

LEGOLAS

Bridge

Instructions

Parts List

4 x



90-degree L-Bracket*

4 x



M3 – 6 mm Wing Bolt*

2 x



10 x 10 mm Profile – 75 mm
Anodized Aluminum T-slot
Extrusion*

28 x



M3 – 4mm Round-Head Bolt*

2 x



10 x 10 mm Profile – 300 mm
Anodized Aluminum T-slot
Extrusion*

32 x



M3 – T-Slot Nut*

*MakerBeam Product

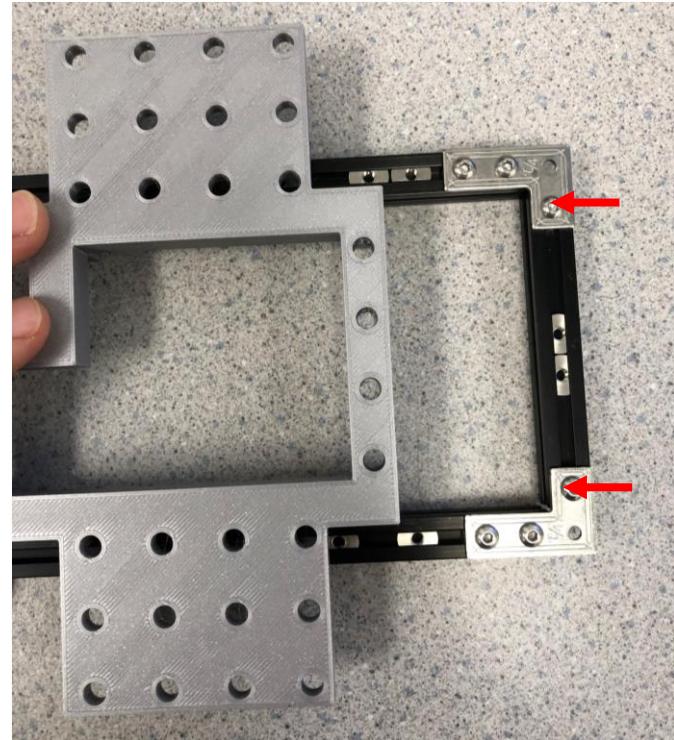
- You will also need a 2 mm Hex bit



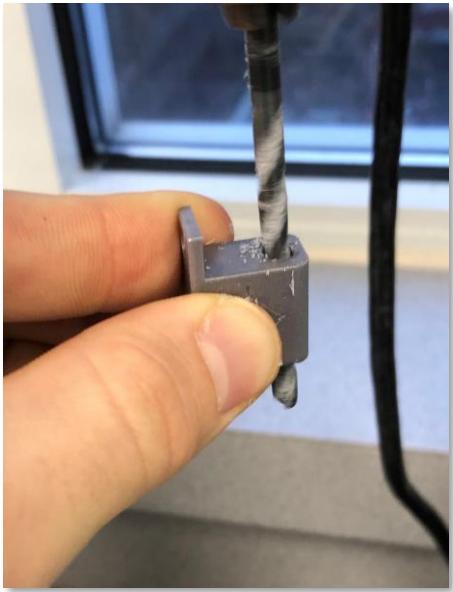
Slide two T-slot nuts into one of the 75 mm extrusions (*left*) and connect the short arm of two L-brackets to these nuts (w/ M3-4mm RH Bolts) so that they extend at a 90-degree angle (*middle left*). Line up two 300 mm extrusions, each with two more T-slot nuts near the end (*middle right*) and fasten these to the L-bracket with M3-4mm RH Bolts as well (*right*). Do not overtighten connections, so that they



Add 8 T-slot nuts into each 300 mm extrusion, keeping two separate for fastening the next two corner brackets (*left*). Line up a 75mm extrusion to the right side of the assembly, ensuring it has 4 T-slot nuts in one of the slots (*middle*). As in the step before, fasten these brackets with M3-4mm RH Bolts (*right*). You should now have a rigid rectangle assembly. Again, do not overtighten the connections as we will adjust them in the following steps.



To adjust the rectangular assembly is the correct length, place it on the assembled stand to see if it is the same length (*left*). If not, loosen the screw pairs along the horizontal beams in the 4 corners till it is the correct width and re-tighten the screws (*red arrows in left picture*). To make sure the assembly is the correct width, use the 3D printed trolley frame as a stencil, loosening the screws shown in the right picture and re-adjusting the frame width until the trolley can slide freely (with still less than 2 mm extra space) along the entire bridge length (*right*). When making length and width adjustments, try to do so symmetrically on both sides.

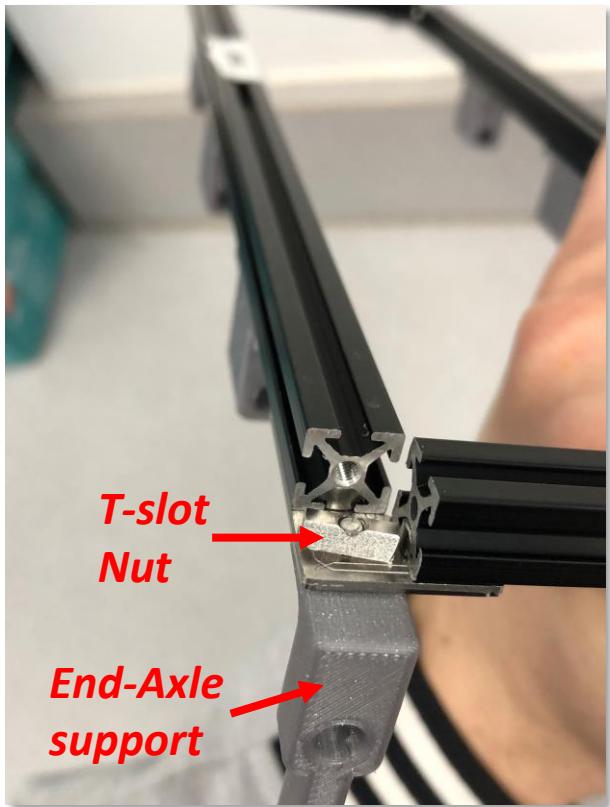


(left) Use a 3/16" or 5 mm drill bit on a drill press to bore out the axle holes on the mid-axle supports

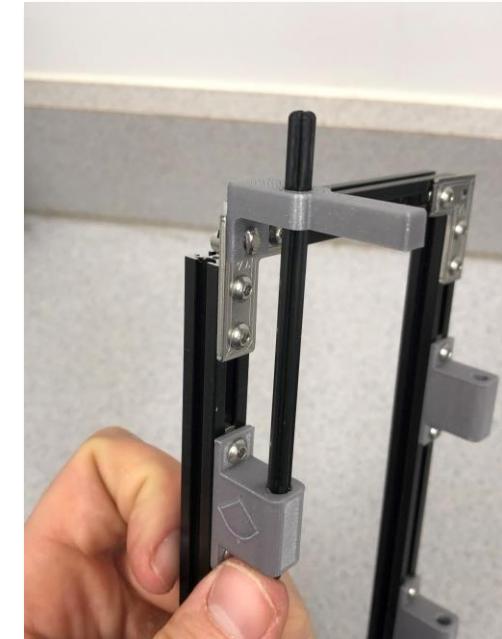
(mid-left) After this step, the hole profile should be more circular. Test that a technic axle can slide freely within the shaft

(mid-right) Aline the 3D printed supports with two of the T-slot nuts on one of the 300mm extrusions.

(right) Fasten each with two M4-4mm RH Bolts. Repeat this for 3 mid-axle supports on each side (6 total). Space them out evenly for now. Do not overtighten the joints as we will adjust them later.

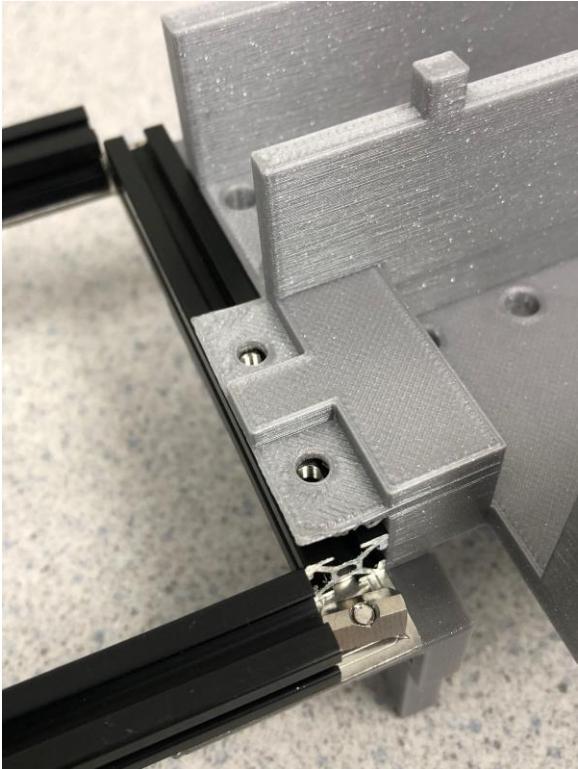


In the next steps, we will be installing the 3D end-axle supports on the 4 corners (where the last empty L-bracket holes are) using T-slot nuts and M3-6mm Wing Bolts (*left*). To begin, if any of the corners have a 75mm extrusion encroaching on the space where we will be rotating the T-slot (*as shown in the middle picture*), we will need to move that out of the way. If this is the case, loosen the bolt shown in the picture on the right, and slide that extrusion away to make space. Re-tighten after sliding away so that it doesn't come completely off the bracket. You can re-adjust the bridge width with the 3D printed trolley stencil again after we have installed the end-supports.



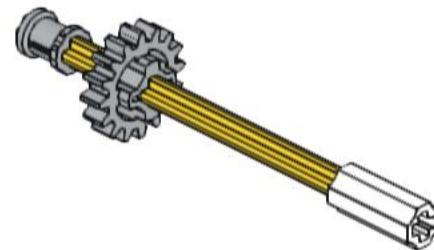
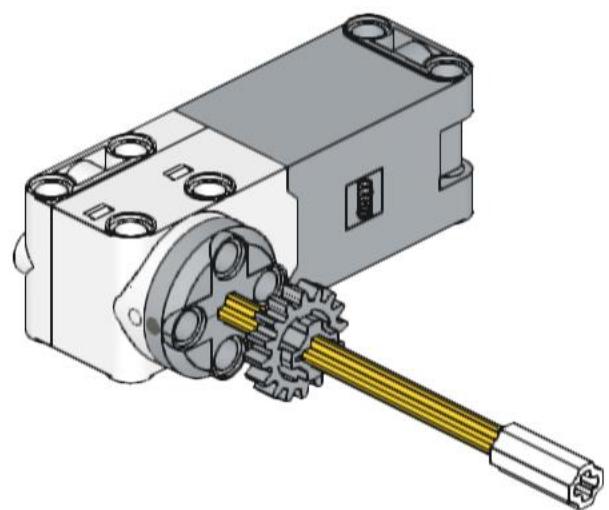
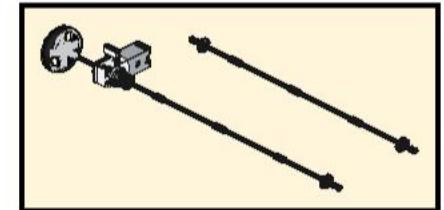
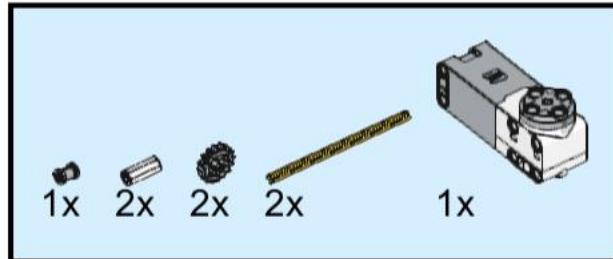
Insert an M3-6mm Wing Bolt through the End-axle support and empty L-bracket hole (*left*) so that the thread is sticking through to the other side (*mid-left*). Place a T-slot nut on this thread (with the flat side facing the L-bracket) and turn it until the End-Axle support is snug against the L-Bracket (*mid-right*). Ensure that the End-axle support is in the correct orientation by sliding a LEGO Technic, 12L axle through the axle hole and a mid-axle support and checking that it can rotate freely (*right*).

Repeat in each corner (4 times) and then make any necessary width adjustments to the bridge frame.



We will now install the 3D printed Side Assembly. Place this on the 75mm extrusion with the extra 2 T-slot nuts on the bottom. Add another 2 T-slot nuts to the top slot of this extrusion, align with the holes on the 3D printed part, and fasten using M3-4mm RH Bolts (*left*). Next, flip the assembly over, align the 2 T-slot nuts that we had placed before with the two bottom holes, and fasten these with the same type of bolts (*right*). Do not overtighten the bolts or they can puncture through/crack the thin 3D printed portion.

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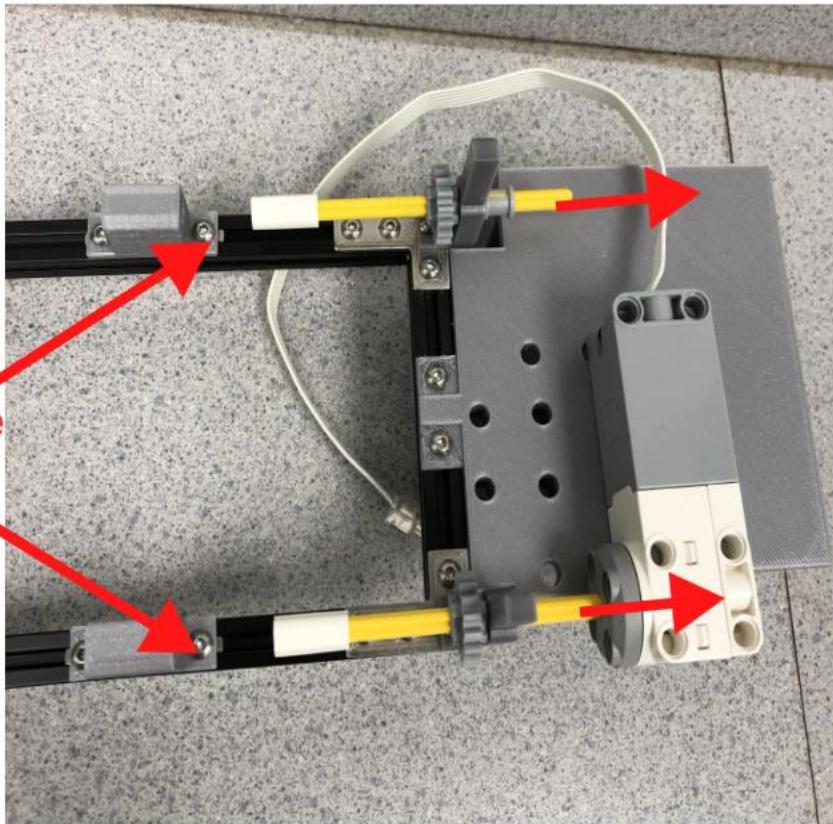


Powered Axle

Unpowered Axle

See next page for installation instructions

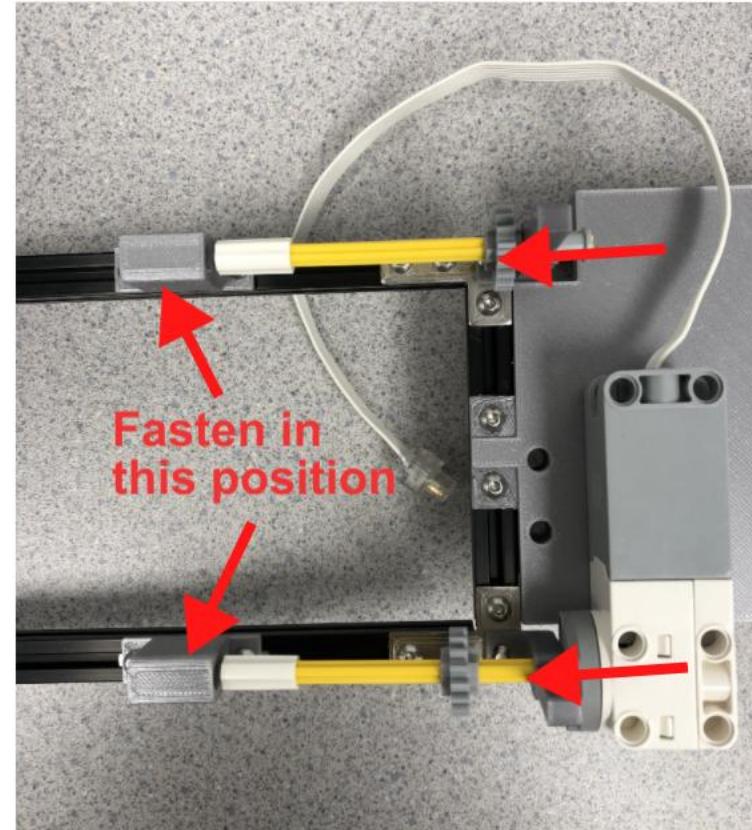
Expose
these
bolts



Assemble the LEGO pieces so that the axle runs though the End-axle supports nearest the 3D printed Side Assembly.

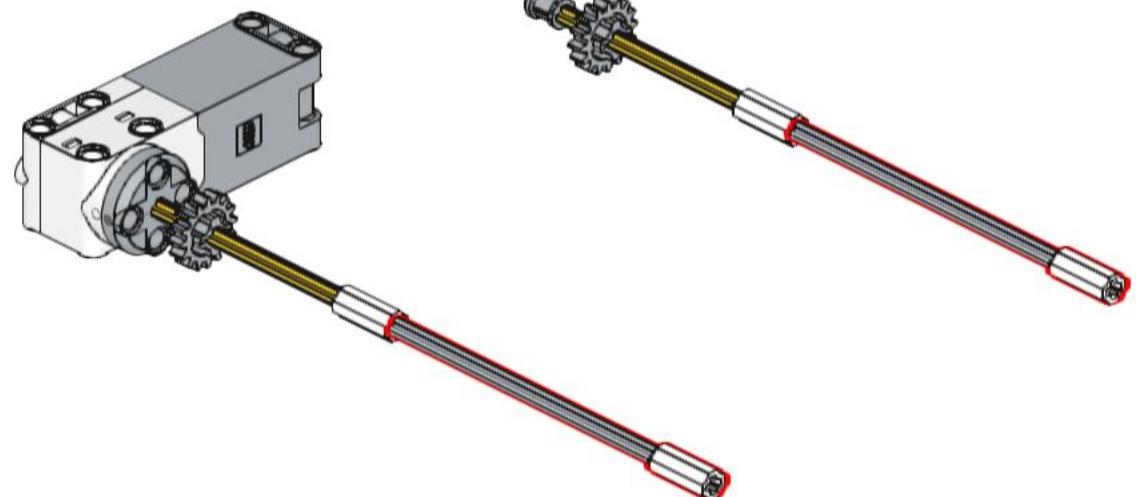
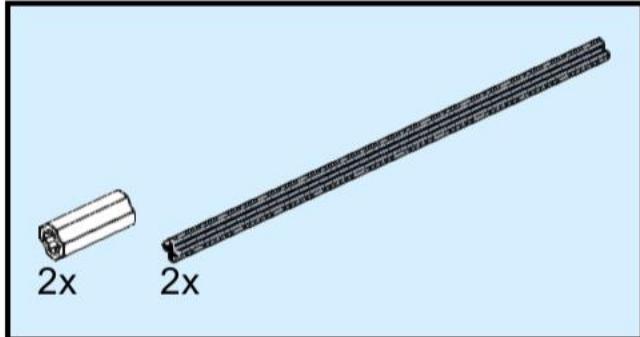
Slide the axles & motor back about 1 inch to the right to expose the bolts that hold down the mid-axle supports.
Loosen these so that the mid-axle supports can slide freely.

Fasten in
this position



Push the axles back to the leftmost position, and slide the mid-axle supports up to meet them. This is where you should fasten the mid-axle supports. Slide the LEGO axles back to the right to make space for your tool, and fasten the mid-axle supports down

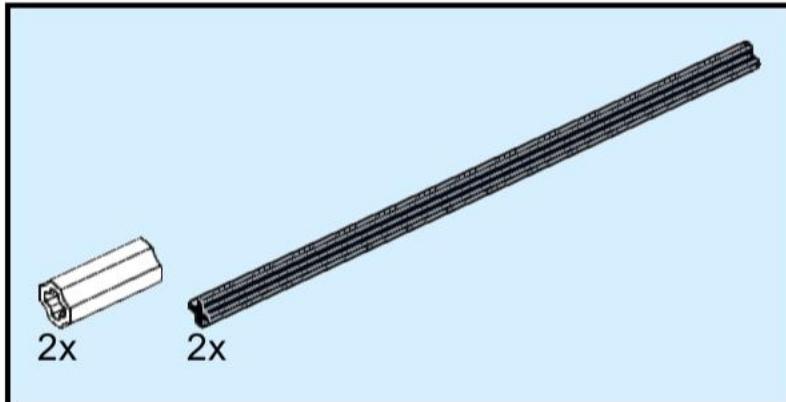
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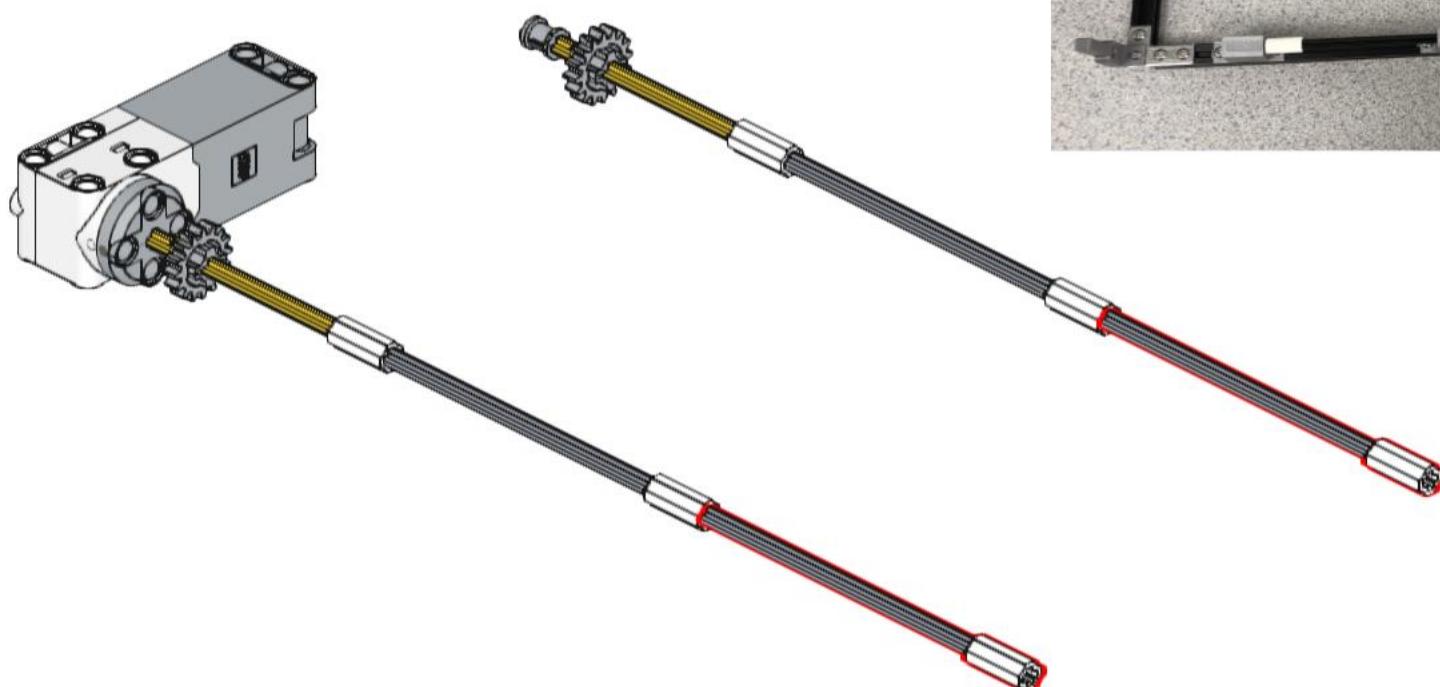
Slide the Technic, 12L axles in to through the opposite end-axle supports to get them in position

Use the same technique as the last step (slide motors and axles to the right to make space for new axle, loosen mid-axle supports, slide motor and axle back over, align mid-axle supports to correct position, slide motors back to the right, fasten mid-axle supports in position) to add another round of axles and axle connectors

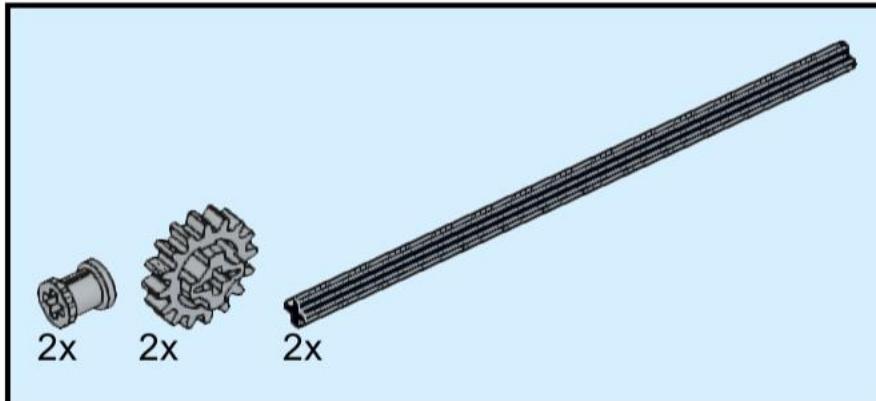
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Repeat this process again

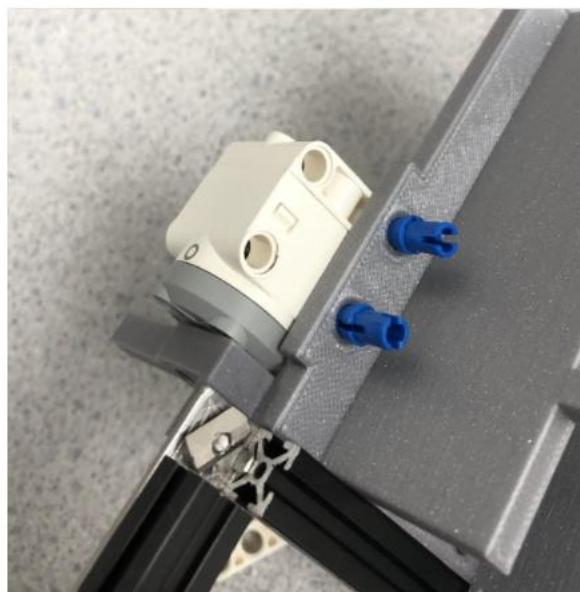
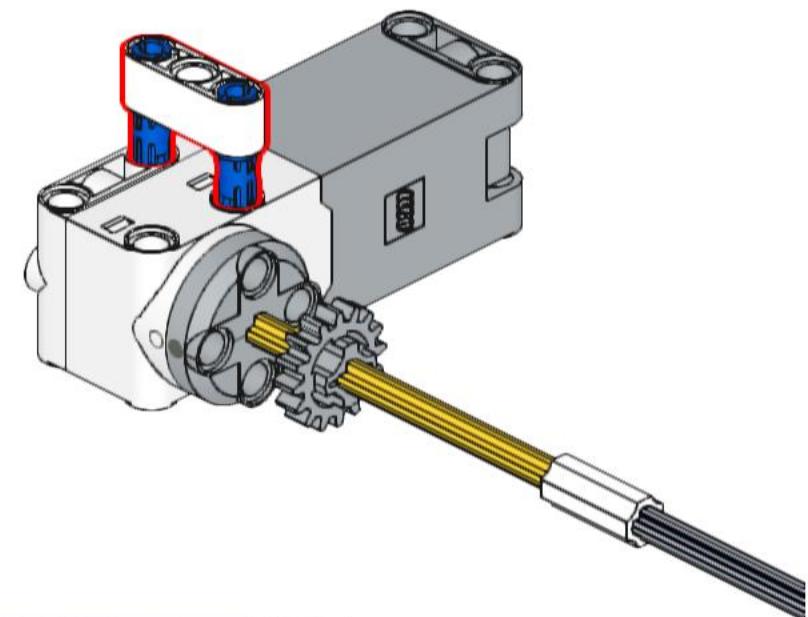
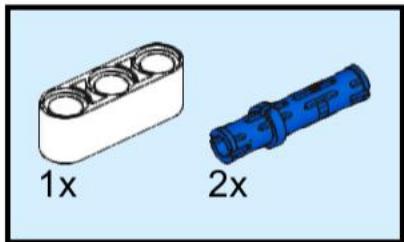


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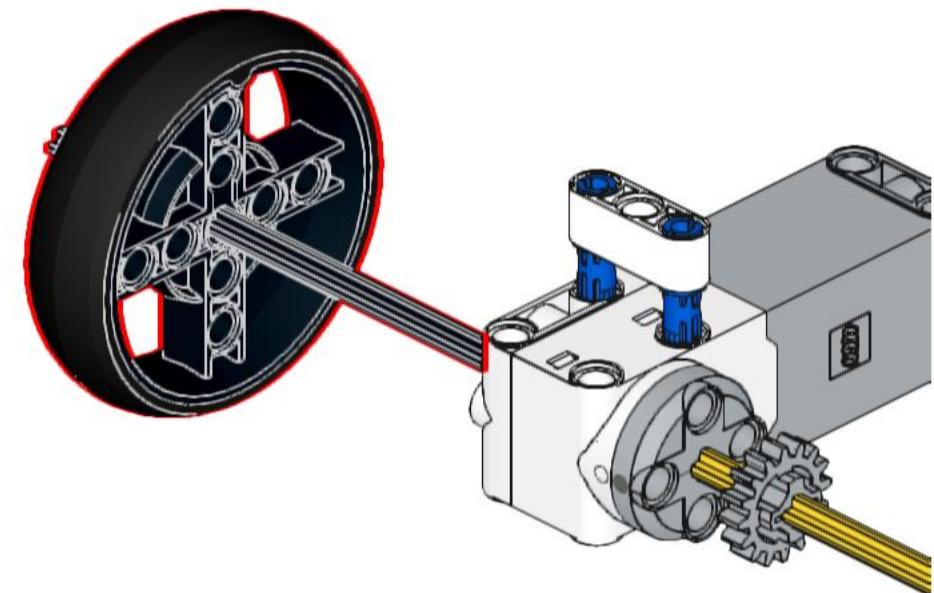
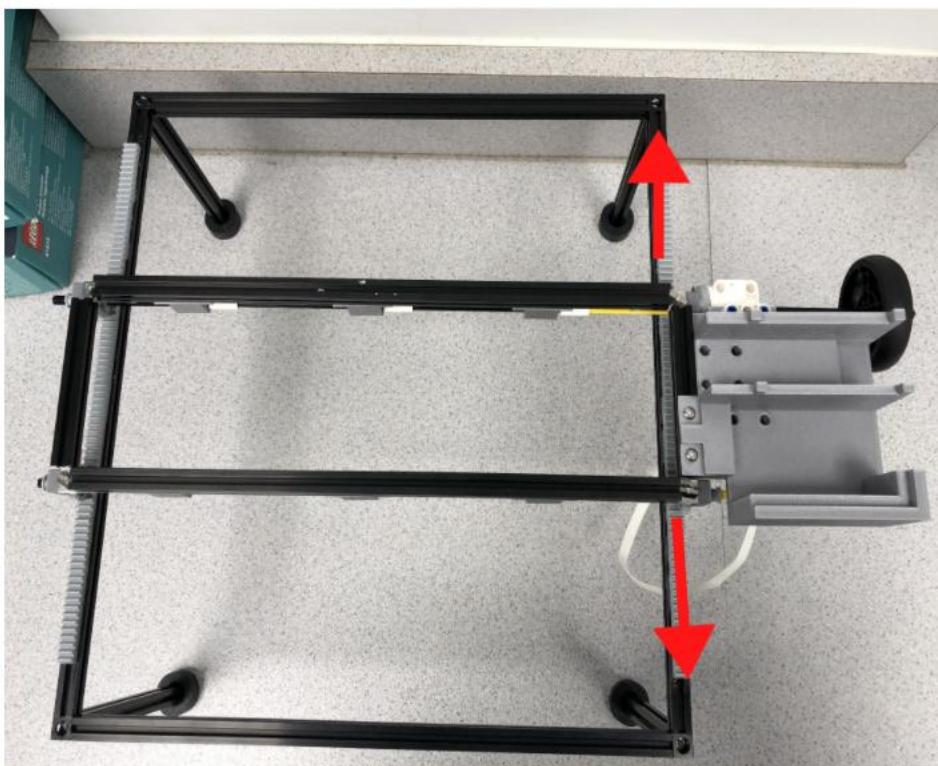
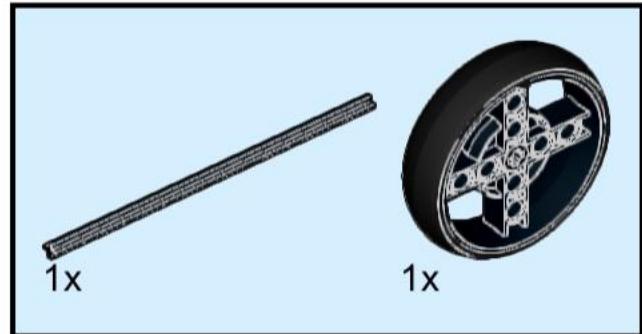


Insert the final two axles in through the leftmost end-axle supports, this time leaving the motors and axle assemblies all the way to the left for the entire step. Add on the Technic, Bush pieces to secure the powered and unpowered axles in place. In the next step we will connect the motor to the Side Assembly

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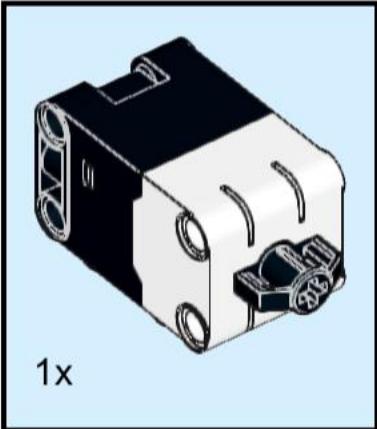


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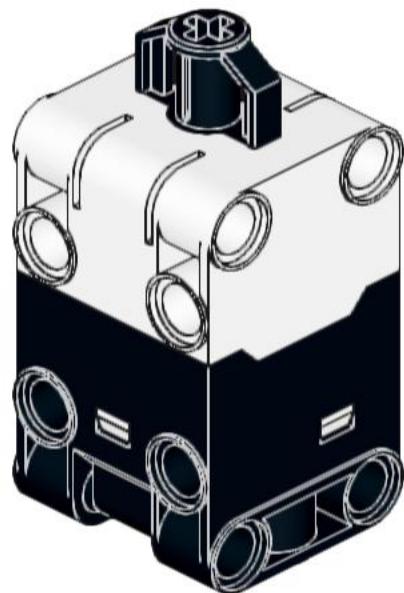


After placing on the stand, the grey gears should align with the teeth of the gear rack, and turning this black wheel should allow the cart to move up and down in the Y-direction

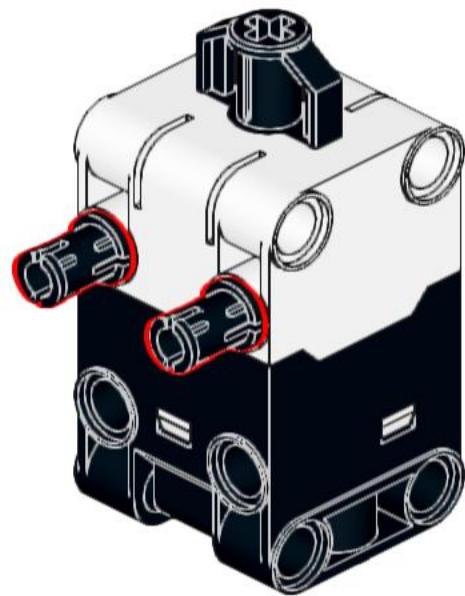
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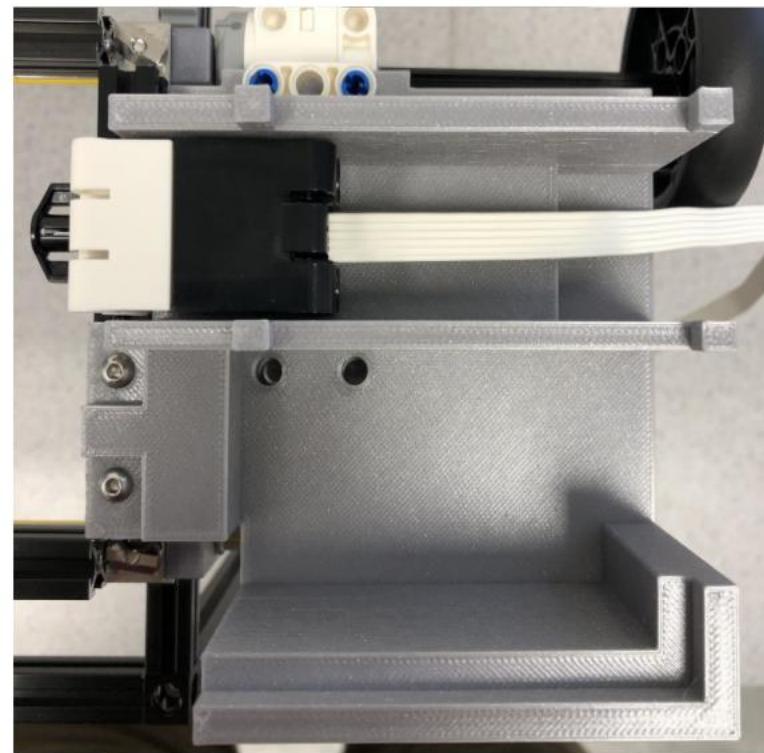
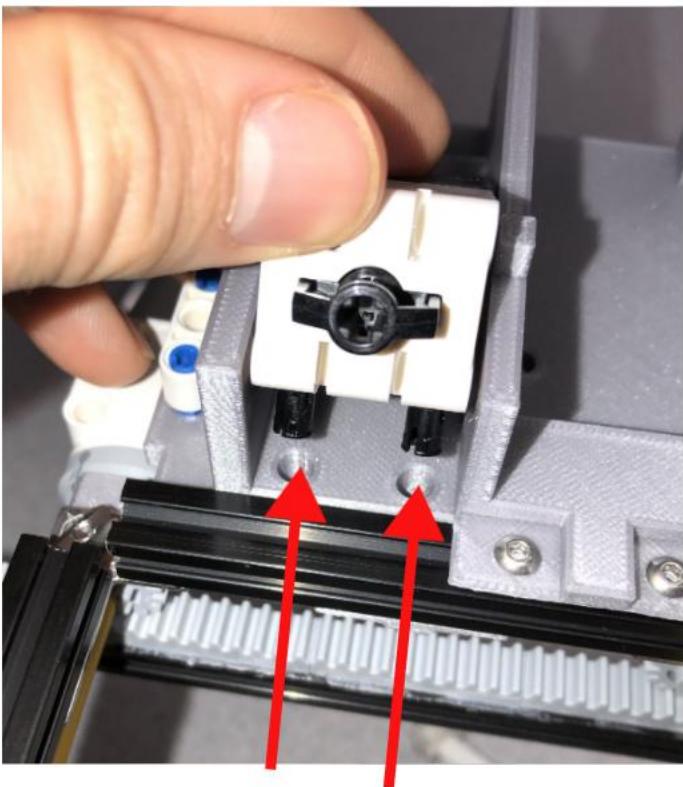


1x

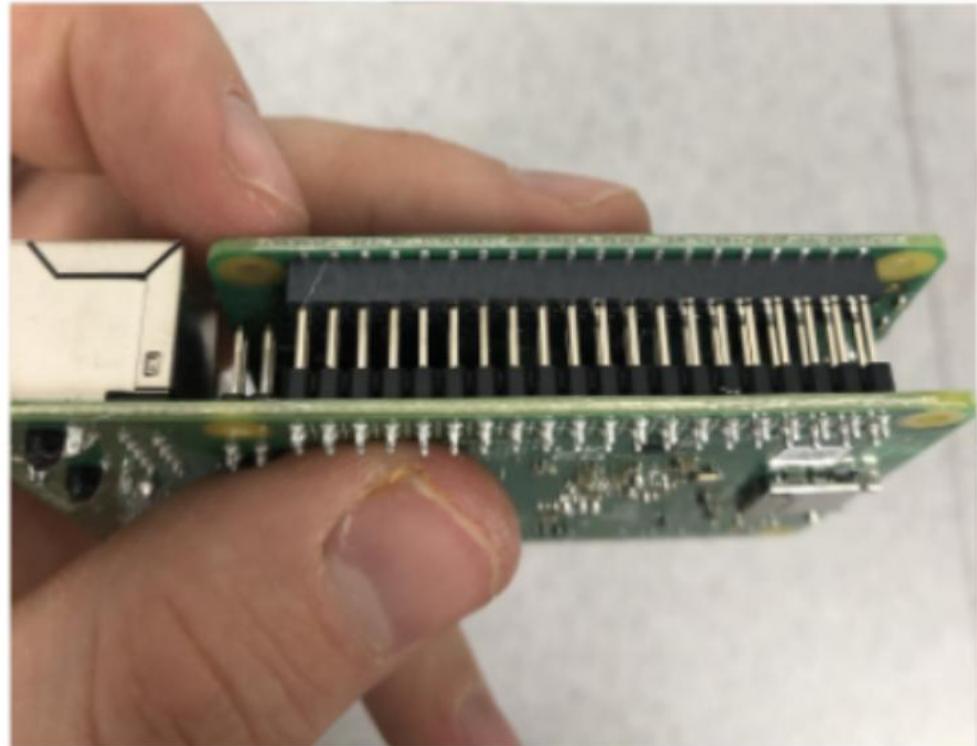


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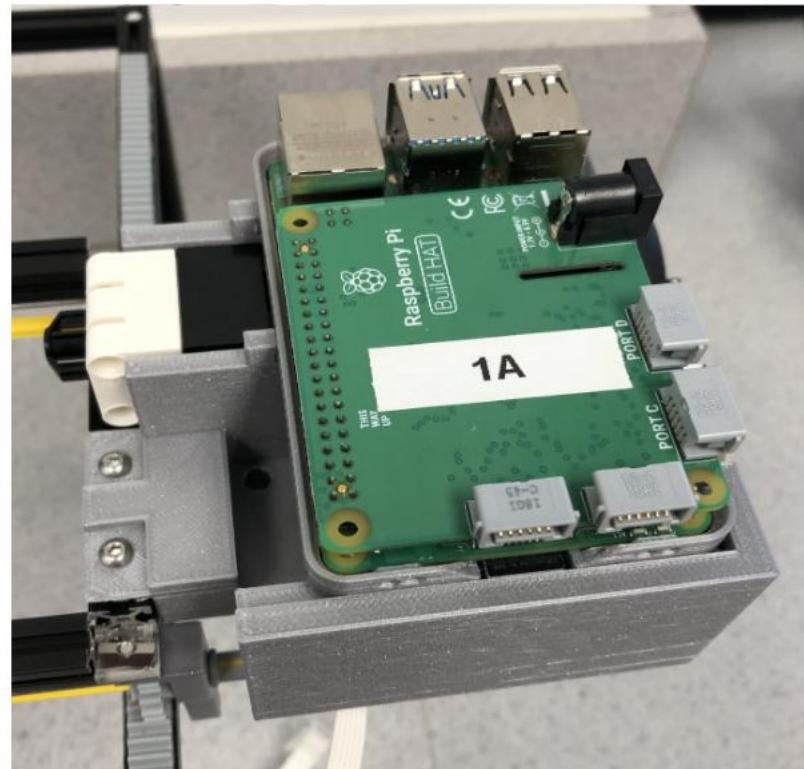




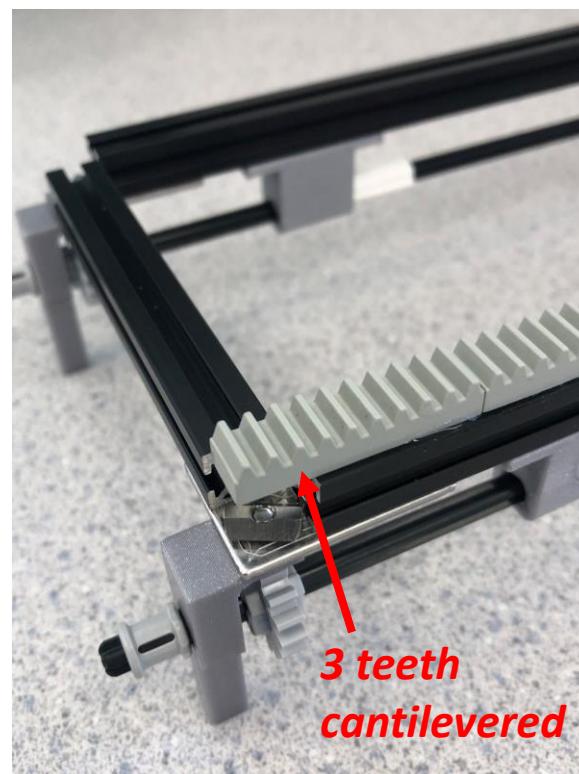
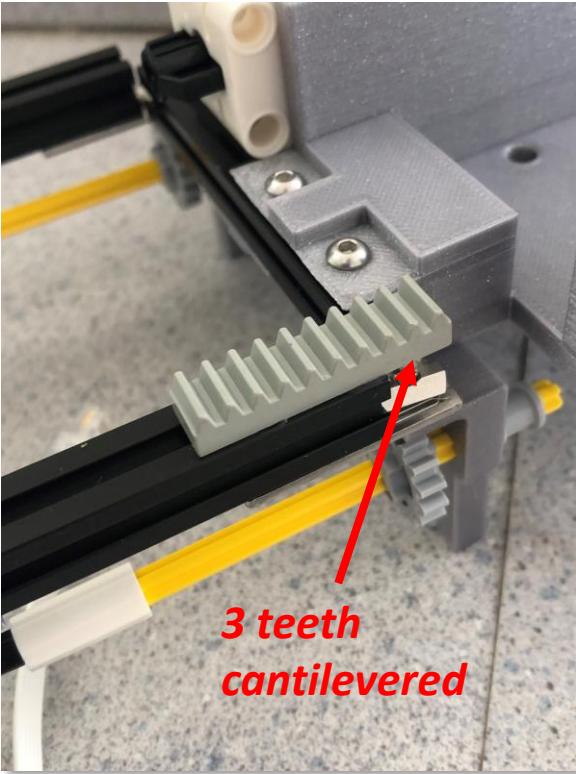
Align the two black pins with the front holes found on the Side Assembly (left) so that the push sensors is in the proper position (right)



Gather R-Pi and Buildhat, and align pins as shown in the image on the right, then push them all the way in.



Place the R-Pi + BH into the 3D printed holder (left) and place into the space on top of the Side Assembly with the proper orientation (right).

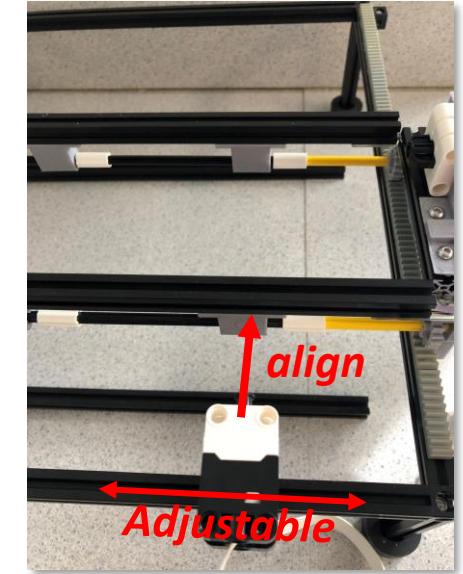


(left) add about a 1" strip of superglue on both sides of the channel on the end of a rack extrusion.

(mid-left) add a rack piece, with about 3 teeth that hang over the edge of the extrusion. Ensure it is aligned parallel to the extrusion and centered along the channel running down it.

(mid-right) Wait about 30 seconds before placing the next piece and repeat this process until you have placed all the pieces along the rack. At the end, there should be about another 3 teeth hanging over the edge.

(right) repeat again for the other extrusion so there are rack pieces on both sides.



(left) place the bridge on the stand and ensure it can move properly when turning the y-axis manual motor gear.

(mid-left & mid-right) move the bridge all the way to the highest y-position (farthest away from the y-axis push sensor) and ensure that the end stops prevent it from falling off the tracks. If they do not, adjust the corner cubes to move the end-stops in*.

(right) now move the bridge towards the lowest y-position (close to the sensor) and ensure that the sensor plunger is aligned with the center of a mid-axle support on a bridge. If not, adjust the y-axis sensor holders that are attached to the frame.

*Tip: When using the robot for experiments, you can verify that the bridge is perfectly perpendicular to the y-axis by lining it up along these end stops prior to calibration