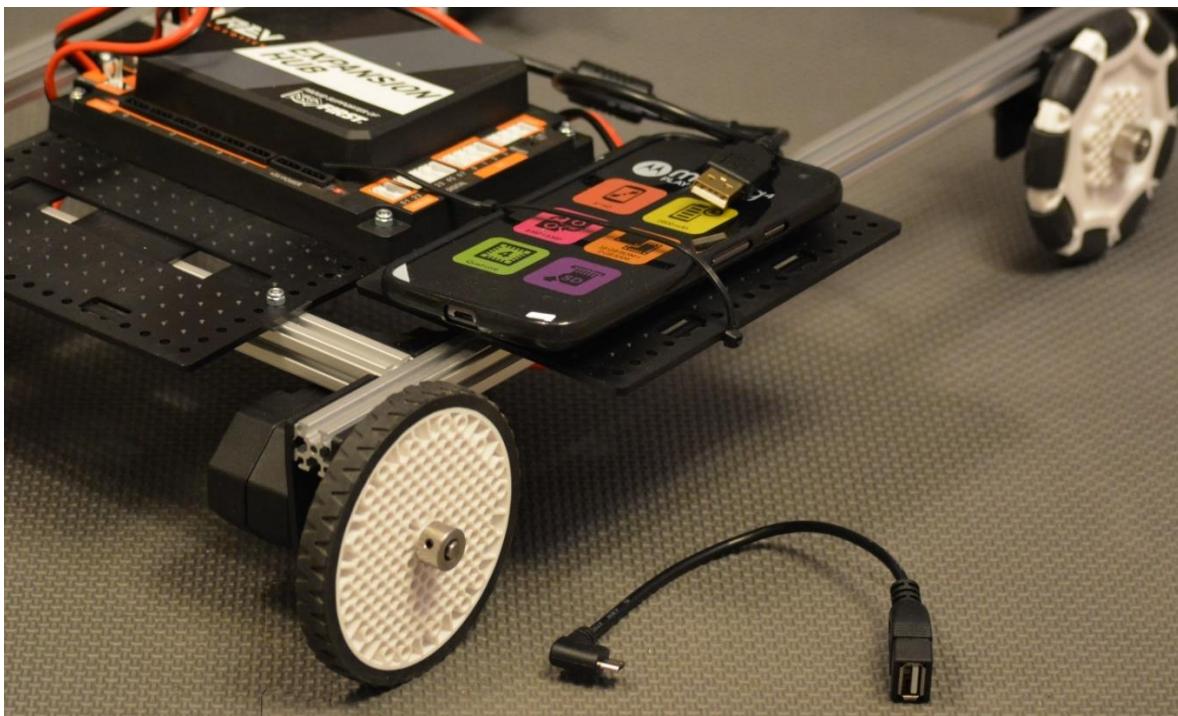
Cell phone configured as the robot controller



It is recommended that an approved material such as non-skid be layered between the phone and the plate to prevent damage to the phone. The foam that comes in the phone's packaging works well for this.

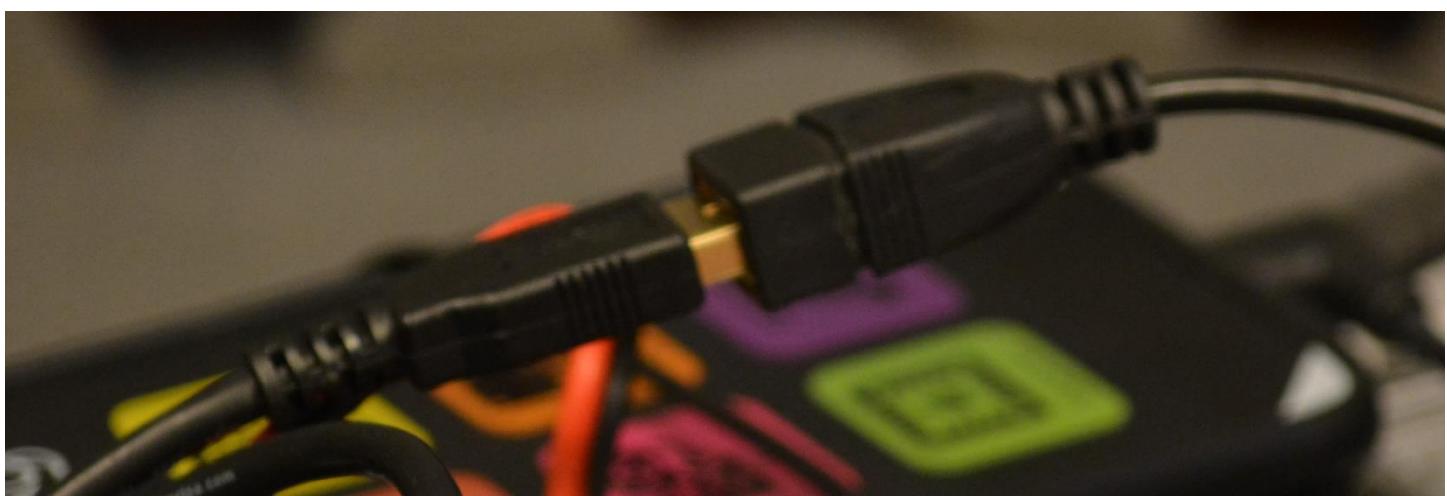
Step 3: Connect the Robot Controller to the Expansion Hub (Part 1)

USB On the Go (OTG) Adapter Cable (1)



Plug the Micro USB plug into the bottom of the cell phone.

Step 4: Connect the Robot Controller to the Expansion Hub (Part 2)

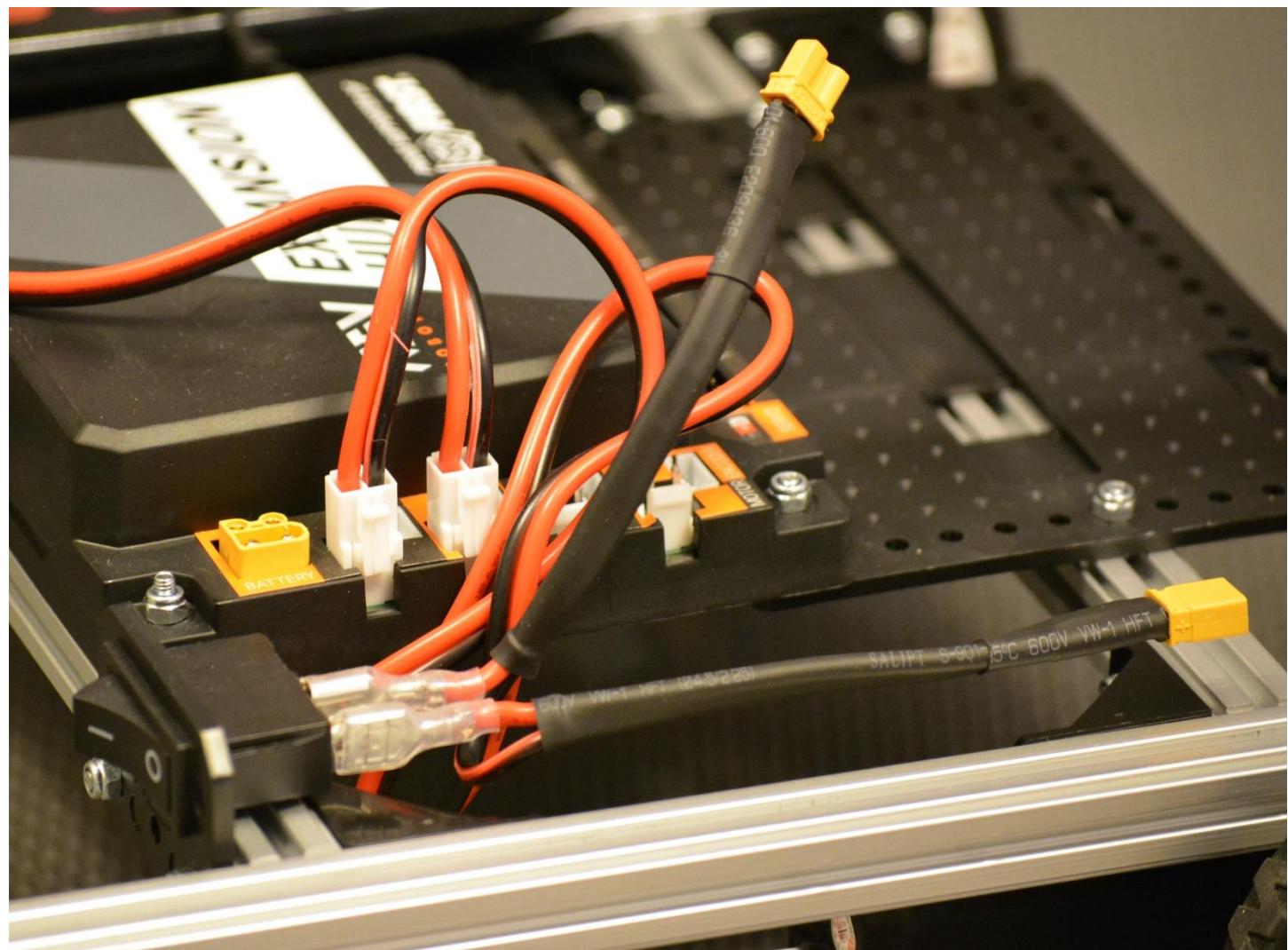
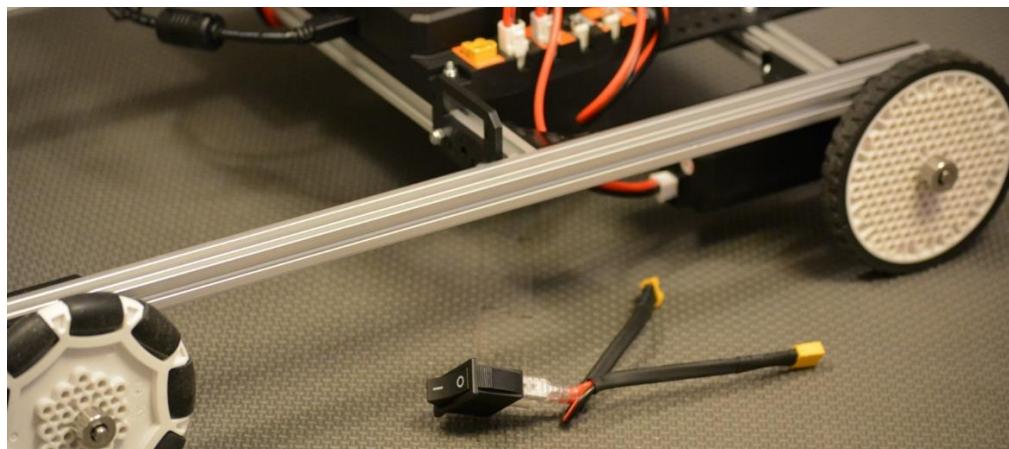


Plug the USB-A socket (from the phone) into the USB-A plug (to the Expansion Hub).

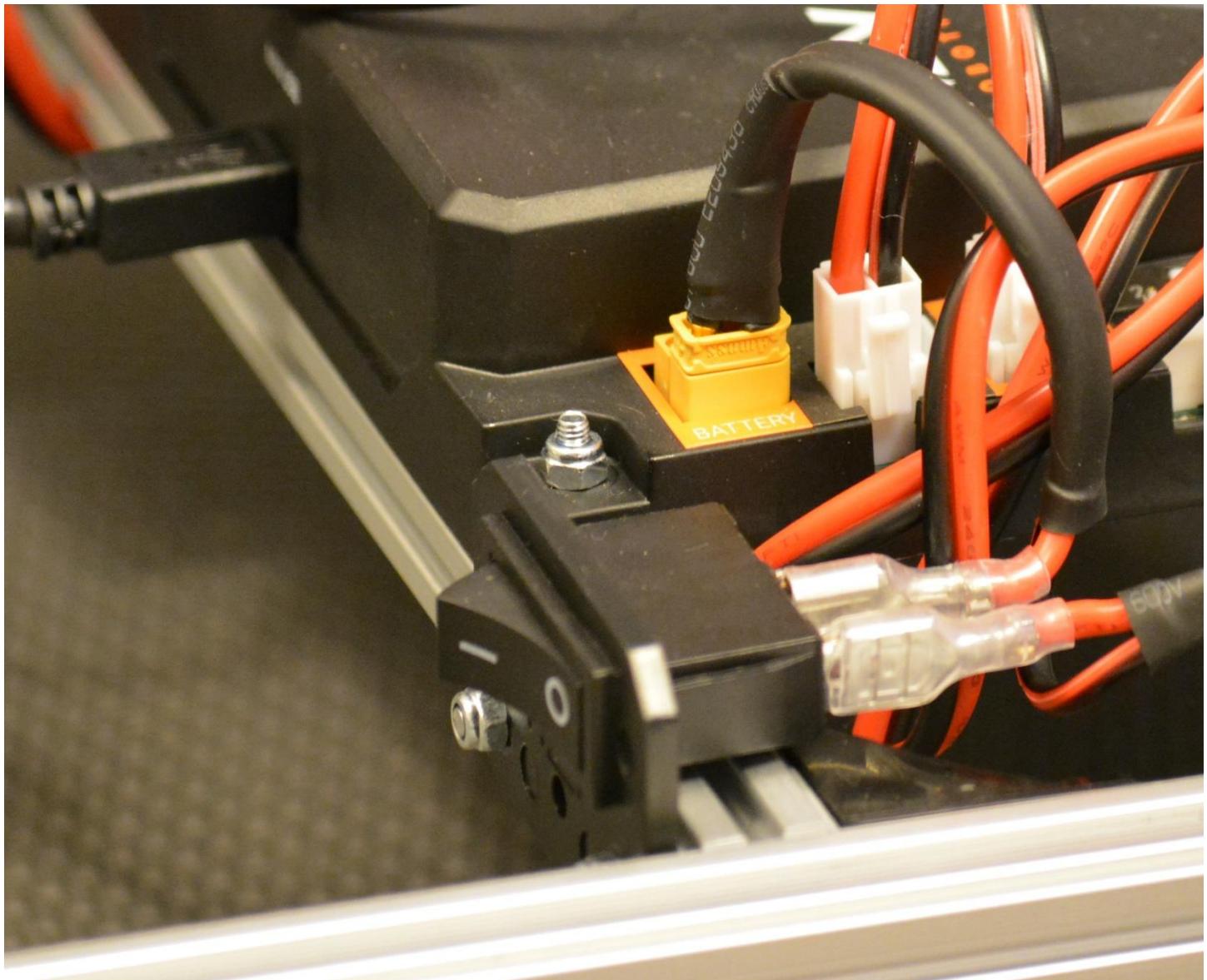
Power Switch

Step 1: Add the Switch

REV-31-1387 Switch (1)



Step 2: Connect the Switch to the Motor and Sensor Controller



Battery

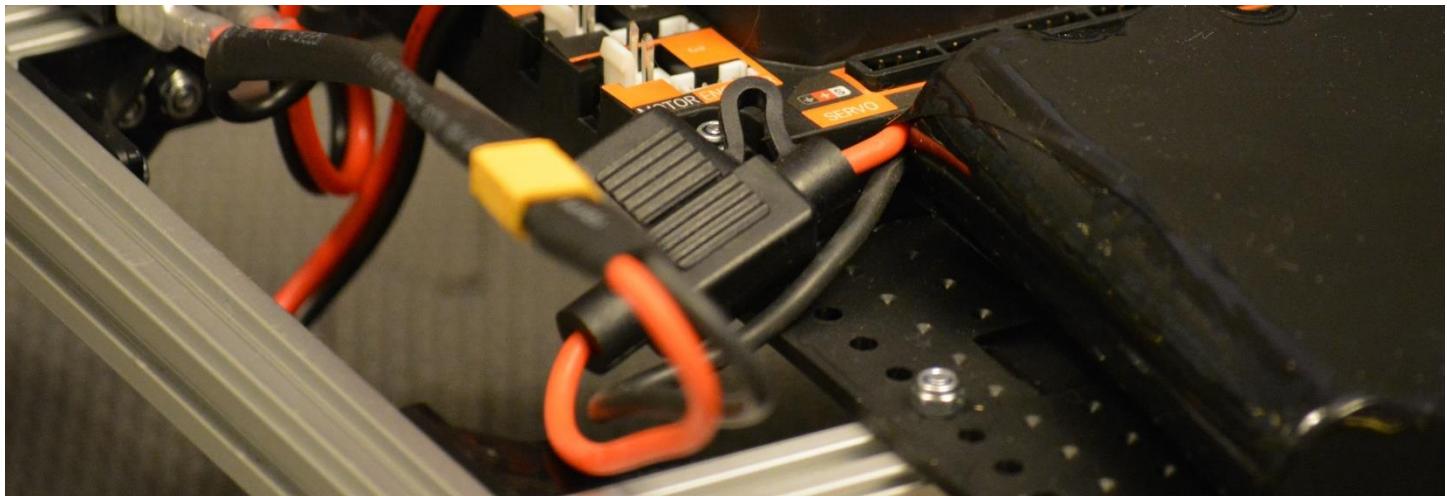
Step 1: Add the Battery

REV-31-1302 – Slim Battery, 3000mAh (1)

REV-41-1161 – Zip Tie, 160mm (2)



Step 2: Connect the Battery to the Switch



Connect the two yellow plugs.

Final Steps

The frame has been built, 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. It will also show whether more cables need to be secured or re-routed. Numbers and other stickers will be needed to make the robot competition ready.

Check the game rules for all the applicable stickers- [The Game Manual Part 1](#) includes a robot inspection checklist. Though it is no longer a rule, it is suggested that you use the self-inspection checklist before a competition to be sure that you are prepared on the day of competition and don't have any disallowed parts on the robot.

Visit the FIRST website for programming instructions and game rules.

The frame alone can be used in a competition. However, the robot can be even better with armature. Watch for the release (later in the season) of the Push 'Bot Armature Guide by visiting our website (www.ssirobotics.lydean-david.net/) or Facebook page (www.facebook.com/ssirobotics/).

Special Thanks and Best Wishes

FIRST® Tech Challenge would like to sincerely thank the creators of this document **Dave and Lydean Spangler**. The Spangler's have worked tirelessly over many years and seasons to create, update and improve this document to give teams a "how to" guide for building the robot chassis of the robot to build upon and improve. We are forever grateful for their help and support in this endeavor.

Please direct any questions or comments about this guide to: firsttechchallenge@firstinspires.org and put "Questions about the Robot Chassis Build Guide for TETRIX" in the subject line and we will redirect the emails to the appropriate responders.

Appendix A – Resources

Game Forum Q&A

<http://ftcforum.usfirst.org/forum.php>

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.

Volunteers that apply for a specific volunteer role will receive an email from FTCTrainingSupport@firstinspires.org with their username and password to the forum. 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 Tech Challenge Event On-Call Support

These numbers are available for event personnel only. Please **do not** call these numbers if you are a team looking for a ruling, a decision, or assistance. We trust that you will not misuse this resource.

Day of Event Robot Control System Support: 603-206-2450

All other Day of Event support: 603-206-2412

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!

Appendix B: Bill of Material (BoM) List

This list does not include the cell phones, the Rev Robotics Expansion Hub, the cables that connect the electronics, nor zip ties.

Qty	Part Number	Common Name
1	REV-31-1302	Slim Battery, 3000mAh
1	REV-31-1387	Switch Cable and Bracket
2	REV-41-1166	Battery Holder Plate
2	REV-41-1190	Wheel, Omni 90mm
2	REV-41-1300	Core Hex Motor w/cables
8	REV-41-1303	Bracket, Motion
4	REV-41-1320	Bracket, Inside Corner
2	REV-41-1323	Spacer, 15mm
10	REV-41-1324	Spacer, 3mm
6	REV-41-1326	Bearing, Through Bore, Short
8	REV-41-1327	Shaft Collar
4	REV-41-1347	Shaft, 5mm Hex, 75mm
2	REV-41-1354	Wheel, Traction 90mm
45	REV-41-1359	Screw, Hex Cap, M3, 8mm
4	REV-41-1360	Screw, Hex Cap, M3, 16mm
43	REV-41-1361	Nut, Locking, M3
2	REV-41-1431	Extrusion, 225mm, 90-90 Degree
2	REV-41-1432	Extrusion, 420mm, 90-90 Degree

