REV ROBOTICS

CLASS BOT BUILD GUIDE

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BILL OF MATERIALS (THROUGH STEP 25)

Part Number	Description	Quantity	Steps	Pkgs
REV-41-1166	Battery Holder Plate	2	1(1x), 14(1x)	1
REV-41-1431	15mm Extrusion - 225mm - 90° Ends	8	1(2x), 5(2x), 6(2x), 15(2x)	2
REV-41-1317	15mm Bearing Pillow Block	11	2(4x), 6(4x), 18(2x), 23(1x)	2
REV-41-1307	15mm Plastic 45 Degree Bracket	4	3(2x), 13(2x)	1
REV-41-1320	15mm Plastic Inside Corner Bracket	10	4(4x), 7(4x), 8(2x), 24(1x)	2
REV-41-1487	15mm Metal Bent HD Hex Motor Bracket V2	2	6(2x)	1
REV-41-1349	5mm x 135 mm Hex Shaft	4	9(2x), 11(2x)	1
REV-41-1327	Shaft Collars	11	9(2x), 10(4x), 11(4x), 17(1x)	2
REV-41-1354	90mm Traction Wheel	2	9(2x)	1
REV-41-1336	72 Tooth Plastic Gear	4	9(2x), 12(2x)	1
REV-41-1329	Through Bore Bearing - Long	10	9(2x), 10(2x), 11(4x), 17(2x)	1
REV-41-1190	90mm Omni Wheel	2	11(2x)	1
REV-41-1301	HD Hex Motor (with cables)	2	12(2x)	2
REV-41-1430	45-degree 150mm extrusion	2	13(2x)	1
REV-41-1300	Core Hex Motor (with cables)	1	16(1x)	1
REV-41-1433	15mm Metal Bent Core Hex Motor Bracket V2	1	16(1x)	1
REV-41-1334	45 Tooth Plastic Gear	1	16(1x)	1
REV-41-1347	5mm x 75mm Hex Shaft	2	16(1x), 17(1x)	1
REV-41-1333	125 Tooth Plastic Gear	2	17(1x)	1
REV-41-1316	15mm Hex Pillow Block	1	17(1x)	1
REV-41-1432	15mm Extrusion - 420mm - 90° Ends	1	18(1x)	1
REV-41-1485	15mm Metal Bent Servo Bracket V2	1	19(1x)	1
REV-41-1097	Smart Robot Servo	1	19(1x)	1
REV-41-1363	Aluminum Servo Horn	1	20(1x)	1
REV-41-1311	15mm Plastic 120 Degree Bracket	2	20(1x), 24(1x)	1
REV-31-1387	Switch Cable and Bracket	1	21(1x)	1
REV-11-1130	36" PWM Cable	1	23(1x)	1
REV-41-1359	M3 x 8mm Hex Cap Screws	94	1(4x), 2(8x), 3(10x), 4(8x), 6(12x), 7(8x), 8(4x), 12(4x), 13(10x), 14(2x), 16(4x), 17(2x), 18(4x), 19(4x), 20(2x), 21(2x), 23(2x), 24(2x), 25(2x)	1
REV-41-1361	M3 Nyloc Nuts	92	1(4x), 2(8x), 3(10x), 4(8x), 6(12x), 7(8x), 8(4x), 13(10x), 14(4x), 16(2x), 17(2x), 18(4x), 19(4x), 20(2x), 21(2x), 23(2x), 24(4x), 25(2x)	1
REV-41-1360	M3 x 16mm Hex Cap Screws	4	14(2x), 24(2x)	1
REV-31-1425	Touch Sensor (with cable)	1	25(1x)	1
REV-31-1595	REV Control Hub	1	14 (1x)	1

This guide was created in collaboration with Patrick R. Michaud, University of Texas at Dallas & *FIRST*® Tech Challenge UK & Ireland

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BILL OF MATERIALS (EXTRA PARTS)

Part Number	Description	Quantity	Pkgs
REV-31-1299	Battery Charger	1	1
REV-31-1302	12V Slim Battery	1	1
REV-31-1408	JST PH 4-pin Sensor Cable	4	1
REV-31-1413	JST VH 2-pin Motor Cable	4	1
REV-31-1426	USB Female A to Micro USB Adapter	1	1
REV-31-1557	Color Sensor V3	1	1
REV-39-1647	Logitech F310 USB Gamepad	1	1
REV-41-1119	5.5mm Nut Driver	1	1
REV-41-1161	Zipties, Black, 160mm	50	1
REV-41-1167	M3 X 8MM T-Slot Screw	100	1
REV-41-1303	15mm Plastic Motion Bracket	8	1
REV-41-1315	15mm Gearbox Motion Bracket	4	1
REV-41-1323	15mm Spacer	12	1
REV-41-1324	3mm Spacer	16	1
REV-41-1326	Through Bore Bearing - Short	12	1
REV-41-1331	15 Tooth Plastic Gear	8	1
REV-41-1335	60 Tooth Plastic Gear	4	1
REV-41-1364	Servo Gear Adapter	4	1
REV-41-1373	Hook and Loop Fastener	1	1
REV-41-1374	5.5mm Combination Wrench	1	1
REV-41-1376	1.5mm Allen Wrench	2	2
N/A	15mm Extrusion - 120mm - 90° Ends	2	2
N/A	Plastic Storage Tote	6	3
N/A	Android Driver's Station Device	1	1

You will not use all the parts in the kit for this build so expect to have pieces left over. This robot design is one of many possible designs you can build with the EDU Kit. Customizing your design is encouraged.

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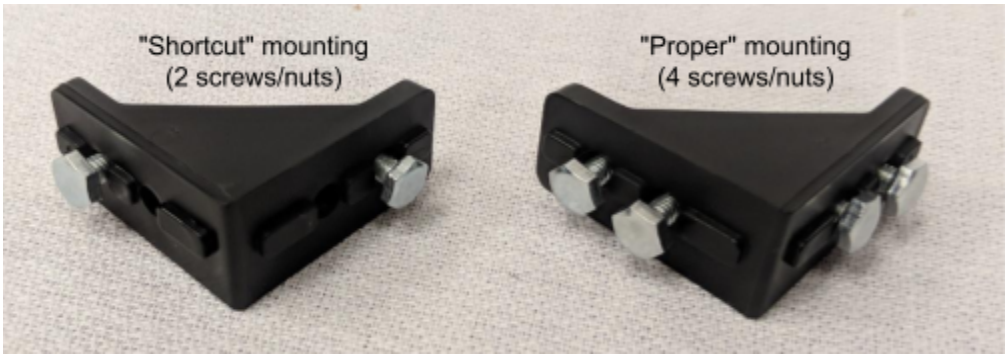
PART 1 - MECHANICAL BUILD

General assembly notes

"Pre-load screws" in the notes below indicate that some brackets should be loaded with screws and nuts prior to attaching the bracket to another component. Some brackets have "alignment ribs" (raised plastic bumps inline with mounting holes); in general the heads of the screws go on the side of the bracket with the alignment ribs.

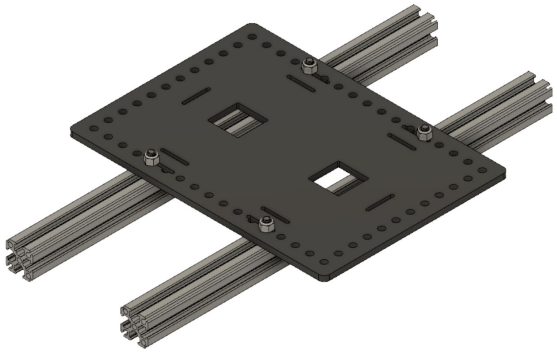
This robot assembly guide also uses only 2 screws on inside corner brackets (one per leg of the bracket) in order to speed assembly and adjustment time in workshops and training. That's not generally a good building practice. For competition robots and places where structural strength is desired, inside corner brackets should have 2 screws per side (four total).



Step 1: Inner chassis frame

Hardware: battery holder plate (1x), 225mm extrusions (2x), 8mm M3 screws (4x), nylon hex nuts (4x)

Instructions: Pre-load 4 screws and nuts to the battery holder plate in the holes indicated by the images below. Slide two 225mm extrusions onto the heads of the screws in the plate. The plate should be approximately in the middle of each of the two extrusions. Tighten the nuts (snug, not overly tight).



Step 2: Add inner pillow blocks

Hardware: bearing pillow blocks (4x), 8mm M3 screws (8x), M3 nylon nuts (8x)

Instructions: Pre-load 4 pillow blocks with screws and slide onto the end of the extrusion rails on the same side as the plate and tighten.

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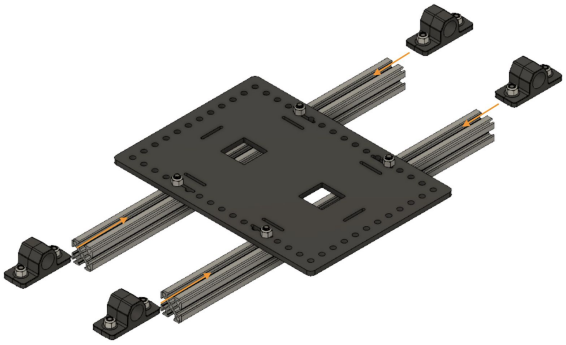
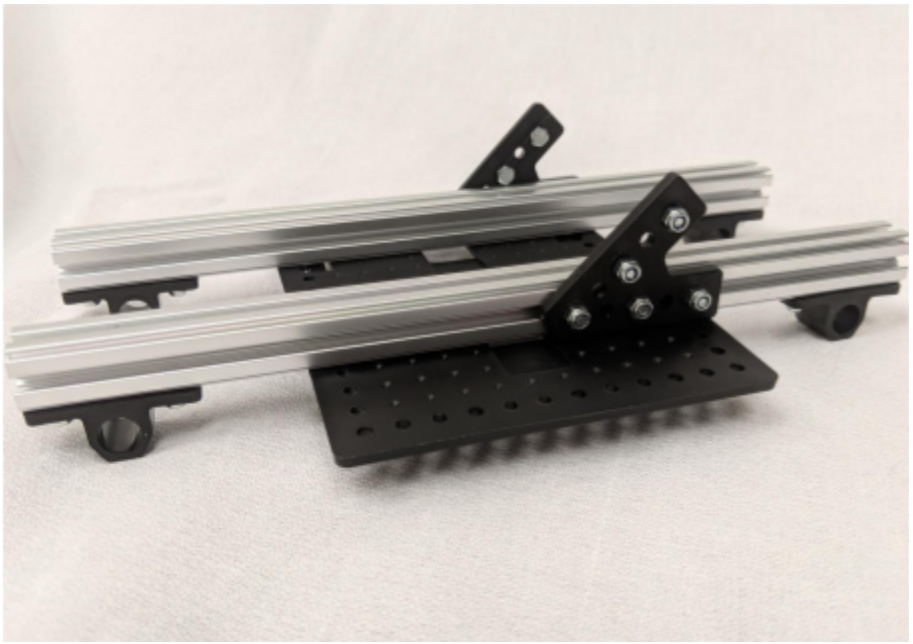


Step 3: Add 45-degree angle brackets

Hardware: 45-degree brackets (2x), 8mm M3 screws (10x), M3 nylon nuts (10x)

Instructions: Pre-load screws onto the brackets as shown in the image below (every other hole). *Screw head is loaded on the side of the bracket with the alignment ribs.* Insert the brackets on the outside of the extrusion rails, aligning the ends of the brackets with the battery plate. Lightly tighten one of the nuts on each bracket to hold them in place; they will be adjusted later.



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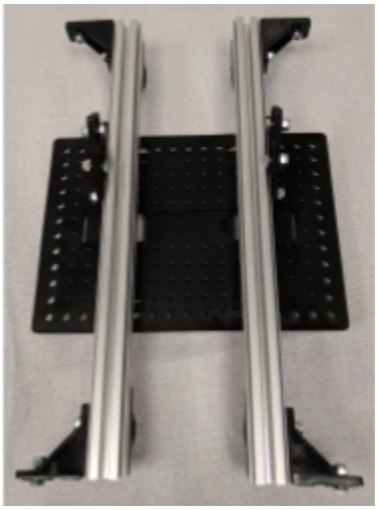
Step 4: Add inside corner brackets

Hardware: inside corner brackets (4x), 8mm M3 screws (8x), M3 nylon nuts (8x)

Instructions: Add screws and nuts to each of the inside corner brackets. The heads of the screws go on the outside of the corner bracket with the nuts to the inside. Slide the brackets onto the extrusion rails on the same side as the 45-degree bracket added in step 5 above. Make sure the brackets are flush with the end of the extrusions (some adjustments may need to be made).

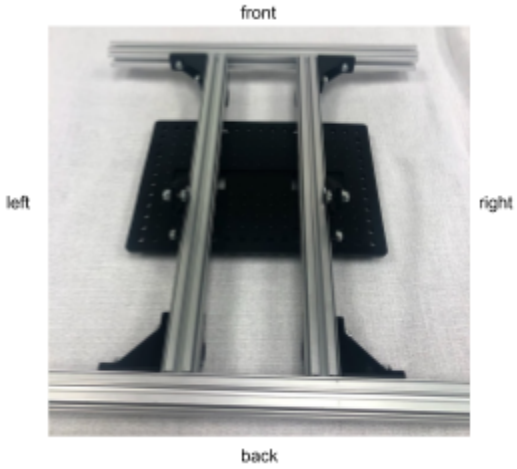


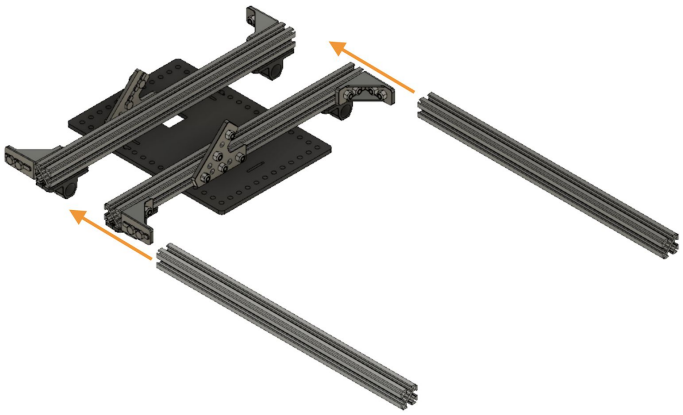
Step 5: Add front and back extrusions

Hardware: 225mm extrusions (2x)

Instructions: Slide the extrusions onto the corner brackets. The extrusions should be centered on the chassis with the ends of the front and back extrusions will be 73mm from the vertical extrusions.

For the remaining instructions in this build guide, we will refer to the side where the 45 degree angle brackets open as the "front" of the robot. "Left" and "right" are as the robot faces away from you.





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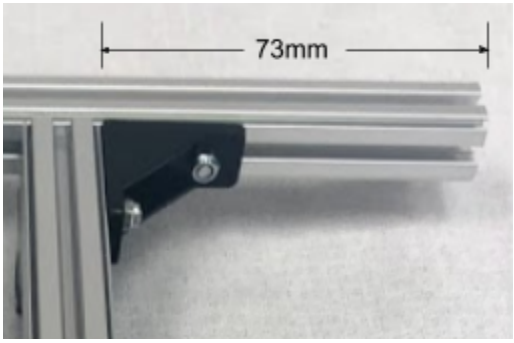

Step 6: Create side rails (2x)

Hardware: 225mm extrusions (2x), bent HD Hex Motor brackets (2x), bearing pillow blocks (4x), 8mm M3 screws (12x), M3 nylon nuts (12x)

Instructions: Pre-load bent HD Hex Motor bracket with 2 screws on the outside holes of the smaller leg of the bracket. Slide the motor bracket onto the middle of the rails and tighten enough to keep still for now -- these will be adjusted on a later step. Pre-load 4 pillow blocks and place opposite of the motor bracket flush with the ends of the extrusion.

Step 7: Add side rails to chassis

Hardware: Side rails (2x) from step 6, inside corner brackets (4x), 8mm M3 screws (8x), M3 nylon nuts (8x)

Instructions: Pre-load 4 inside corner brackets. Place bracket on extrusion rail *opposite the flat side of the motor bracket*. The brackets should be flush with the ends of the side rails. Slide each side rail assembly between the front and back rails of the chassis, keeping the flat sides of the motor brackets to the outside of the chassis. The side rails should be flush with the corners of the front and back rails.

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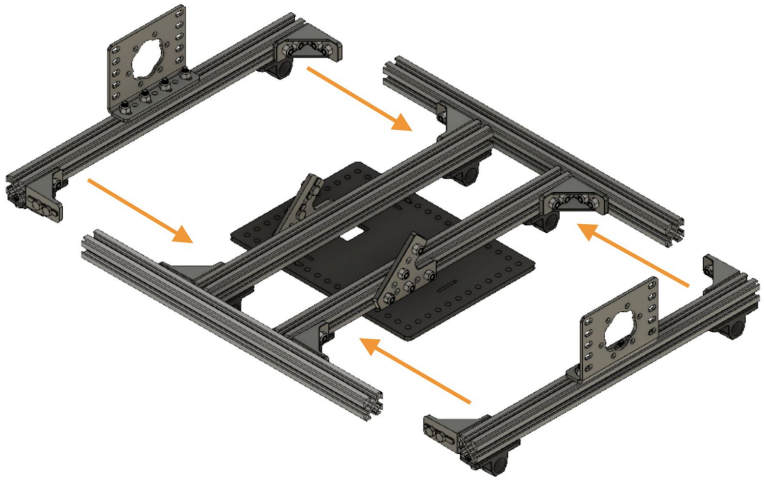

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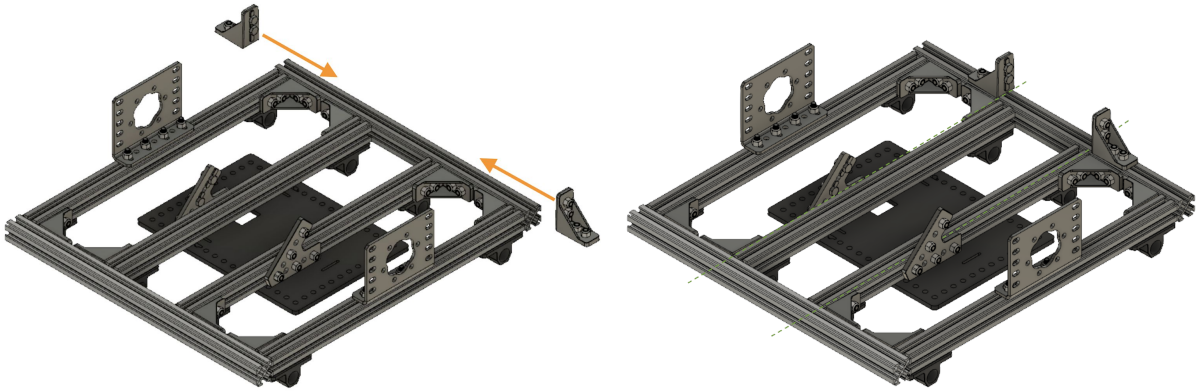
Step 8: Add riser brackets

Hardware: Inside corner brackets (2x), 8mm M3 screws (4x), M3 nylon nuts (4x)

Instructions: Pre-load 2 inside corner brackets and slide them onto the front rails (the side facing away from you, where the 45 degree angle bracket opens). Tighten the brackets aligned with the outside of the middle rails (some adjustment will be needed later).



Step 9: Create rear wheels (2x)

Hardware: 135mm hex shafts (2x), shaft collars (2x), 90mm traction wheels (2x), 72T gears (2x), through bore long bearings (2x)

Instructions: Secure a collar to the end of the shaft. Slide on a 90mm traction wheel all the way up against the collar followed by a 72T gear and a bearing. Repeat for other wheel.

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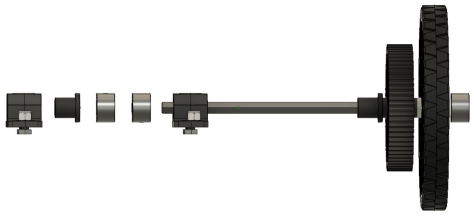
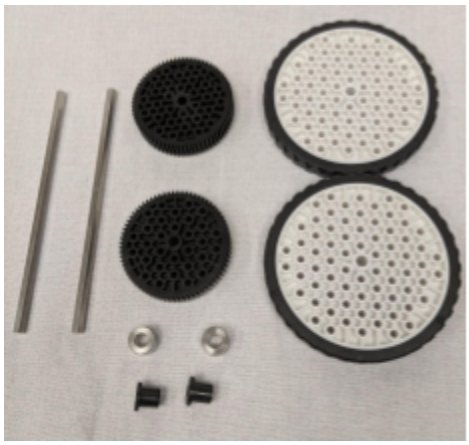
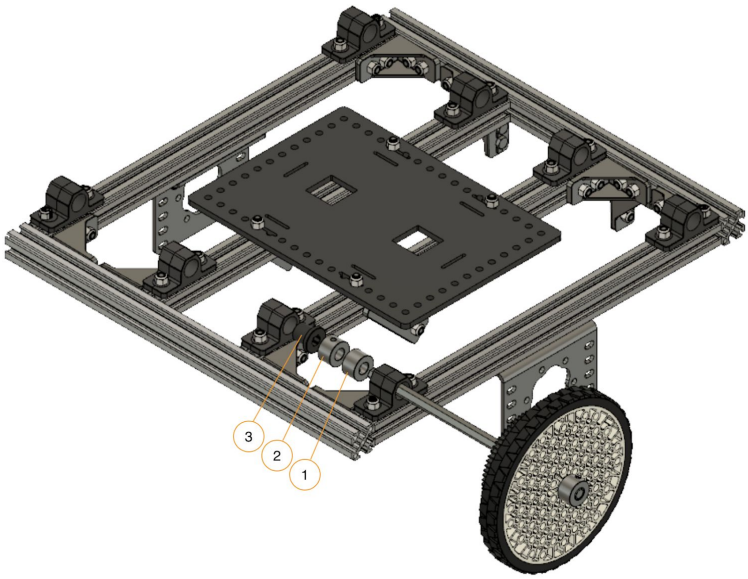
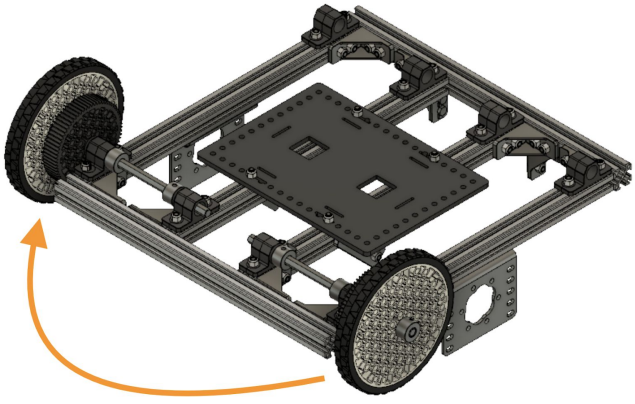






Step 10: Attach rear wheels (2x)

Hardware: rear wheel assemblies from Step 9, shaft collars (4x),through bore long bearings (2x)
Instructions: Slide a wheel assembly through an outside rear pillow bracket and place the remaining two collars on the shaft *do not tighten yet* and then the second bearing before placing through the second pillow bracket. Both bearings should be facing toward the center of the chassis. Tighten the collars against the inside of either pillow bracket to secure the wheel as shown in the picture. Repeat for the other side.



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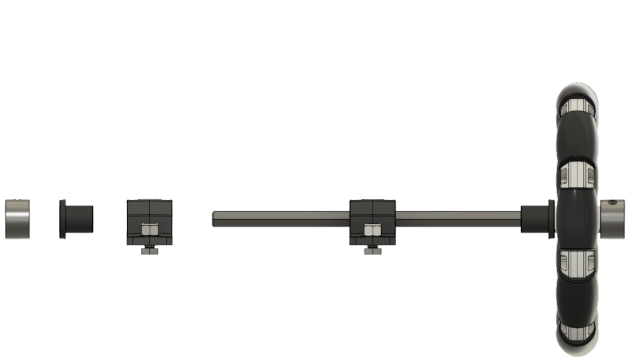
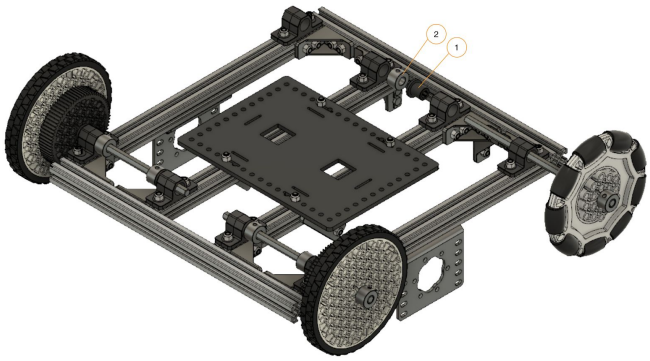
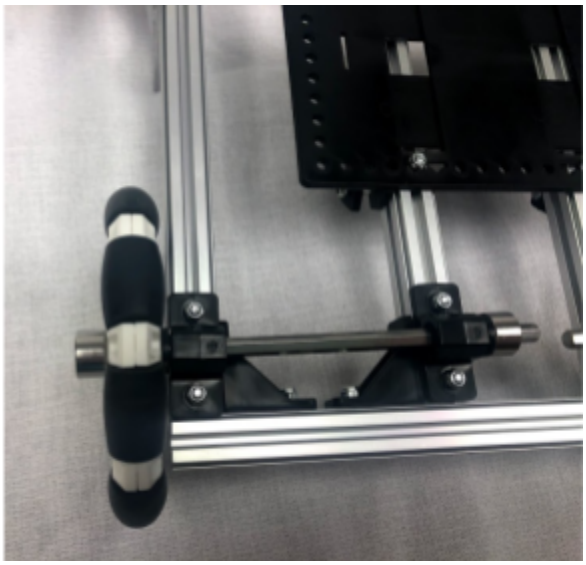
Step 11: Create and attach front wheels

Hardware: 135mm hex shafts (2x), 90mm omni wheels (2x), through bore long bearings (4x), shaft collars (4x)
Instructions: Secure a collar to the end of the shaft, followed by the omni wheel, then 1 bearing with the flange against wheel. Slide shaft through two front pillow brackets and place another bearing facing outward through the second pillow bracket. Secure a collar next to the bearing. Repeat with other omni wheel.







Step 12: Add drive motors

Hardware: HD Hex Motors (2x), 8mm M3 screws (4x), 72T gears (2x)
Instructions: Attach the motor with the shaft located on top right "dent" (as viewed when facing the bracket) and secure in the top left and bottom right holes. Some rotating of the motor may be necessary to align the openings, and the mount itself might need to be slid so that the 45 degree bracket is not in the way of the motor and wheel to then attach the gear. Place a 72T on the motor shaft and slide all the way to the gearbox. Once the gear is on, slide the entire mount so the gears from the motor and the rear wheels are meshed and tighten the mount in place. The motor mounts have been mounted using slotted holes, so try to keep the mounts parallel to the side rails.

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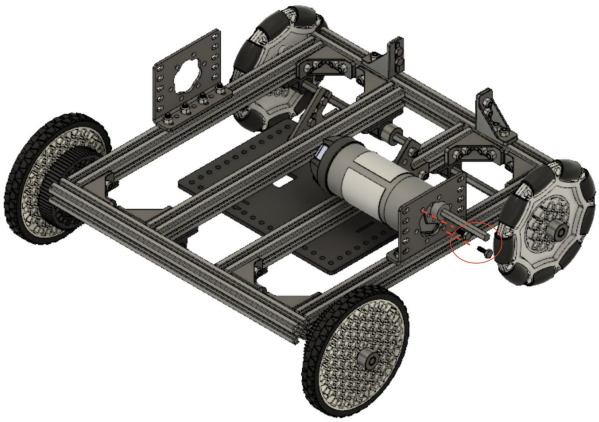

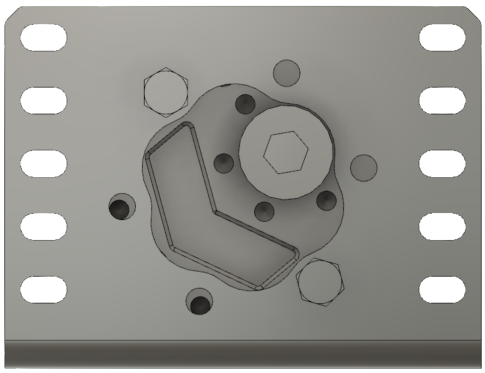

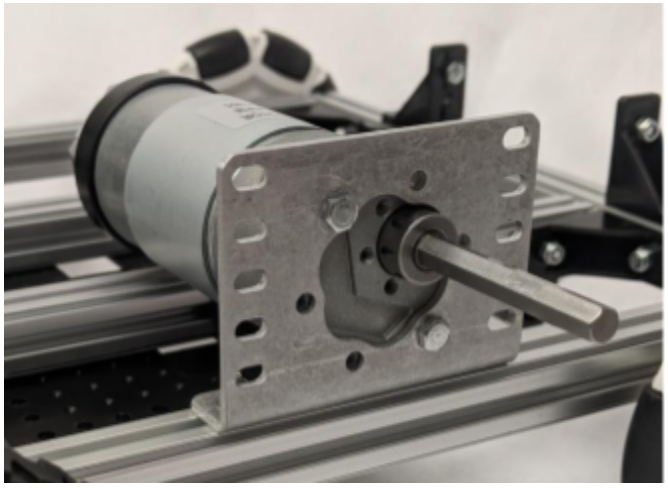

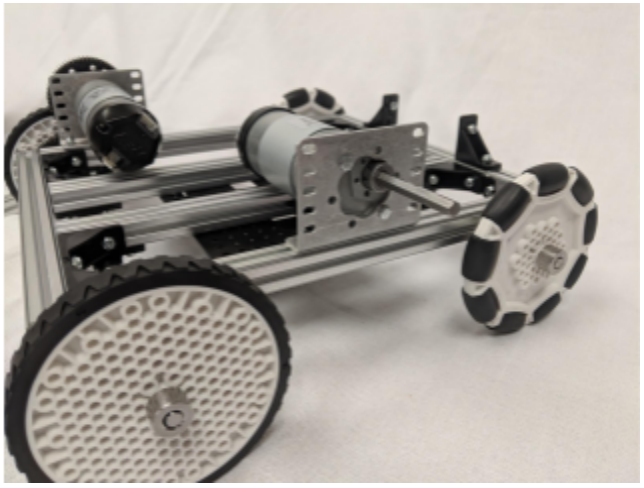

Step 13: Attach riser supports and angle brackets

Hardware: 45-degree 150mm extrusions (2x), 45-degree brackets (2x), 8mm M3 screws (10x), M3 nylon nuts (10x)

Instructions: Slide the 45 degree extrusion rails onto the inside of the 45 degree brackets and tighten them. Slide two 45 degree brackets to the top of the rails. The corner screw will be attached to the upright rail so do not insert/tighten it on the 45 degree rail. Only 2 of the screws will be on the 45 degree rail. Adjustments will happen when adding the upright rails.

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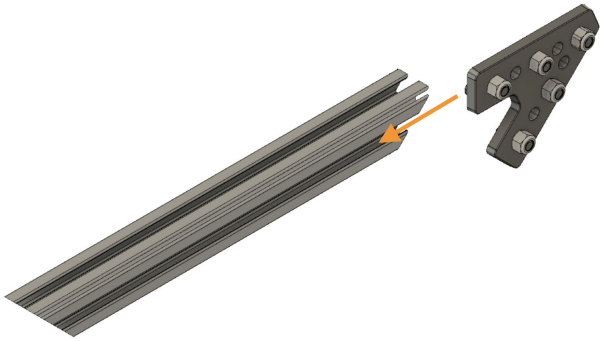

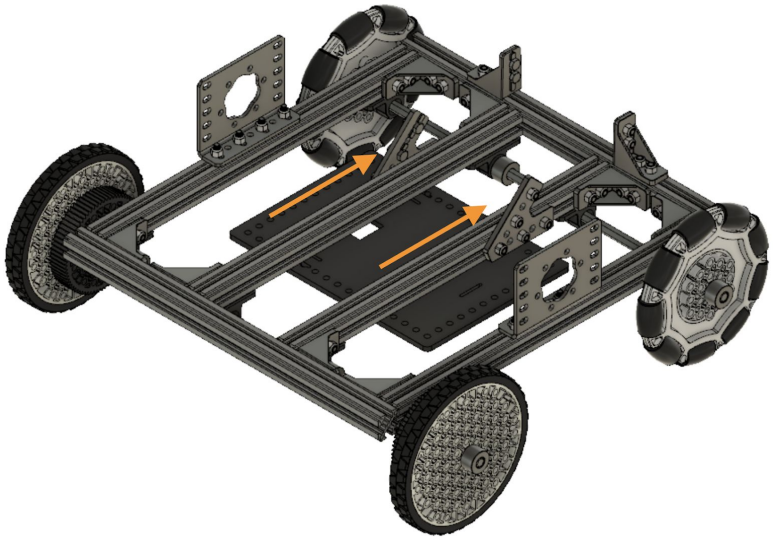

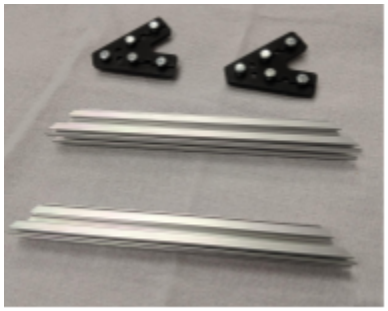

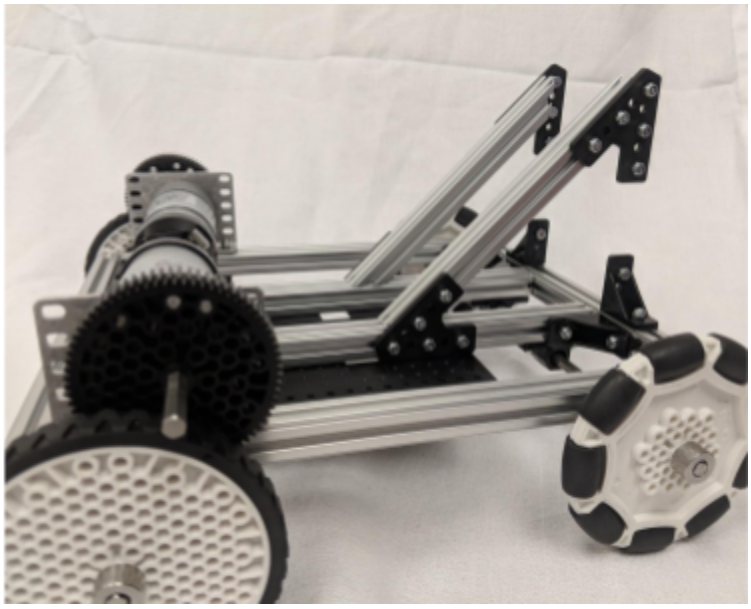

Step 14: Expansion/Control Hub and base plate

Hardware: battery holder plate, 8mm M3 screws (2x), REV Expansion Hub or REV Control Hub (1x), 16mm M3 screws (2x), M3 nylon nuts (4x)

Instructions: Pre-load the battery holder plate with *two* screws in the holes shown with the yellow arrows. On the side of the battery plate with the nuts (opposite of the screw heads), attach the expansion hub using 16mm screws in the holes shown with the green arrows. Slide the battery holder plate onto the angled riser supports and tighten.

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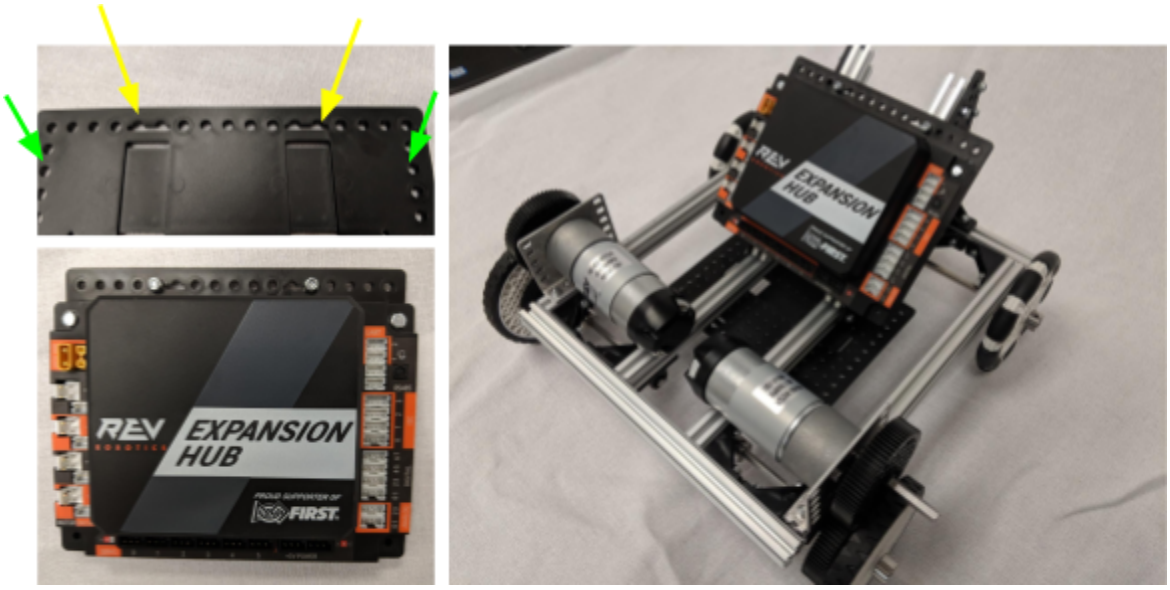
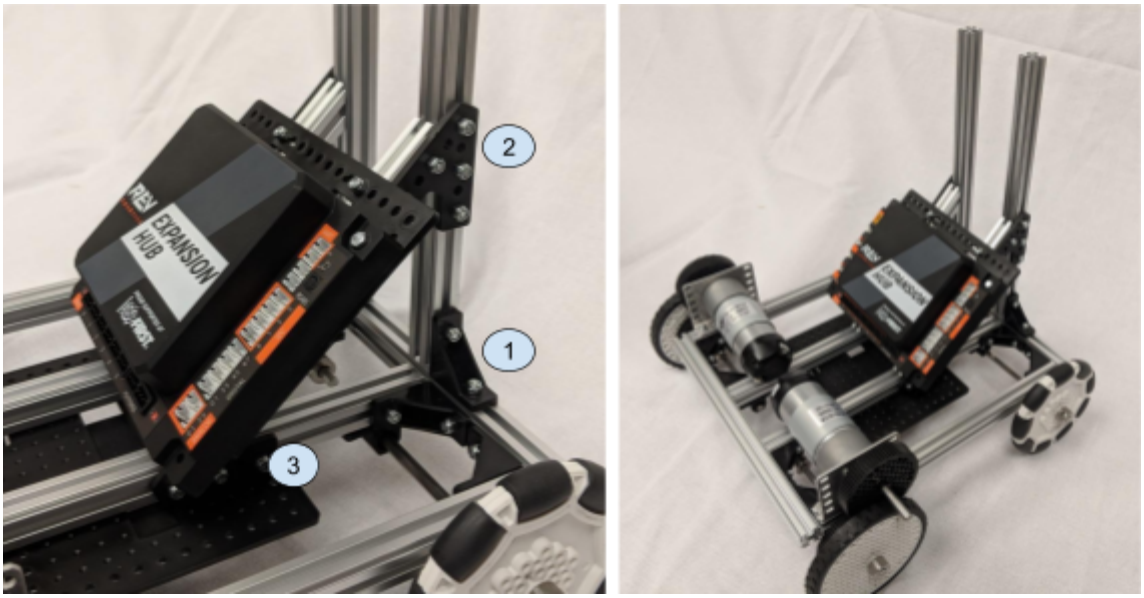


Step 15: Attach vertical risers

Hardware: 225mm extrusions (2x)

Instructions: Loosen the inside corner brackets as well as the 45 degree angle brackets to allow the upright risers to slide and adjust. Slide each of the extrusions onto the vertical legs of the 45-degree angle brackets on the angled riser supports, then continue onto the inside corner brackets on the front rail of the chassis. Once all is in place, start by tightening the inside corner brackets, then the 45 degree brackets on the upright rails, and finally the 45 degree brackets on the horizontal rails.



Step 16: Attach arm motor

Hardware: Core Hex Motor (1x), metal bent Core Hex Motor bracket (1x), 8mm M3 screws (4x), M3 nylon nuts (2x), 75mm shaft (1x), 45T gear (1x)

Instructions: Pre-load the bent Core Hex Motor bracket with 2 screws on the outside holes of the short leg. With the Core Hex Motor logo side up and horizontal, align the bracket with the mounting holes and screw into the top-left and bottom-right holes to secure. Slide a 45T gear onto a 75 mm shaft and slide the shaft onto the bracket side of the motor. Slide the mount onto the outside of the right upright rails and allow it to rest at the bottom of the rails to keep it out of the way for now.

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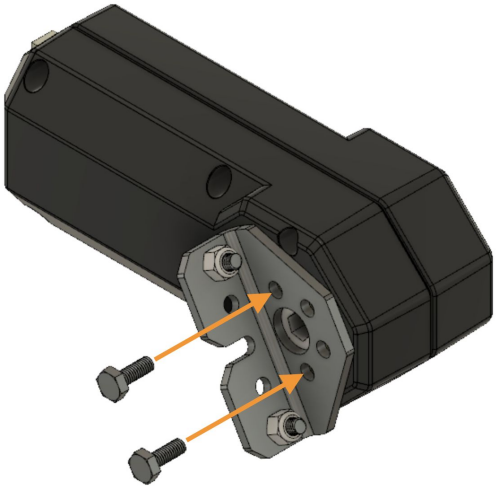
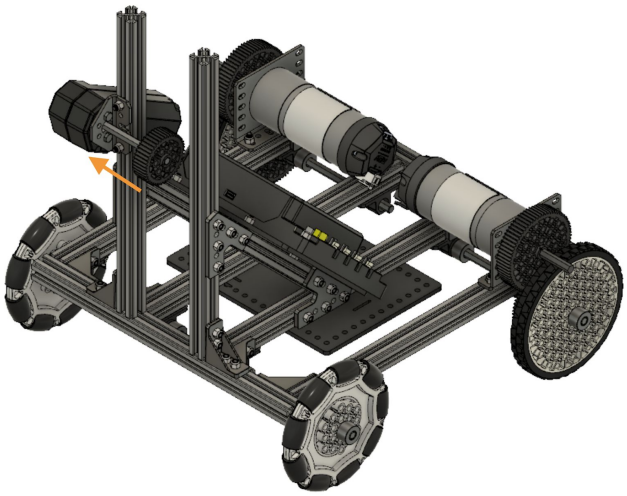
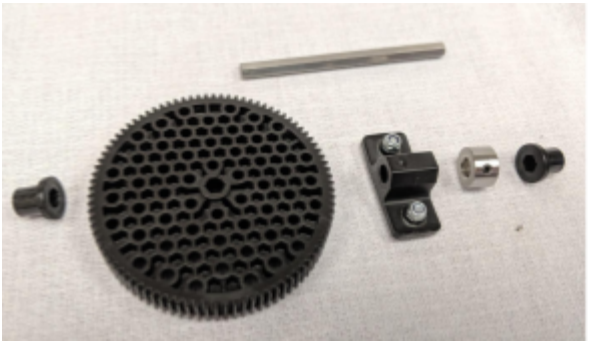




Step 17: Build arm assembly

Hardware: 75mm hex shaft (1x), 125T gear (1x), hex pillow block (1x), collar (1x), 8mm M3 screws (2x), M3 nylon nuts (2x), long through bore bearings (2x)

Instructions: Pre-load the hex pillow block. From left to right, load 75mm axle with 1 bearing (flange to the right), 125T gear, hex pillow block, collar, and the second bearing (flange to left). *Collar will tighten later



Step 18: Attach arm to risers

Hardware: 420mm extrusion (1x), bearing pillow blocks (2x), through bore bearing longs (2x), 8mm M3 screws (4x), M3 nylon nuts (4x)

Instructions: Slide the 420mm extrusion rail onto the hex pillow block, leaving the end of the extrusion just beyond the 125T gear and tighten. Place a bearing pillow bracket onto the bearings on either end of the shaft, and slide the bearing pillow blocks and arm assembly onto the front of the upright risers. Tighten the pillow blocks at the top of the upright rails, making sure the motor is below and gears are not yet connected. Push

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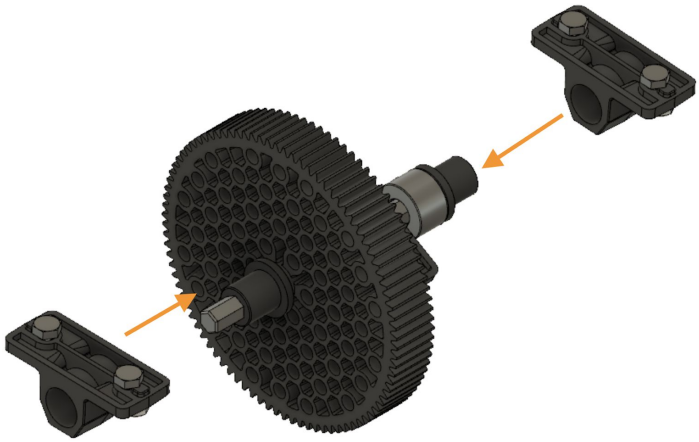
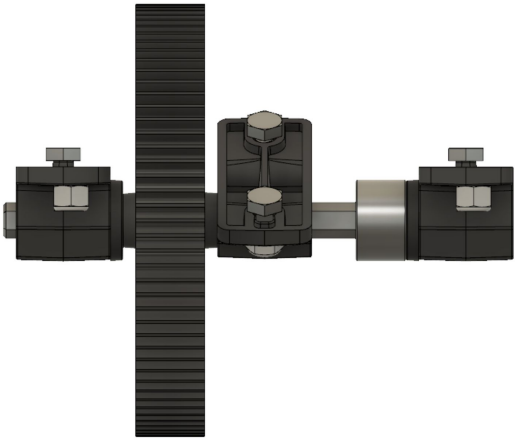
the collar against its bearing and right pillow block and tighten the collar. Finally, slide the arm motor up and secure such that the gears mesh.





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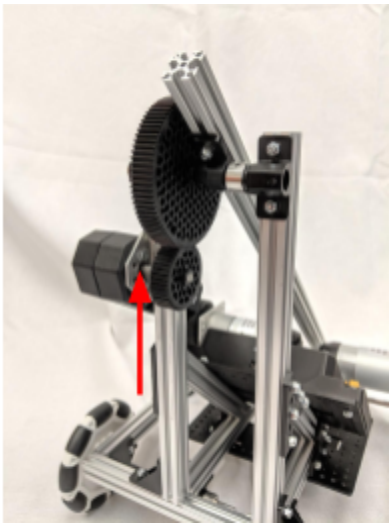
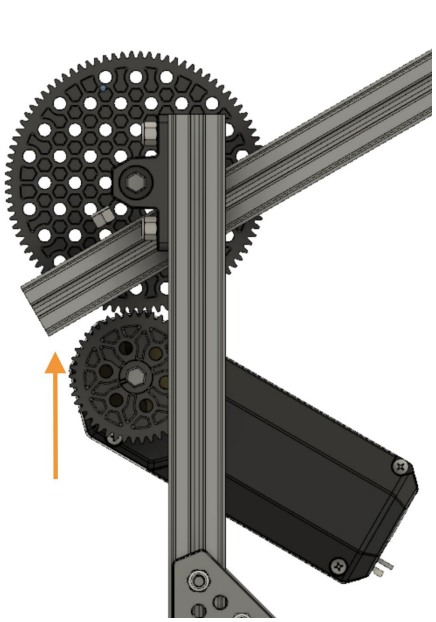
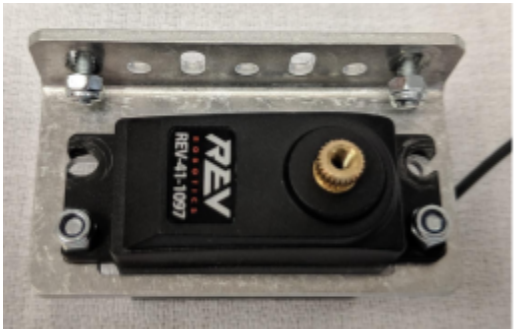
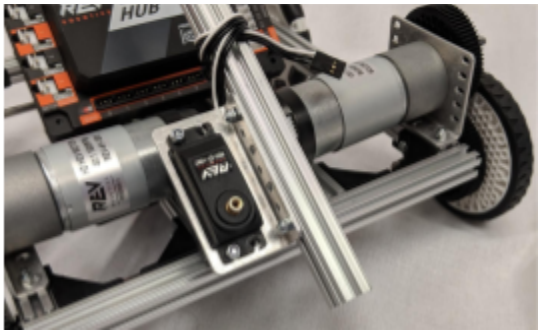




Step 19: Add servo assembly

Hardware: metal bent servo bracket (1x), smart robot servo (1x), 8mm M3 screws (4x), M3 nylon nuts (4x)

Instructions: Pre-load the servo bracket with screws and nuts on the outermost holes of the short leg of the bracket. Insert the smart robot servo into the bracket, attach the servo using two screws and nuts in the mounting holes farthest from the vertex of the bracket. Slide the assembly onto the end of the arm extrusion on the side of the rail away opposite the arm gear (at the top of the arm) and tighten. Gently wrap the servo wire to keep it out of the way until needed later.





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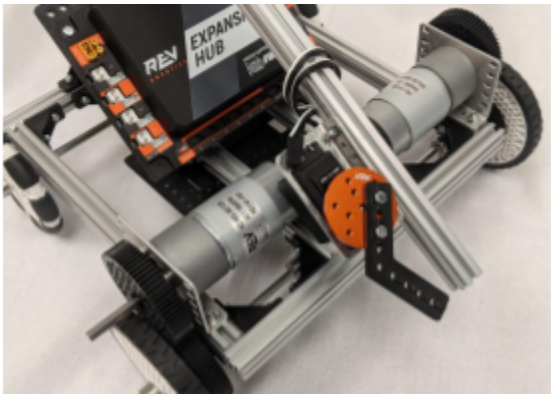
Step 20: Add servo grip

Hardware: aluminum servo horn (1x), 120 degree angle bracket (1x), 8mm M3 screws (2x)

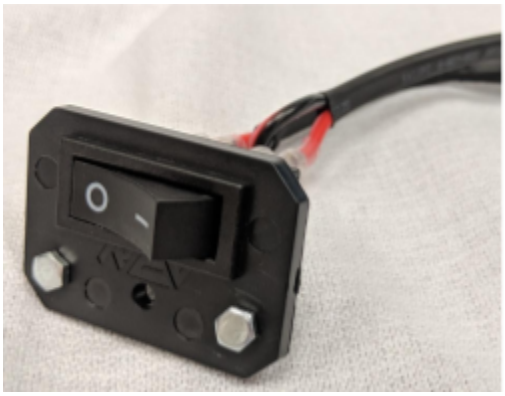
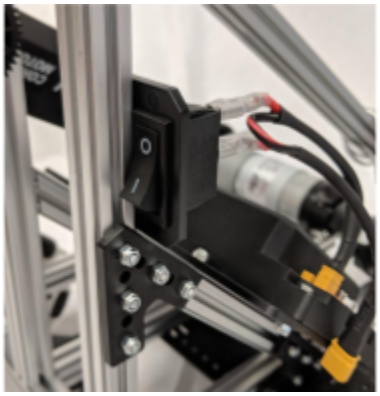
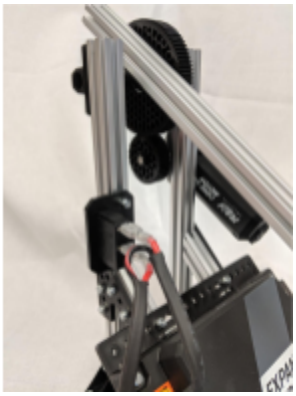
Instructions: Attach the angle bracket (alignment ribs up) to the servo horn using two M3 screws, then push the servo horn onto the spline of the servo.

Step 21: Add power switch

Hardware: Power switch (1x), 8mm M3 screws (2x), M3 nylon nuts (2x)

Instructions: Pre-load the power switch plate with screws on either end with screw heads facing the same side as the switch. Slide the power switch plate onto the rear of the upright extrusion rails. Plug in one of the yellow ends into a battery cable to know which end to plug into the hub. Detach the battery and plug the other end into the expansion hub and tighten down the power switch plate.

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Congrats! You've built the Class Bot!

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PART 2 - WIRING AND SENSORS

Step 22: Connect motors

Hardware: JST-VH 2-pin cables (3x), JST-PH 4-pin cables (3x)
Instructions: Loosen the motor mount and shift the motor towards the Control Hub enough to attach one end of the JST-VH 2-pin cable to the back of the HD Hex Motor. Then run the cable under the Control Hub and out the left side to plug into motor port 0. Next take a JST-PH 4-pin cable and plug into the back of the HD Hex Motor. Run the cable under the Control Hub and out the left side to plug into Encoder Port 0, below the Motor cable that was plugged in earlier. When both the motor and encoder are plugged in, move the motor mount back to mesh the gears. Repeat with the right HD Hex Motor and plug the cable into motor port 1. Attach a JST-VH 2 wire cable to the upright Core Hex Motor and run the cord under and out the left side of the Control Hub to plug into motor port 2. Take a JST-PH 4-pin cable and plug into the back of the Core Hex Motor. Run the cable under the Control Hub and out the left side to plug into Encoder Port 2, below the Motor cable that was plugged in earlier for the Core Hex Motor.

Step 23: Connect servo

Hardware: bearing pillow block (1x), 36" PWM cable (1x), painters tape, 8mm M3 screws (2x), M3 nylon nuts (2x)
Instructions: Pre-load the bearing pillow block and add to the arm extrusion, opposite the 125T gear, near where the arm joins the uprights. This pillow block will help hold the servo cable. Connect the 36” PWM cable to the servo cable with black wires matching (there is a correct and incorrect way to connect so double check this). Thread the PWM extension cable through the pillow block behind and under the Control Hub to connect to servo port 0 on the hub. Use painters tape or nylon zip ties to enhance cable management. Ensure the cord is secured away from the gears, but not taut to allow the arm to swing fully without pulling the servo cable.

Step 24: Limit switch paddle assembly

Hardware: 120 degree angle bracket (1x), inside corner bracket (1x), 8mm hex cap screws (2x), 16mm hex cap screws (2x), M3 nylon nuts (4x)
Instructions: With the alignment ribs of the 120 degree angle bracket facing down and the legs oriented downward, pre-load 8mm screws at the vertex hole and the bottom hole of the right leg. Attach the inside corner bracket to the 2 far left holes of the angle bracket using two 16mm hex cap screws.

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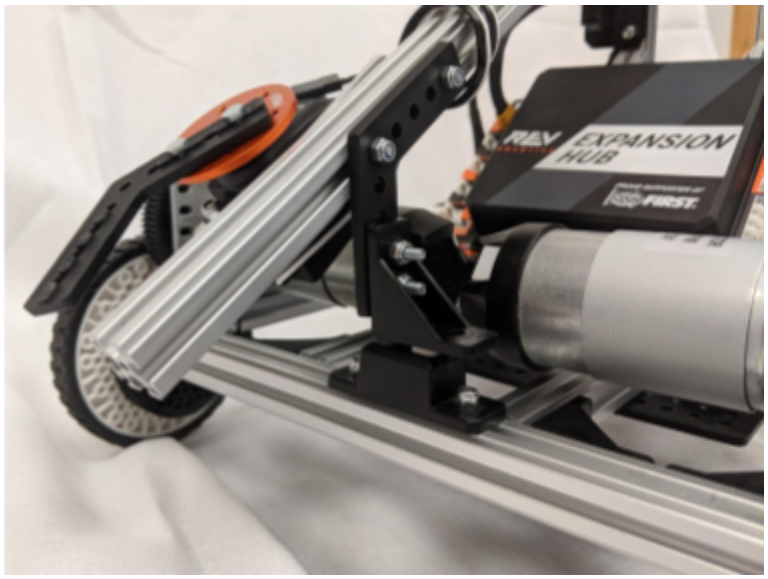
Step 25: Install limit switch and paddle assembly

Hardware: 4-pin sensor cable (1x), touch sensor (1x), limit switch paddle from step 25, 8mm M3 screws (2x), M3 nylon nuts (2x)
Instructions: Attach the touch sensor to the back rail of the robot with the white button pointed to the left.

There are at least two ways to attach the sensor to the rail without needing to move the driving wheels. The first way is to load two 8mm screws into the extrusion from the side, then place the sensor on top of the screws, add nuts, and tighten. The second way is to preload the screws onto the touch sensor (screw heads to the bottom of the sensor), then hold the sensor parallel to the left rear wheel and slide one of the screws a short distance into the extrusion. Then turn the sensor to be parallel with the extrusion and slide the second screw and the sensor into place.

Load the assembly paddle onto the arm rail (opposite side of the servo) and align the center of the paddle to activate the white button of the touch sensor. Thread the cable under the expansion hub and out the right side connecting to the digital port "0-1".



Step 26: After the build

You will not use all the parts in the kit for this build so expect to have pieces left over. This robot design is one of many possible designs you can build with the EDU Kit. Customizing your design is encouraged.

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