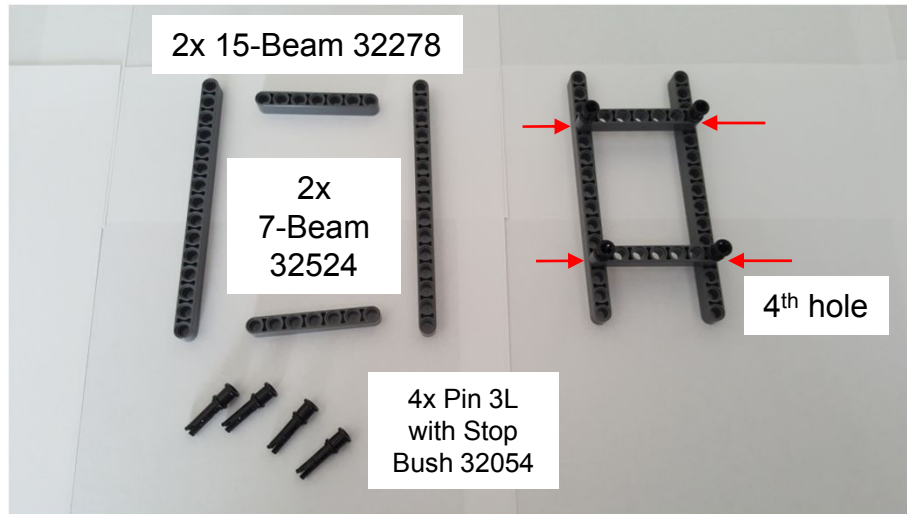
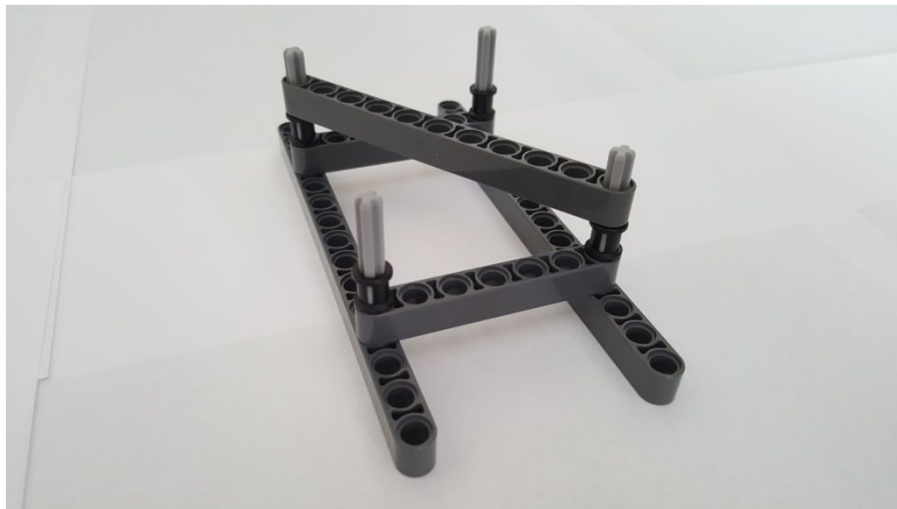


Step A: Truss Sub-Assembly

Step A-1: Lower Truss



Gather parts (left). Insert two Pin 3L at each end of 7-Beam. Repeat with other 7-Beam. Connect 7-Beams to 4th hole of 15-Beam. Finished step (right)



Gather parts (left). Insert a 3-Axle in each Pin 3L's Stop Bush. Lay 11-Beam diagonally across 3-Axles. Finished step (right)

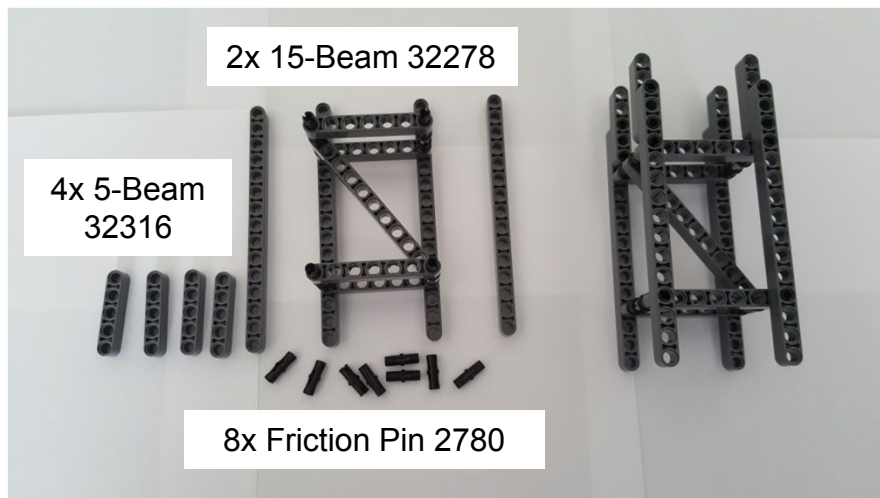
Close-up of Finished step



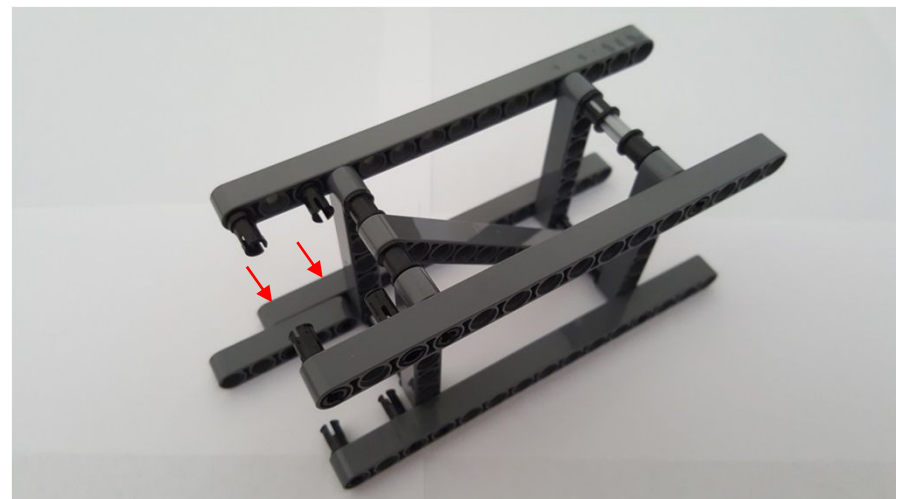
Gather parts (left). Insert each Pin 3L Stop Bush over the 3-Axle. Connect 7-Beam over each Pin 3L. Finished step (right)



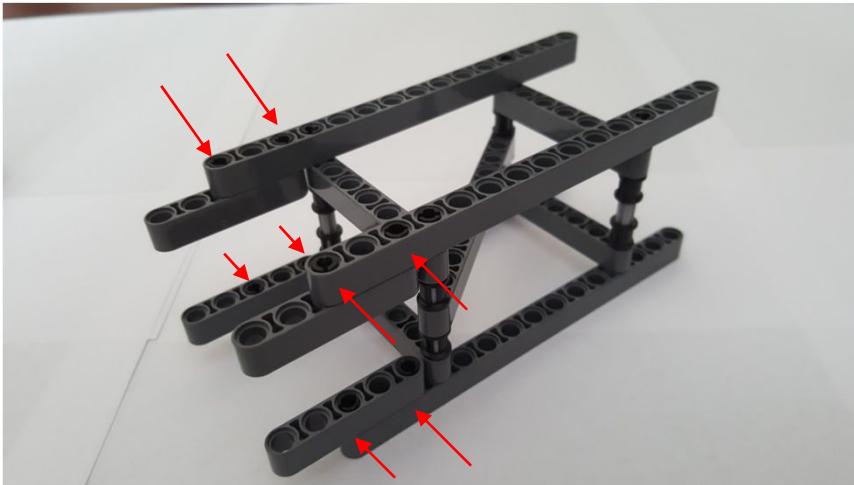
Close-up of Finished step



Gather parts (left). Connect 15-Beams over Pin 3L. Connect 5-Beam to 15-Beam with Friction Pins. Finished step (right)



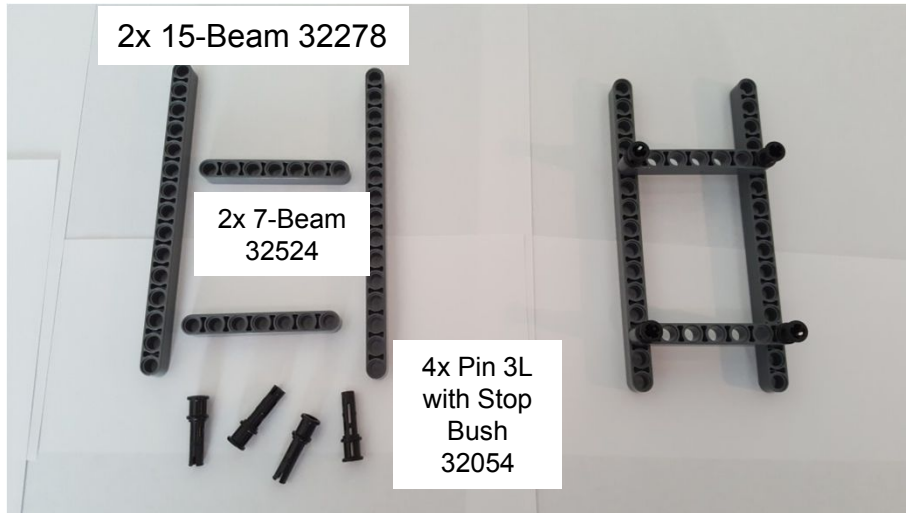
Close-up: Red arrows show where Friction Pins are inserted into 15-Beam and 5-Beam. The remaining 6 Friction Pins are also seen



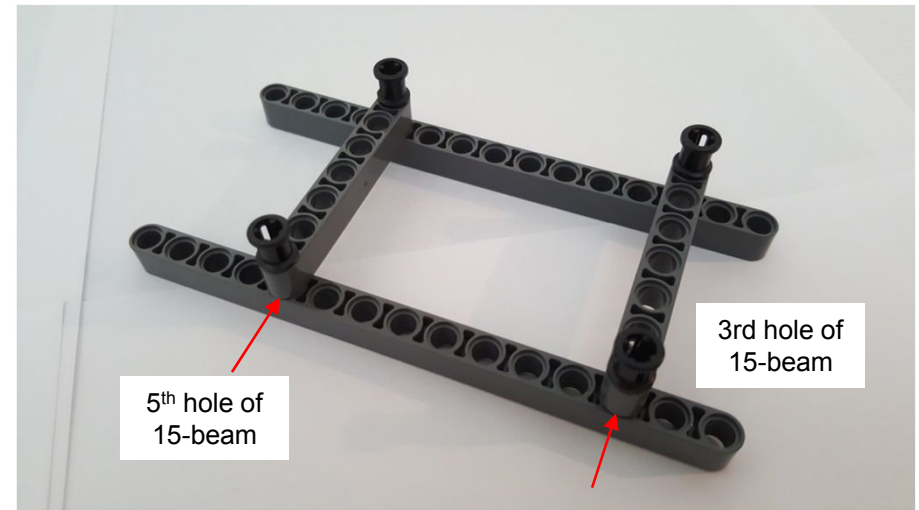
Close-up of Finished brace. Red arrows point to locations of Friction Pins to connect 5-Beams to 15-Beams

Completed Lower Truss

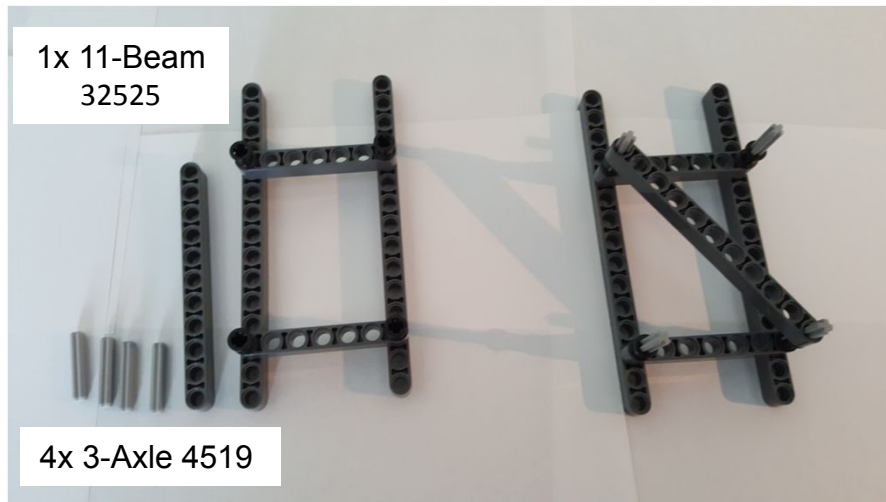
Step A-2: Middle Truss



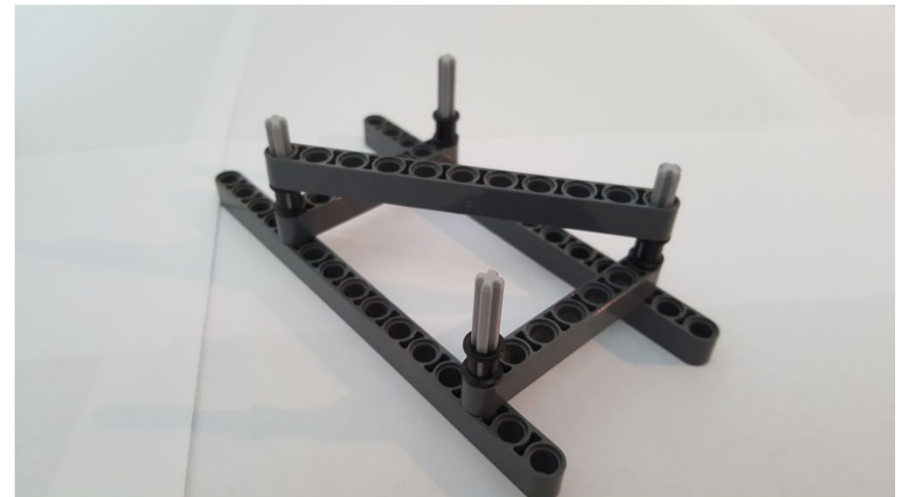
Gather parts (left). Insert two Pin 3L at each end of 7-Beam. Repeat with other 7-Beam. Connect 7-Beams to 3rd and 5th holes of 15-Beam. Finished step (right)



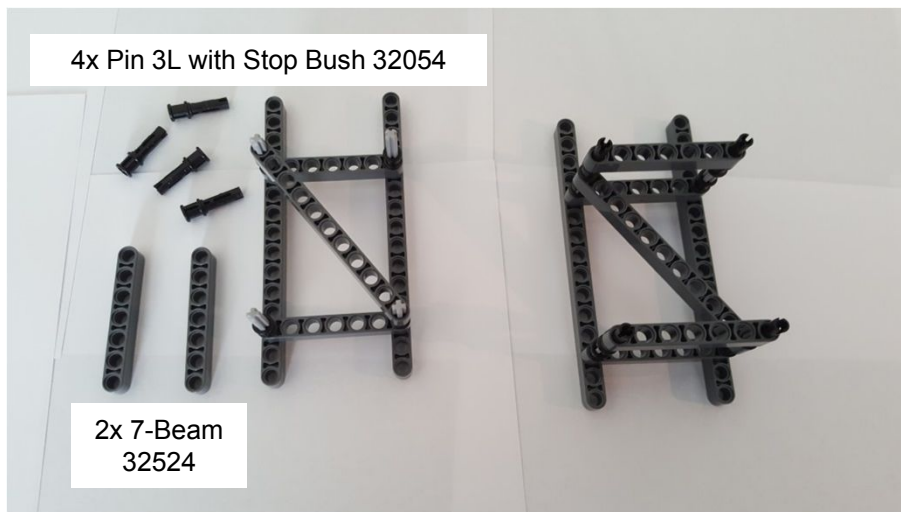
Close-up of finished step



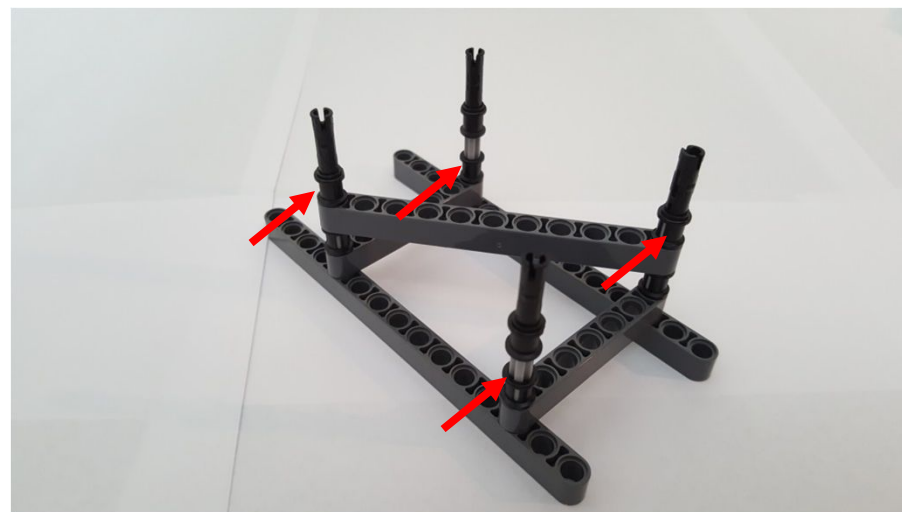
Gather parts (left). Insert each 3-Axle into each Pin 3L's Stop Bush. Diagonally lay 11-Beam over Axles



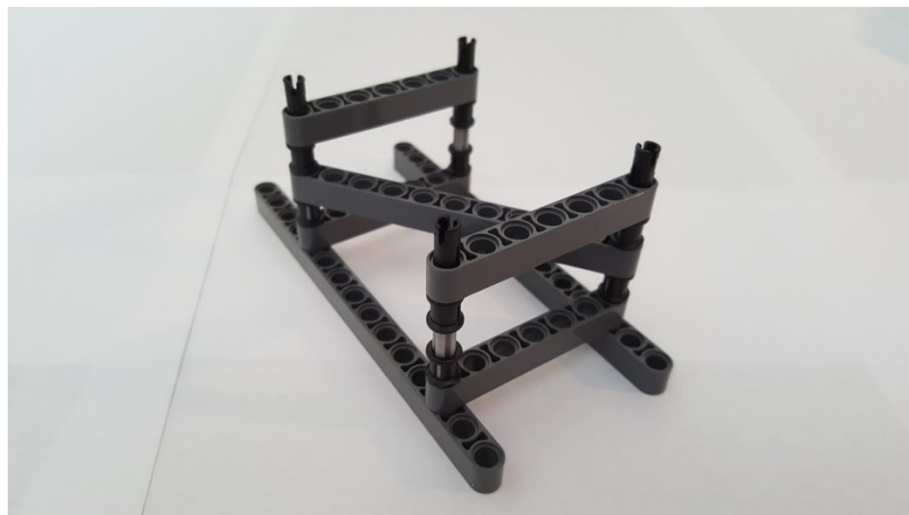
Close-up of finished step



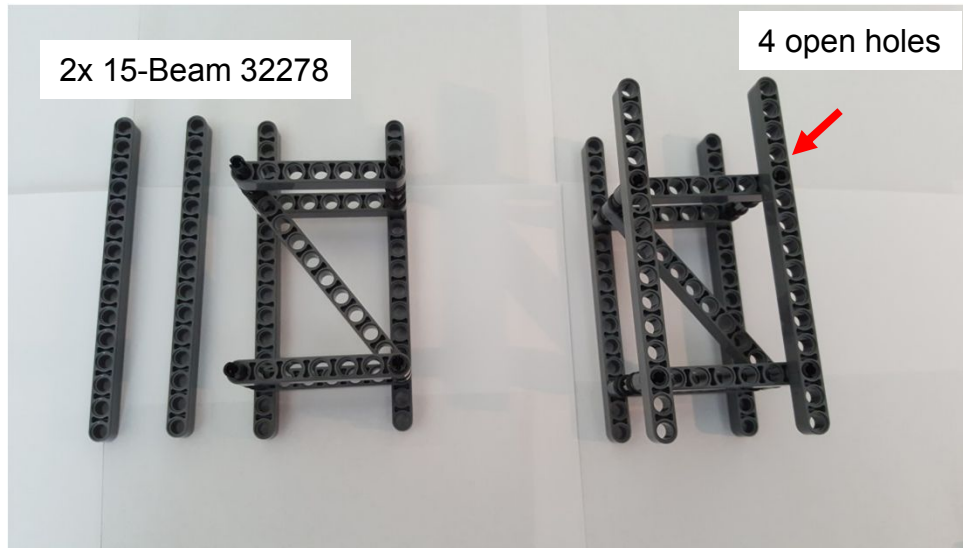
Gather parts (left). Insert each Pin 3L's Stop Bush into 3-Axle. Insert 7-Beam over Pin 3L peg. Finished step (right)



Close-up: Red Arrows show a Pin 3L's Stop Bush inserted over a 3-Axle.



Close-up: 7-Beam inserted into Ping 3L



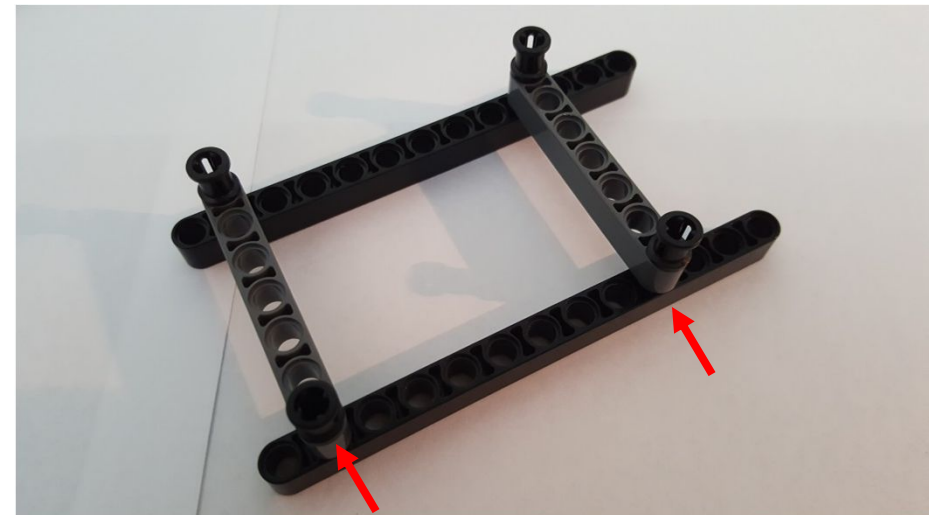
Completed Middle Truss
(NB: Has 4 open holes in 15-Beam)

Gather parts (left). Insert 15-Beam over Pin 3L pegs.
Finished step (right)

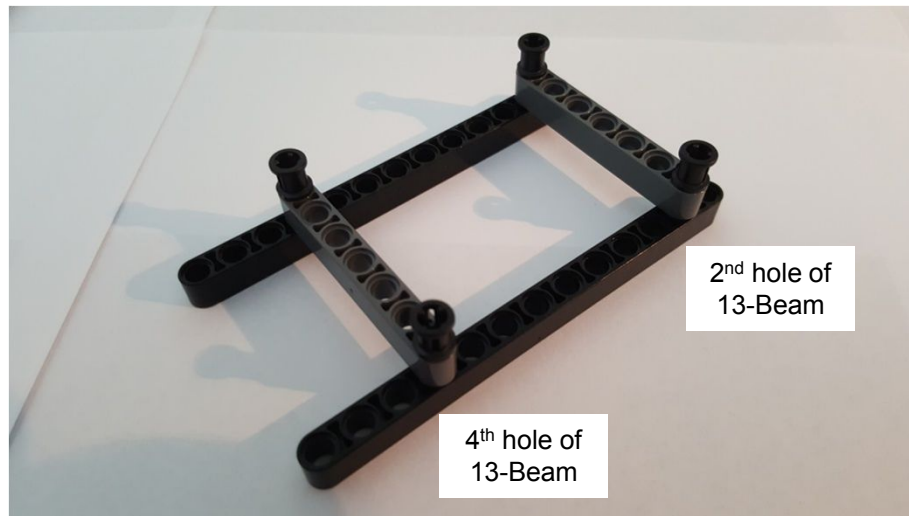
Step A-3: Upper Truss

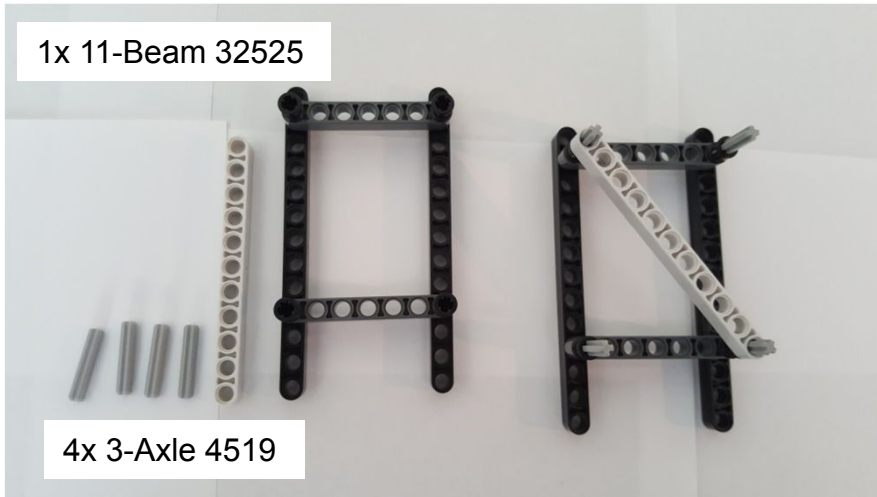


Gather parts (left). Insert two Pin 3L at each end of 7-Beam. Repeat with other 7-Beam. Connect 7-Beams to 2nd and 4th holes of 13-Beam. Finished step (right)



Close-up: Red Arrows show Pin 3L inserted into 2nd and 4th holes of 13-Beam





Gather parts (left). Insert 3-Axles into Pin 3L's Stop Bush. Lay 11-Beam diagonally across. Finished step (right)

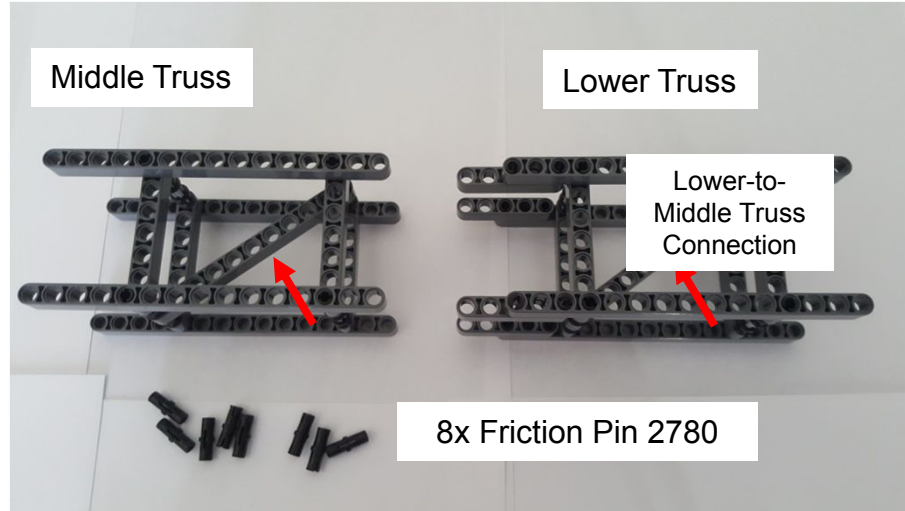
Gather parts (left). Insert Pin 3L's Stop Bush onto 3-Axles. Insert 7-Beams onto Pin 3L's pins. Finished step (right)



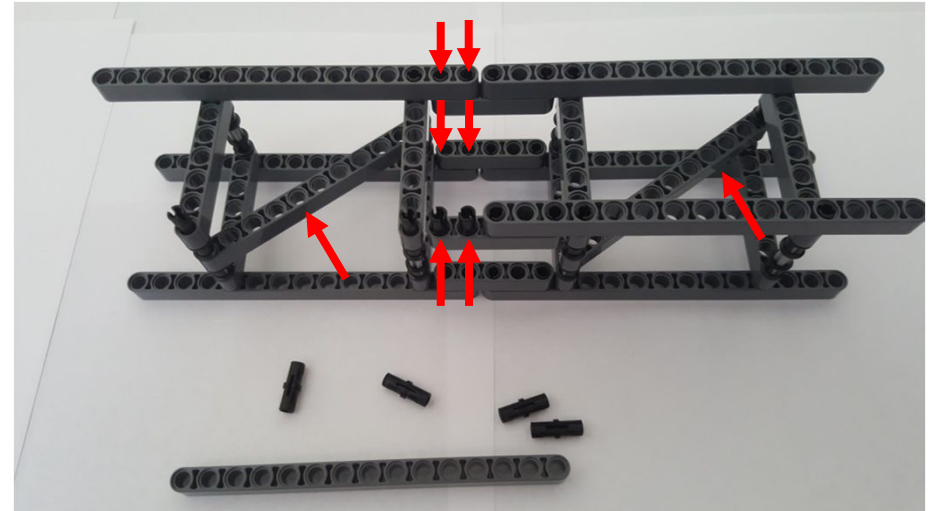
Gather parts (left). Insert 13-Beams over Pin 3L's pins. Finished step (right)

Completed Upper Truss

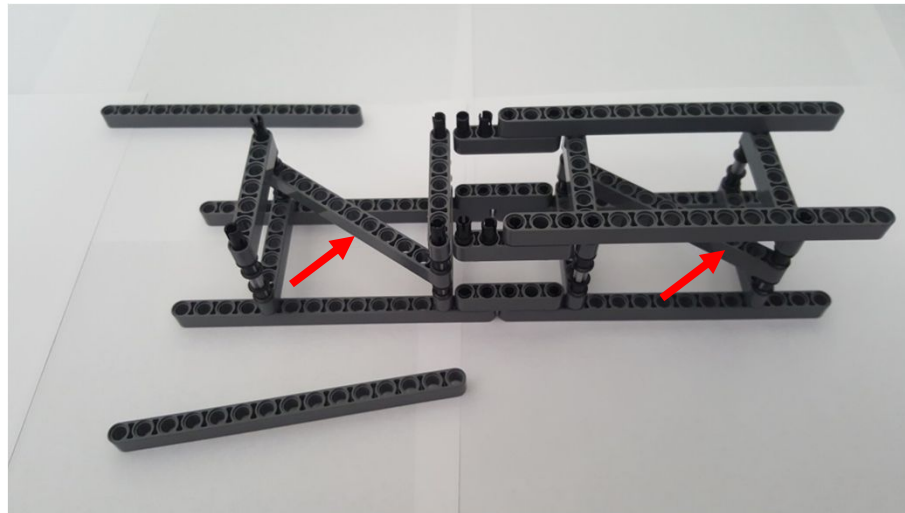
Step A-4: Lower-to-Middle Truss Connection



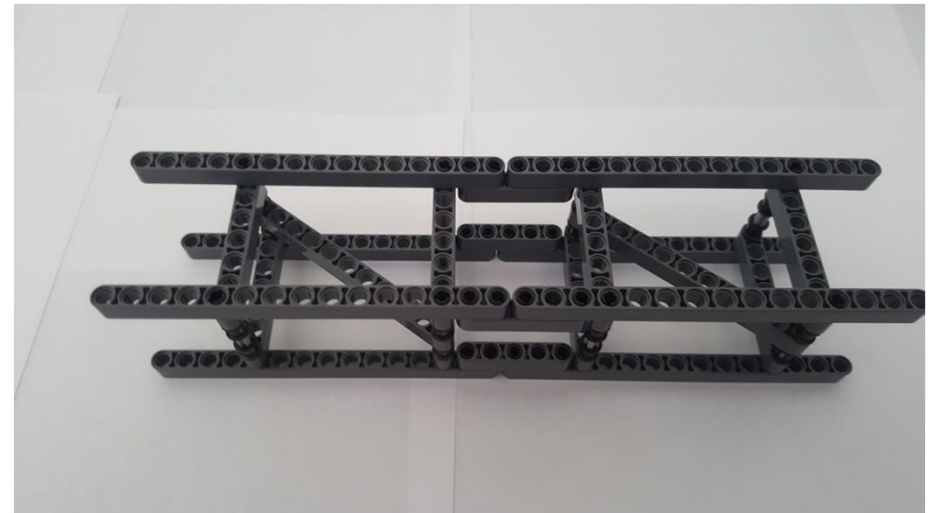
Gather parts Lower (Step A-1) and Middle (Step A-2) trusses. Note the orientation (red arrows) of diagonal braces



Insert friction pins. Top 4 red down-arrows show a completed connection. Bottom 2 red up-arrows show friction pins exposed. Note orientation of diagonal braces

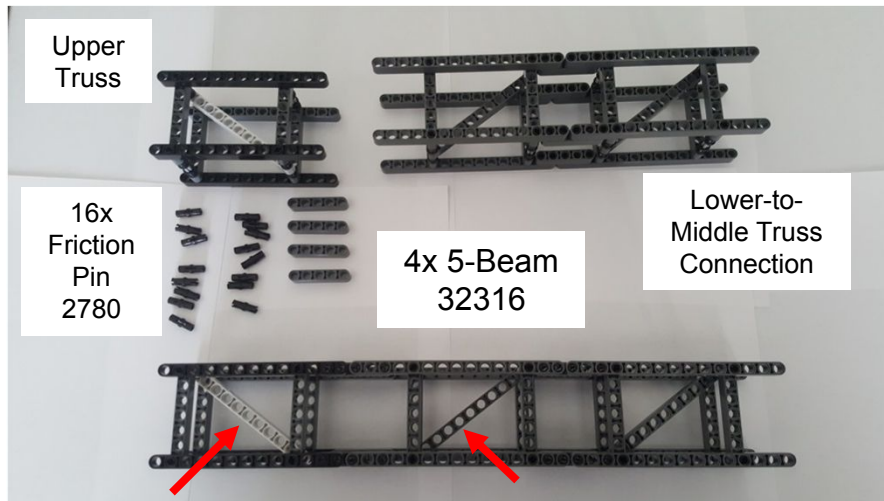


Flip over. 15-Beams removed to make connection easier. Note orientation of diagonal braces

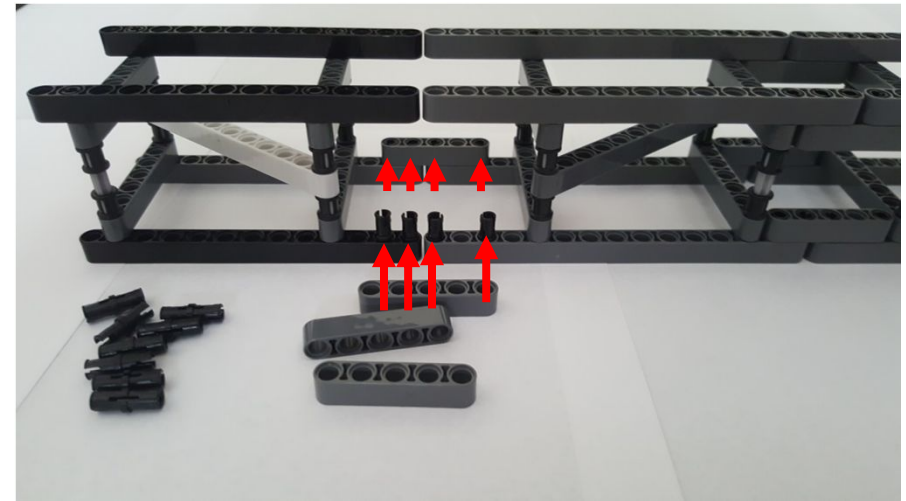


Completed Lower-to-Middle Truss Connection

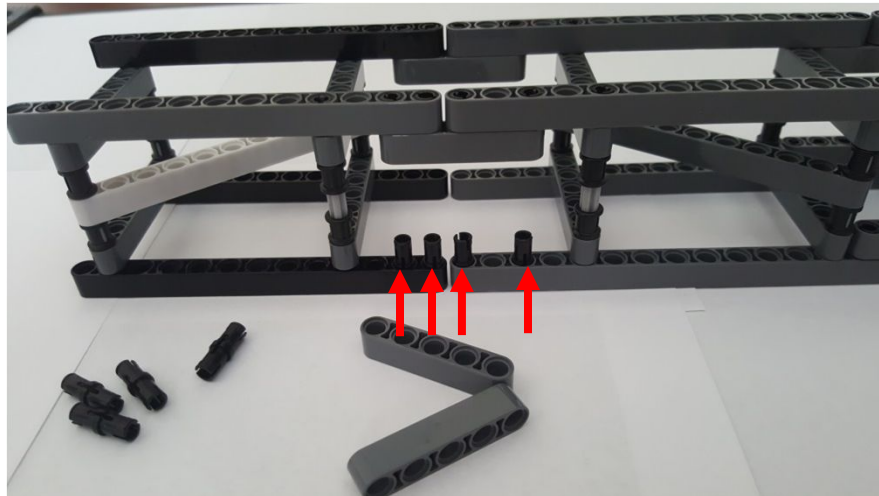
Step A-5: Upper Truss Connection



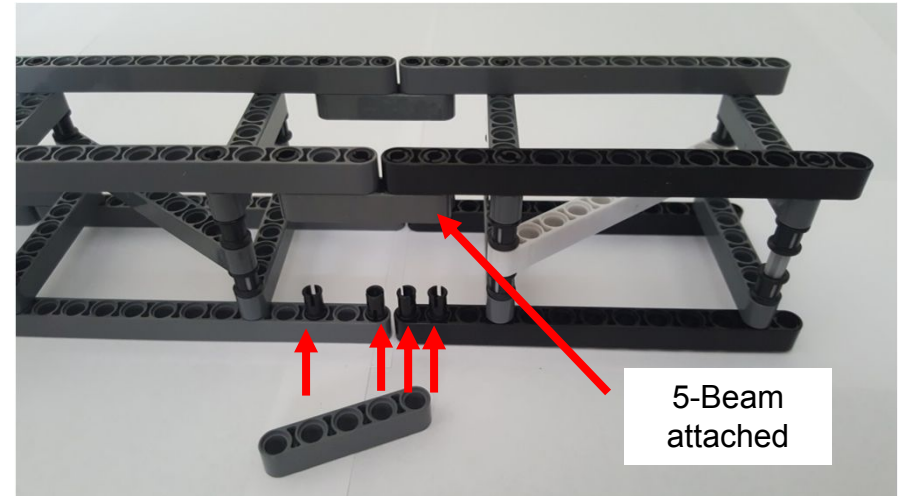
Gather Lower-to-Middle Truss Connection (Step A-4). Bottom assembly: Goal is to connect Upper Truss (Step A-3) to the Lower-to-Middle Truss Connection. Note: Red arrows show diagonal orientation



Insert 8 Friction Pins (red arrows) and use 5-Beam to attach Upper Truss to the Lower-to-Middle Truss Connection



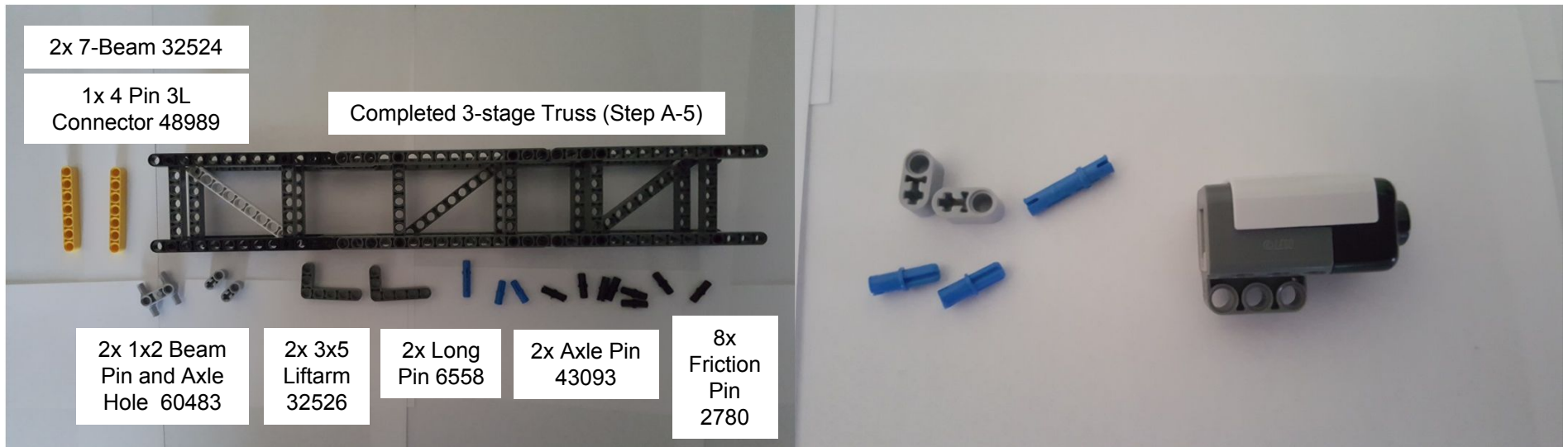
Flip over. Insert 4 friction pins



Connect 5-Beam. Flip over. Insert remaining 4 friction pins.

Step B: Angle Sensor Sub-assembly

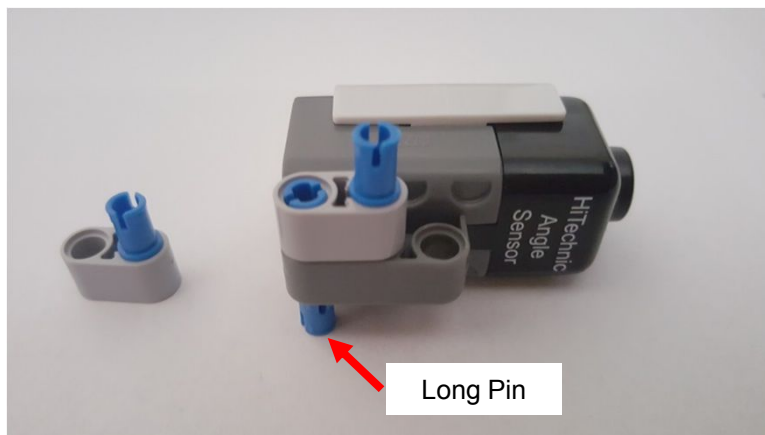
Step B-1: Angle Mount



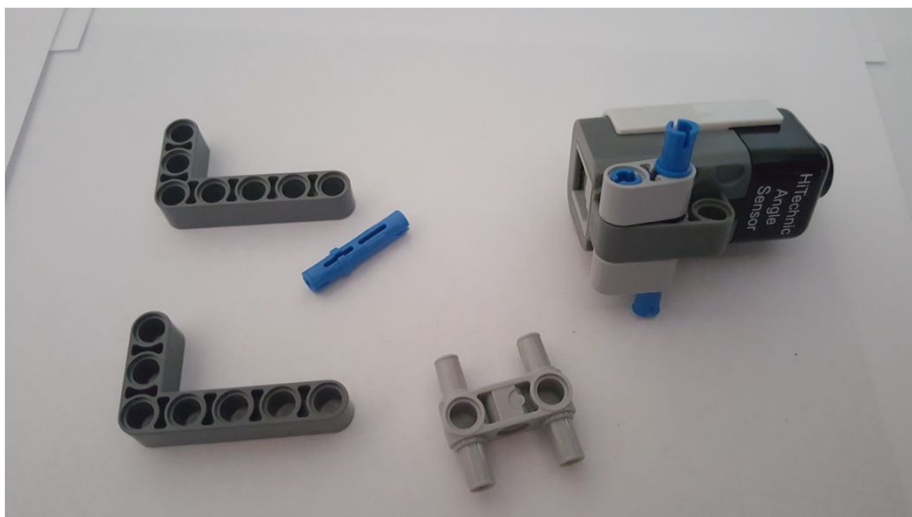
Gather Parts and the Completed Truss (from Step A-5)

Hi Technic Angle Sensor

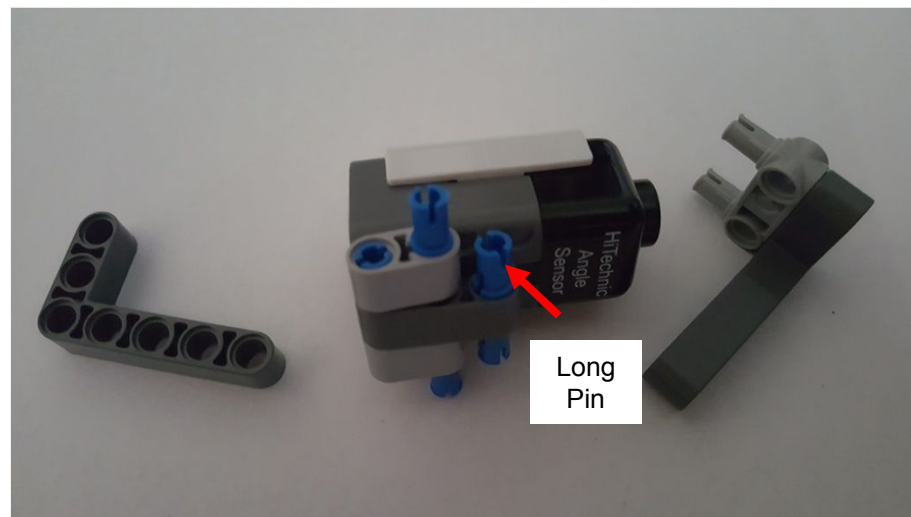
<https://www.hitechnic.com/cgi-bin/commerce.cgi?preadd=action&key=NAA1030>



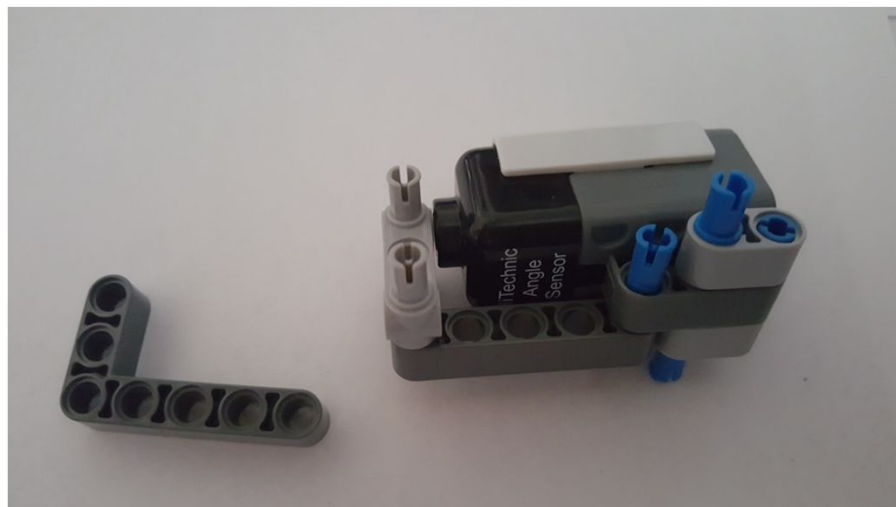
Insert Long Pin in Angle Sensor Mount. Attach 1x2 Beam Pin and Axle. Attach Axle Pin into 1x2 Beam Pin and Axle



Flip-over sensor to attach remaining 1x2 Beam Hole and Axle



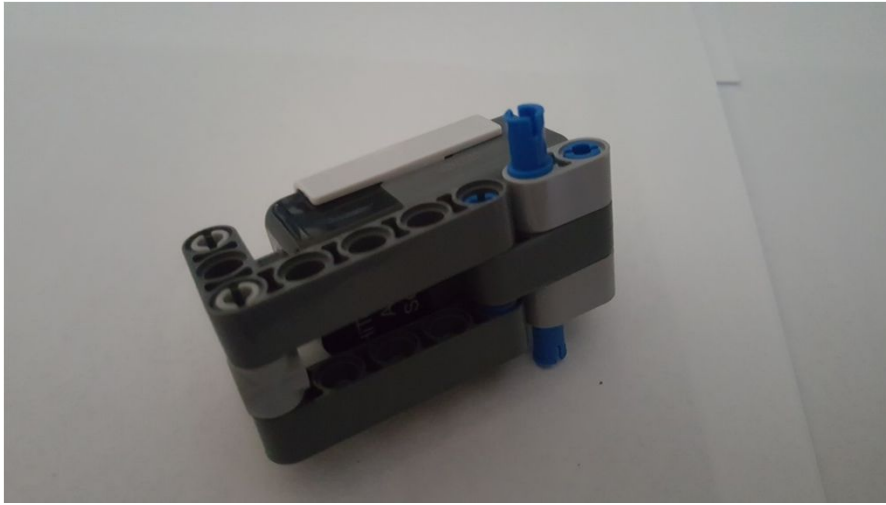
Insert Long Pin in Angle Sensor. Attach 4 Pin 3L into 3x5 Liftarm



Attach 3x5 Liftarm onto pins and flip-over

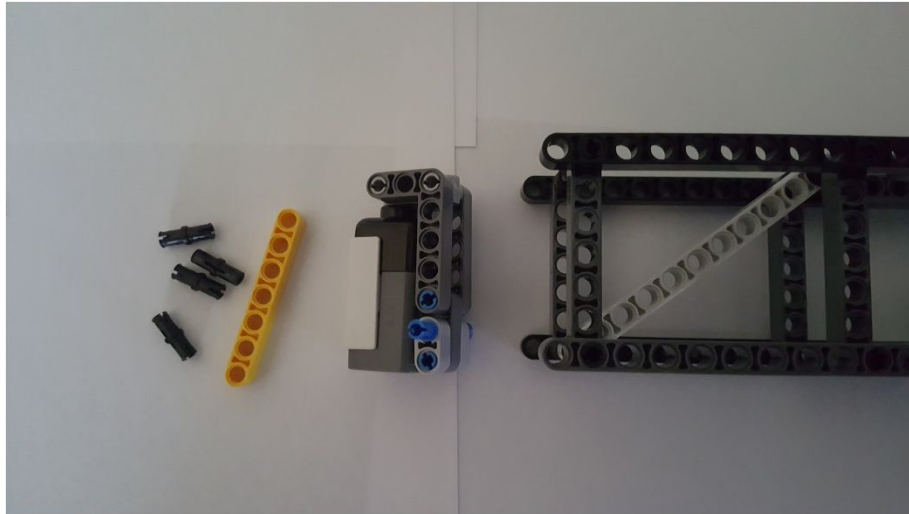


Attach remaining 3x5 Liftarm onto pins

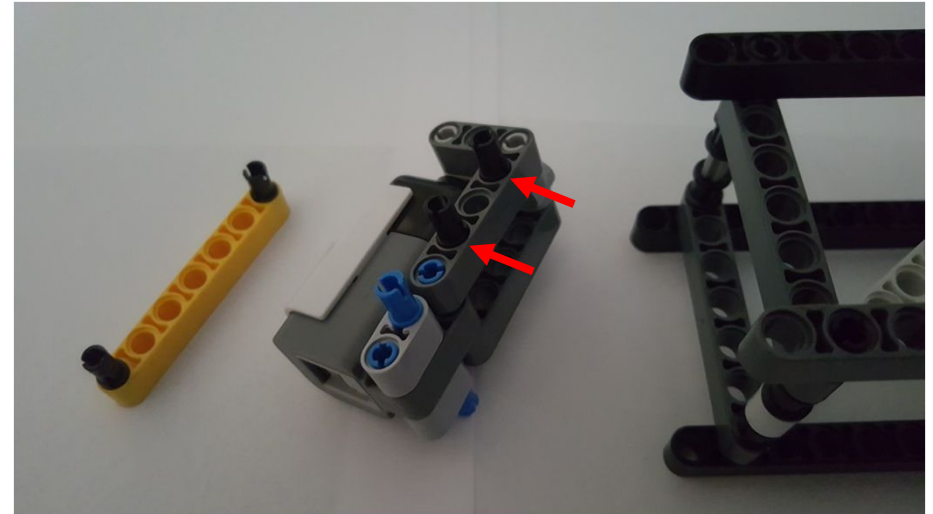


Completed Angle Sensor Mount

Step B-2: Angle-to-Truss Connection



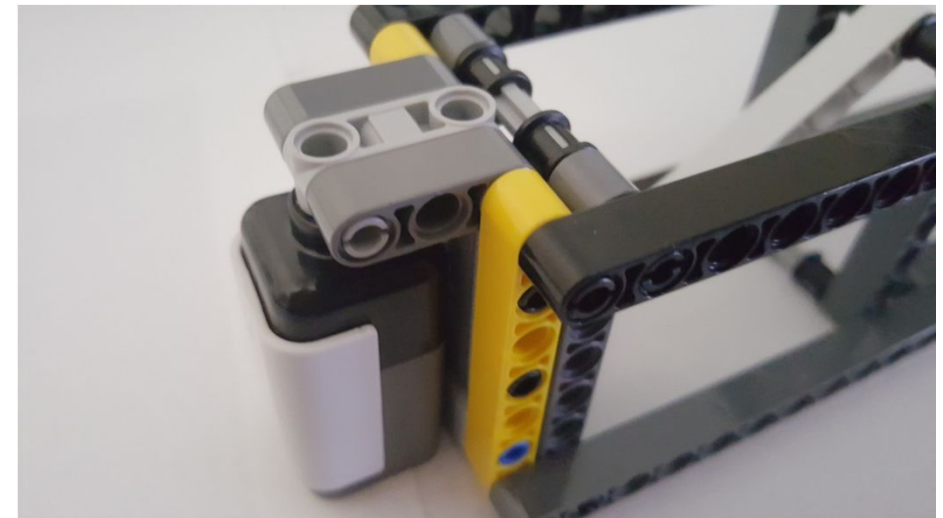
Gather 4 Friction Pins and 1 7-Beam from Step B-1, the Angle Sensor Mount from Step B-1, and Truss Sub-Assembly from Step A-5



Insert 2 Friction Pins at the ends of one of the 7-Beams. Insert 2 Friction Pins on the Sensor Mount



Attach 7-Beam to Sensor Mount. Then, Attach to the Truss Sub-Assembly



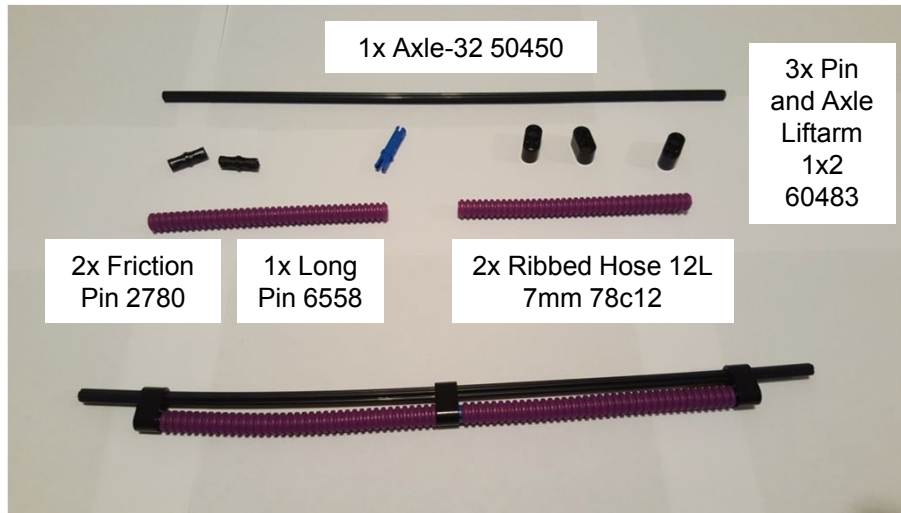
Repeat for other 7-Beam



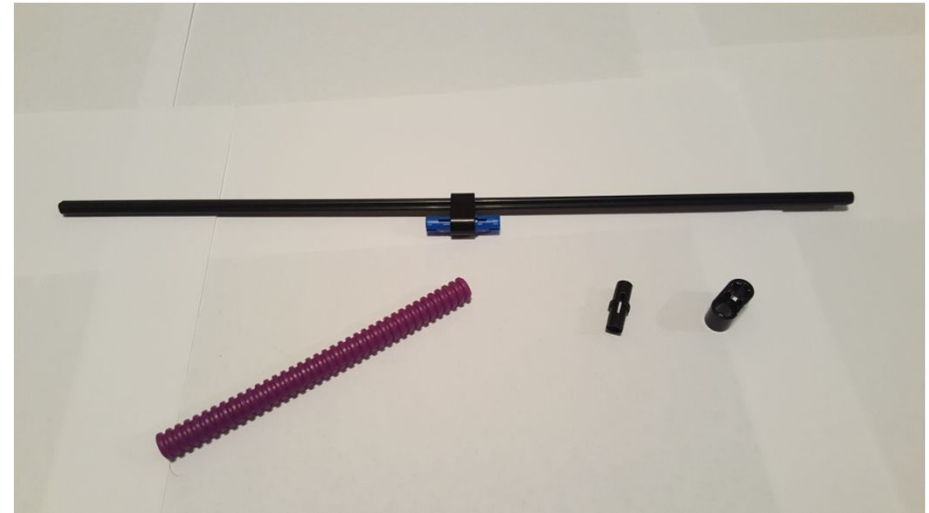
Completed Angle Sensor to
Truss Sub-Assembly

Step C: Pendulum and Wiring Sub-Assembly

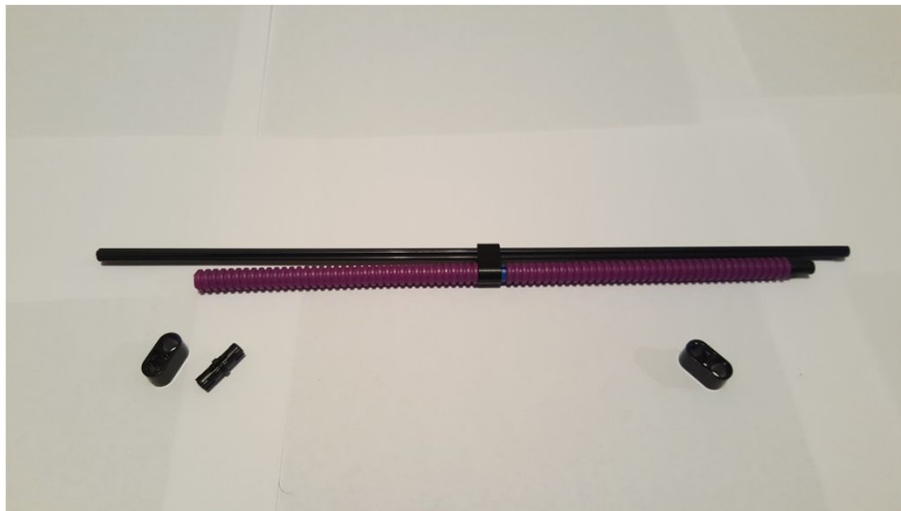
Step C-1: Pendulum



Gather parts (top) to form wire assembly (bottom)



Slide Pin-Axle Liftarm onto Axle-32. Insert Long Pin into Pin-Axle Liftarm



Attach Ribbed Hoses to Long Pin. Attach Friction Pin to end of one of the Ribbed Hoses



Repeat by inserting remaining Friction Pin into end of other Ribbed Hose



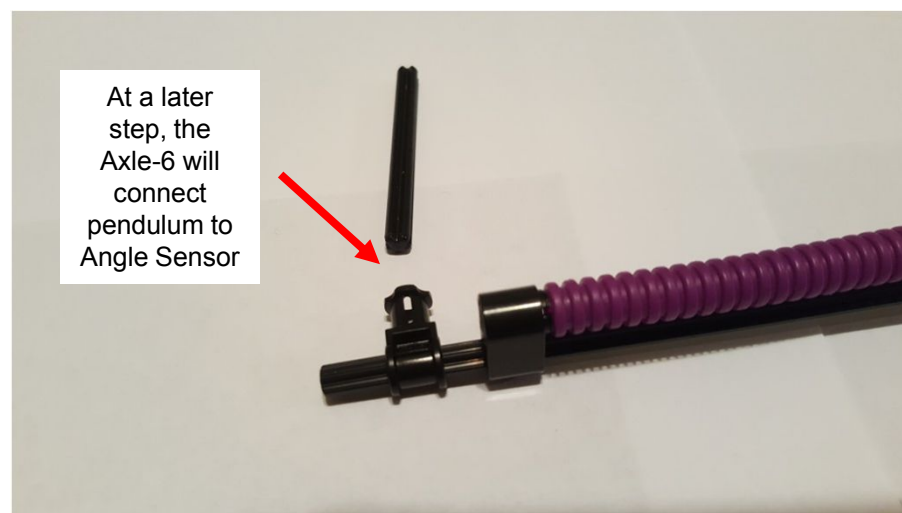
Slide Pin-Axle Liftarm onto Axle-32 and connect to Friction Pin. Repeat for other end. Hoses should be aligned with Axle-32



Gather Parts for Motor Mount



Note orientation (Ribbed Hoses on top). Slide Axle Connector with Axle Hole onto Axle-32



Close-up (Note the 90-deg orientation of Part 32039 (Axle Connector with Axle Hole) with Ribbed Hose



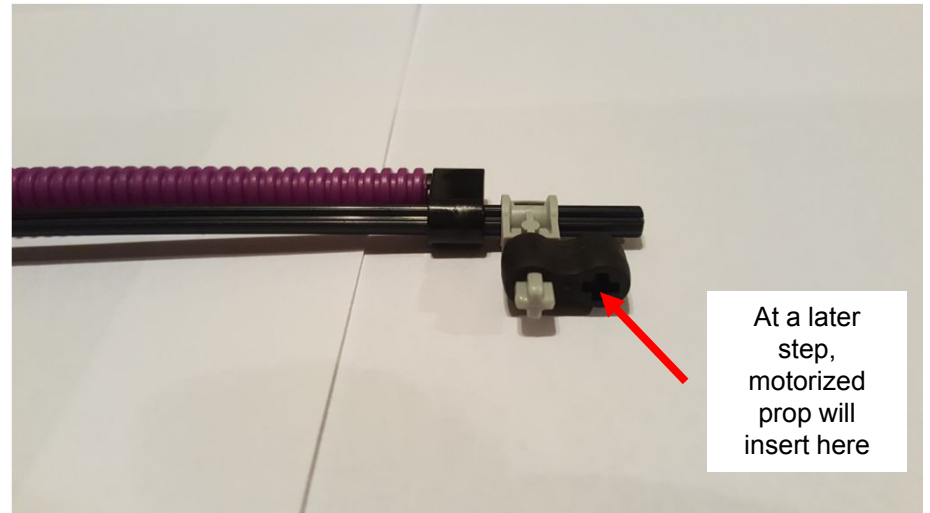
Insert Part 45590 (Rubber Double Axle Connector) onto Part 6553 (Pole Reverser Handle). Slide result onto Axle-32



Close-up 1. Note orientation.



Close-up 2. Note orientation.



At a later step, motorized prop will insert here

Close-up 3. Note orientation.



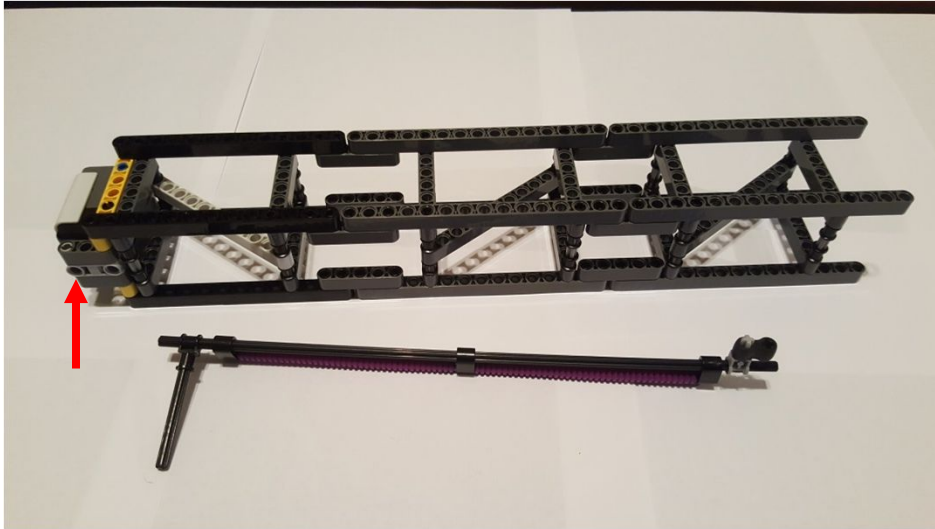
Completed Pendulum

Insert Axle-6 into Part 32039 (Axle Connector with Axle Hole).



Close-up

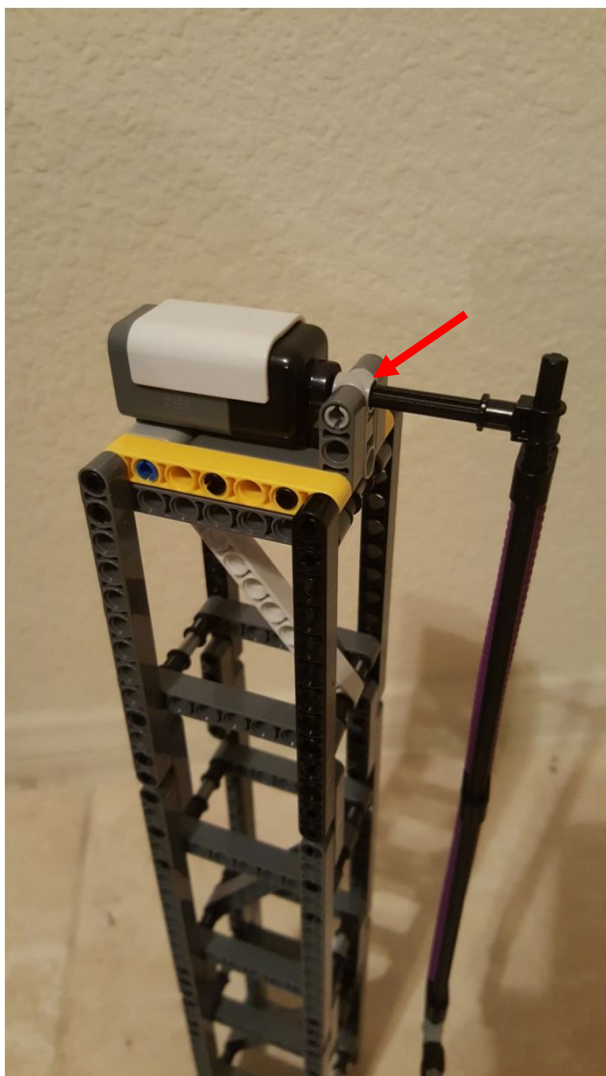
Step C-2: Mounting Pendulum to Angle Sensor



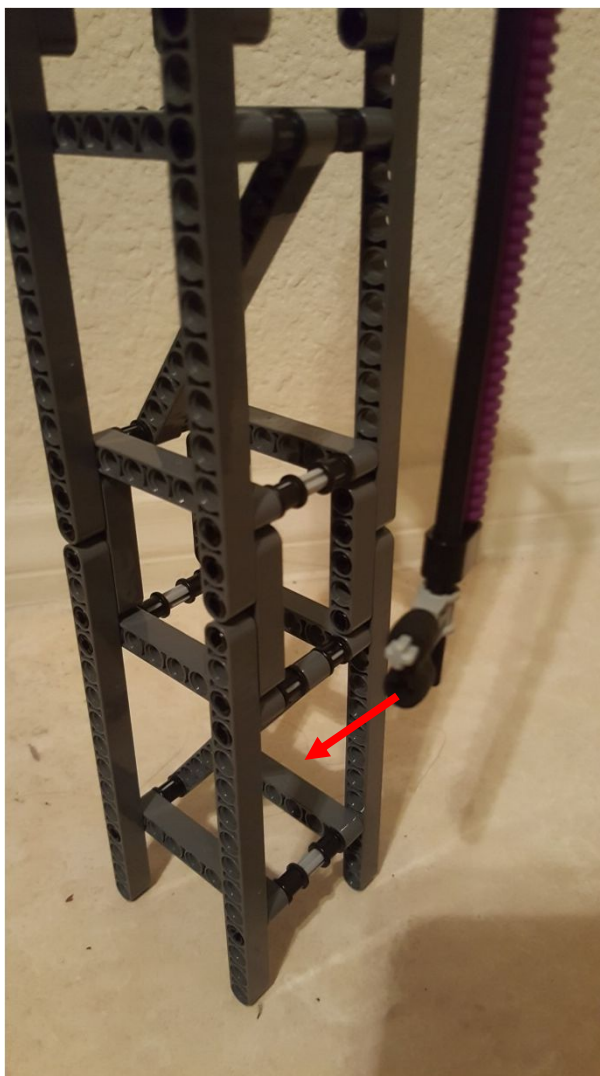
Gather Pendulum(from Step C-1) and Angle Sensor to Truss Sub-Assembly (from Step B-2). Note Red Arrow location



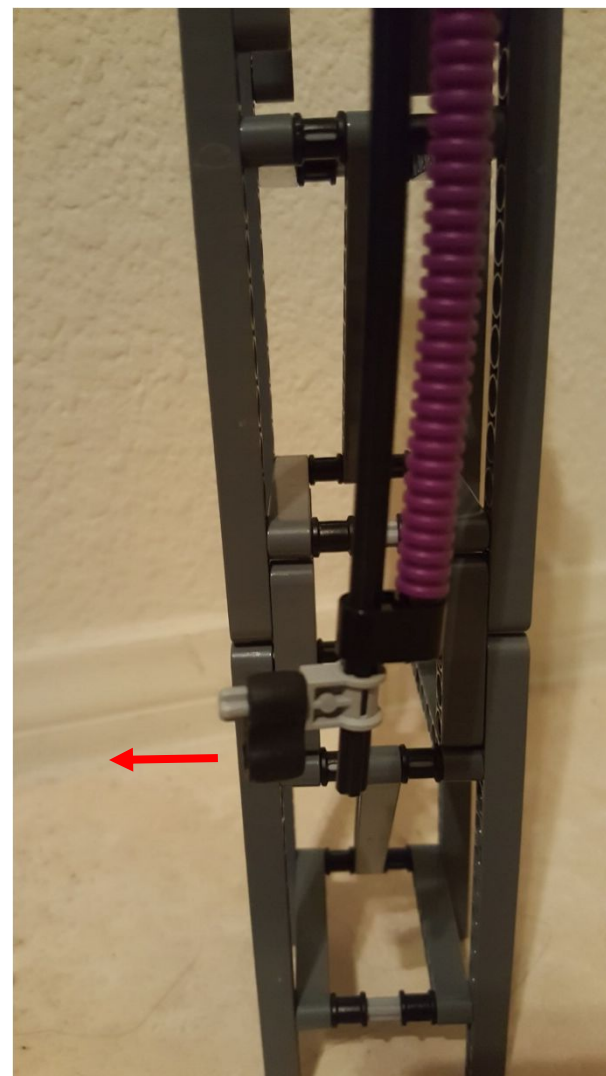
Red Arrow shows where Pendulum attached to Angle Sensor via Axle-6



Close-up 1: Red Arrow shows Axle-6 inserted into Angle Sensor. Axle-6 connects Pendulum to Angle Sensor



Close-up 2: Note orientation of Motor Mount at the end of the Pendulum. Red Arrow is the direction Pendulum will swing when powered by a motorized propeller



Close-up 3: Same as Close-up but face-on perspective. Red Arrow is the direction Pendulum will swing when powered by a motorized propeller



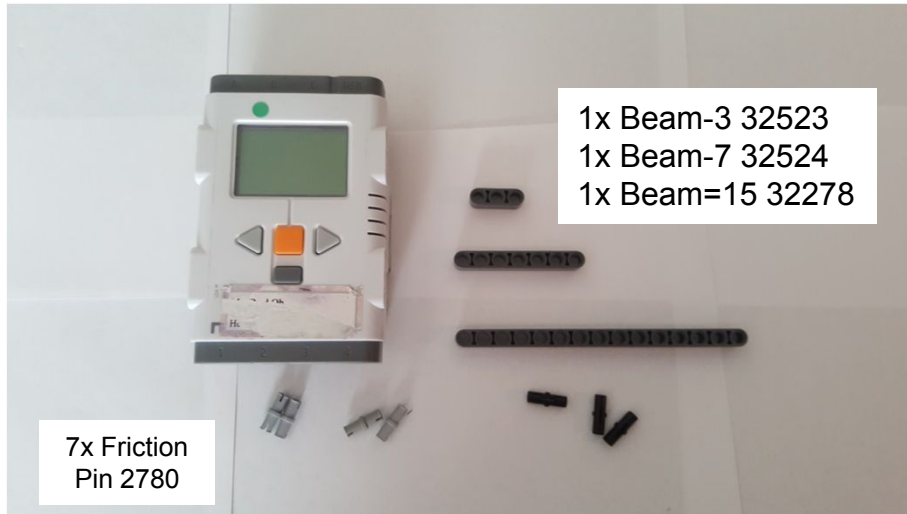
Perspective 1: When motorized propeller is mounted on Pendulum, Red Arrow shows that Pendulum will swing toward wall



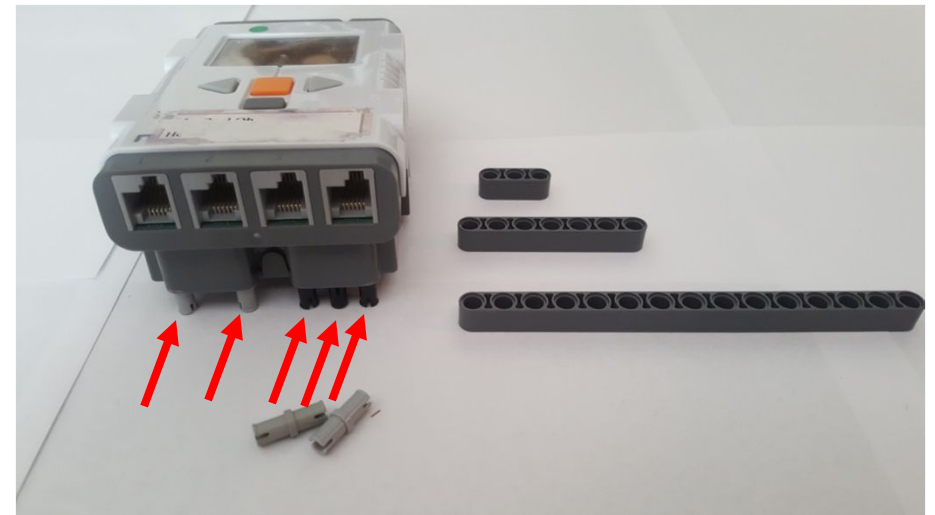
Perspective 2: When motorized propeller is mounted on Pendulum, Red Arrow shows that Pendulum will swing away from wall

Completed
Pendulum mounted
to Angle Sensor

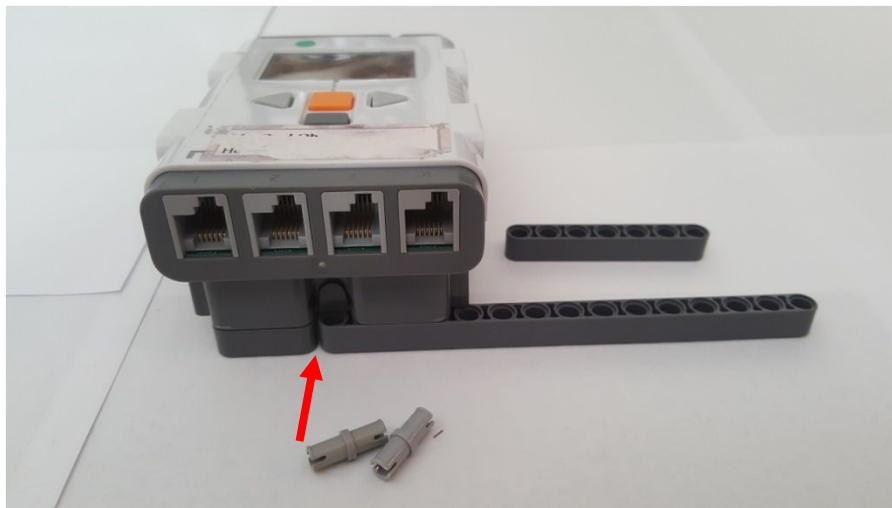
Step D: Base Sub-Assembly



Gather parts: Note orientation of Brick (LCD on top)



Insert 5 Friction Pins at the bottom of the Brick (Red Arrows)



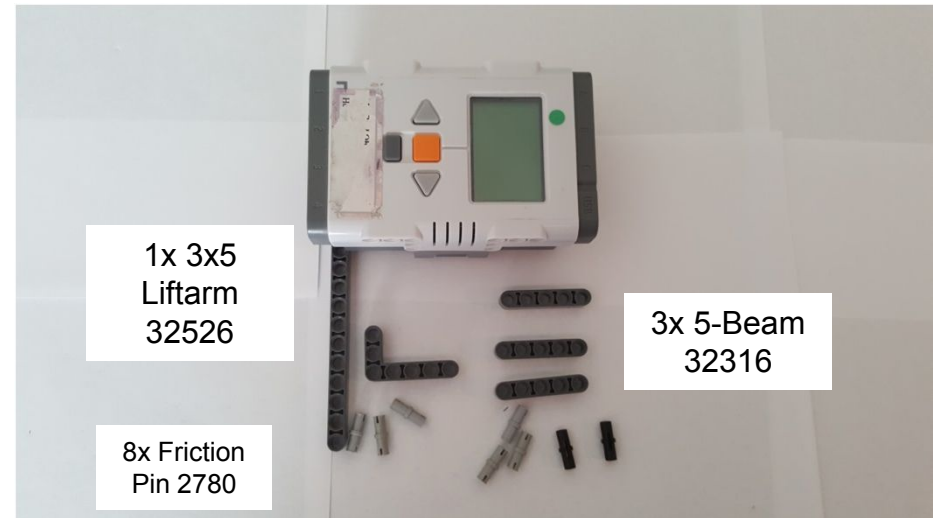
Attach Beam-3 and Beam-15 to Brick. NB: Red Arrow shows there is no space between the two Beams



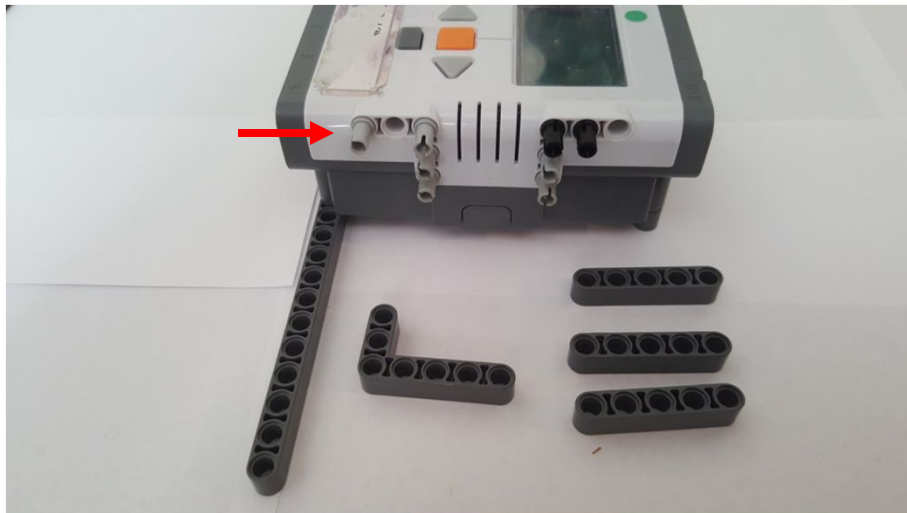
Rotate Brick and insert 2 Friction Pins into Brick (Red Arrows)



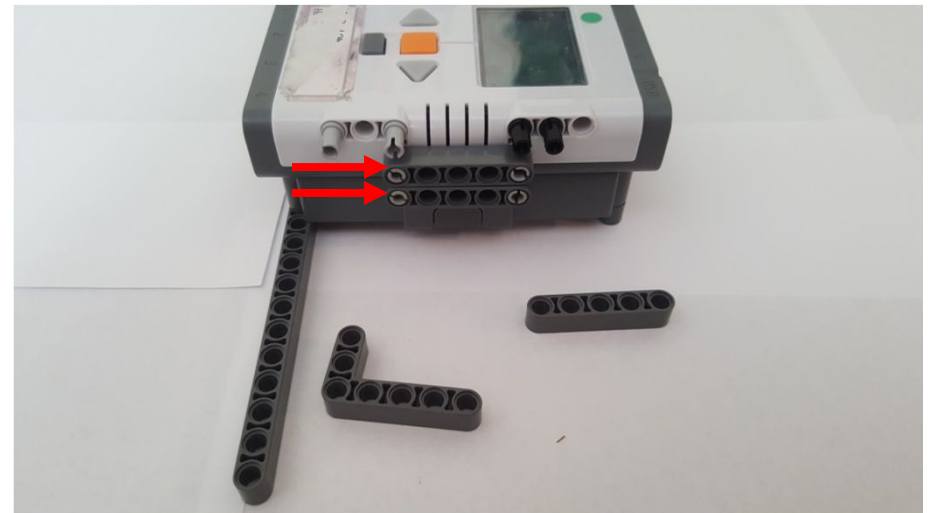
Attached Beam-7 to Brick



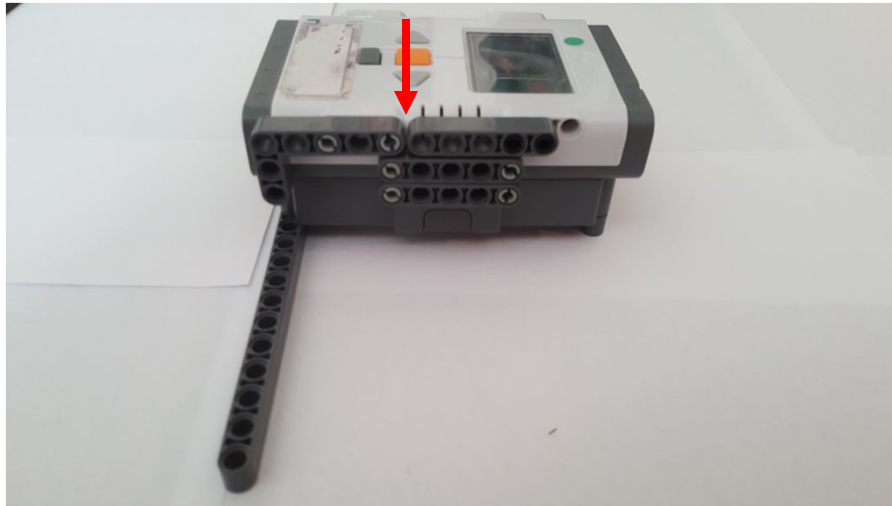
Gather parts: Note orientation of Brick



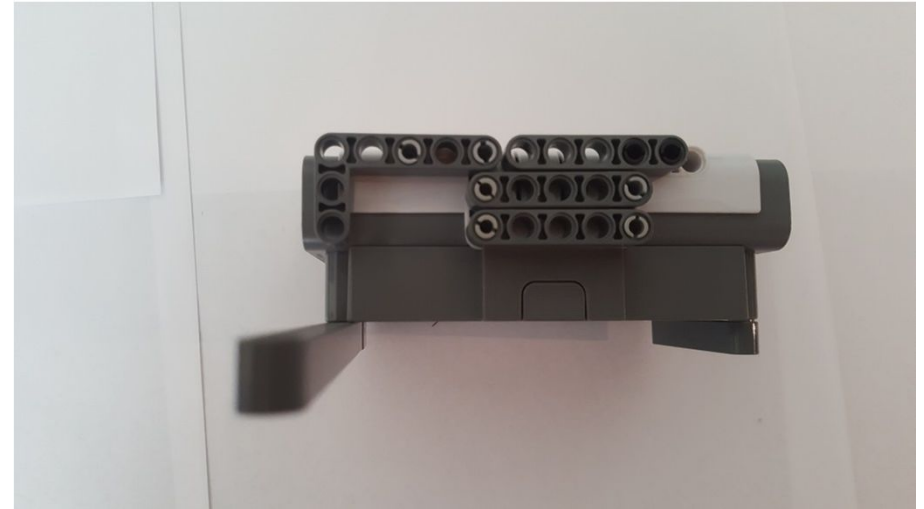
Insert the 8 Friction Pins into Brick's side (Note: Orientation of Brick)



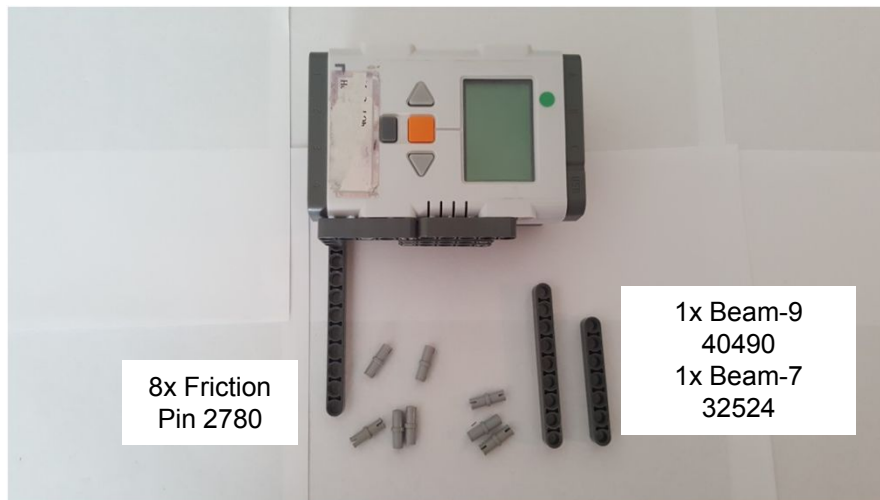
Connect two Beam-5 elements onto Friction Pins



Attach 3x5 Liftarm and remaining Beam-5 to Brick. Note: Red Arrow shows no space between Liftarm and Beam-5



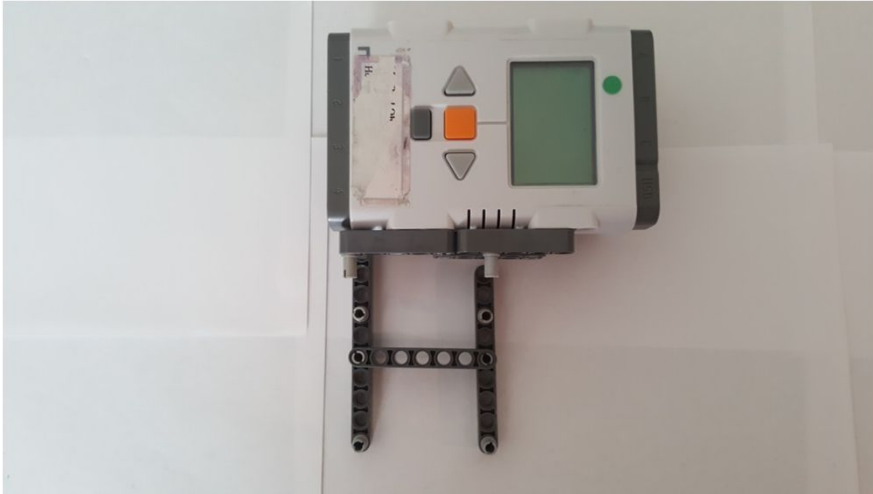
Close-up



Gather Parts: Note orientation of Brick

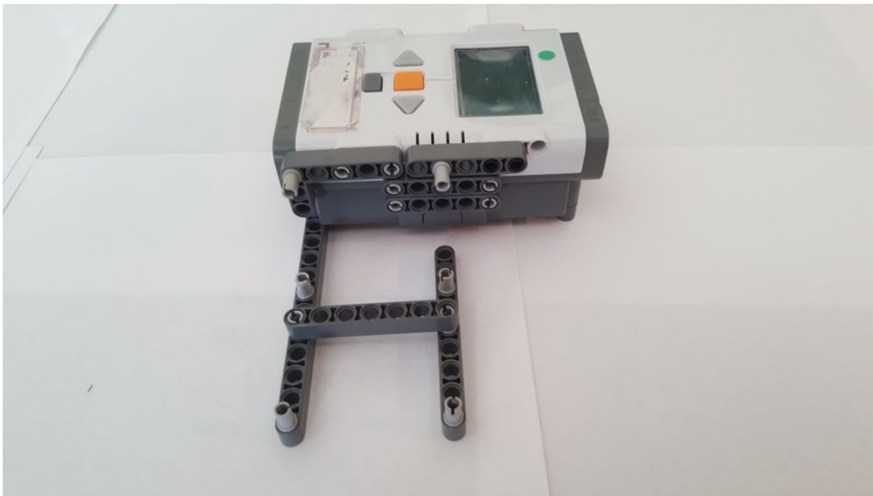


Insert the 8 Friction Pins as shown



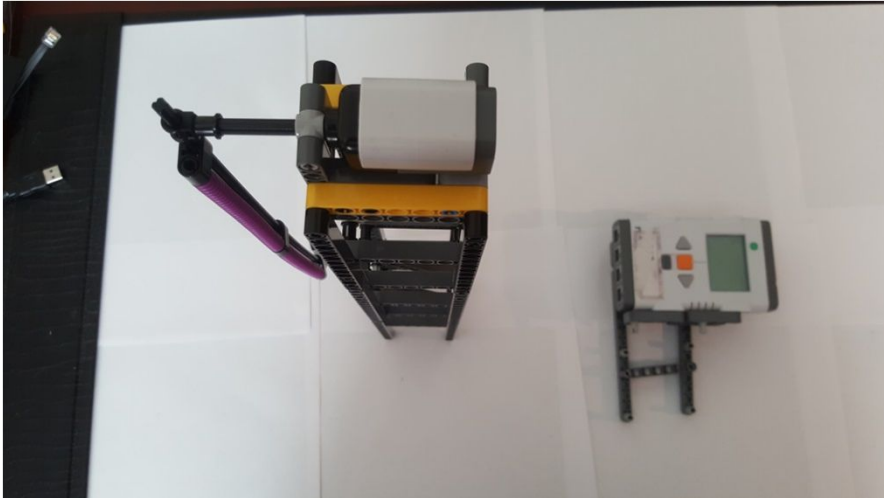
Completed Base Sub-Assembly

Attach Beam-7 to the Beam-15 and Beam-9

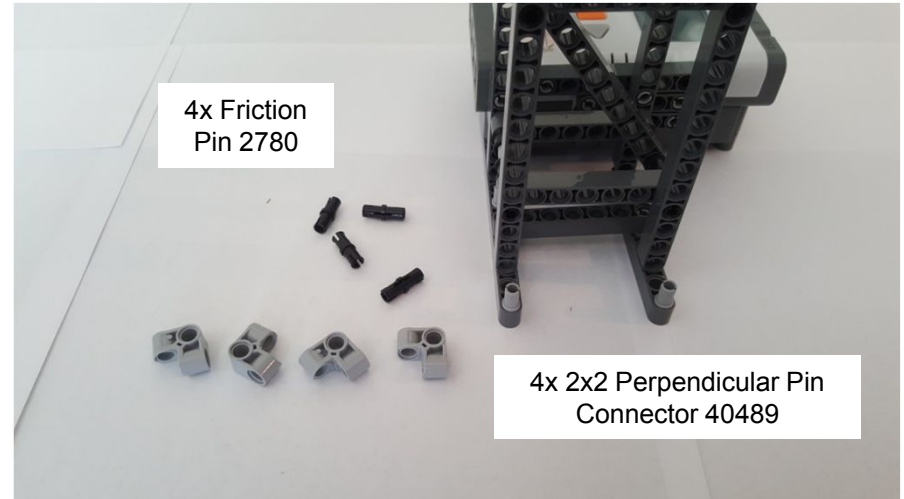


Alternative Perspective View of previous step

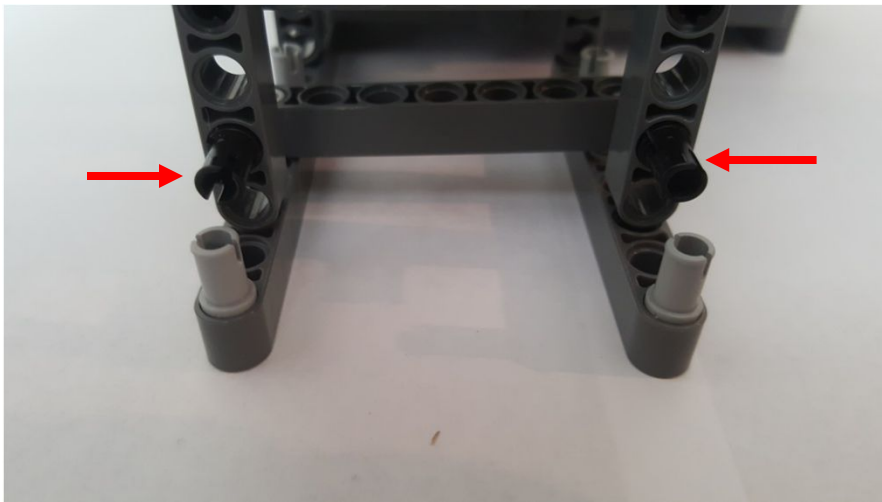
Step E: Base-to-Truss Attachment



Gather Pendulum-Truss (from Step C-2) and Base Assembly (from Step D). Top View seen. Note orientation of Pendulum-Truss, and left of Base



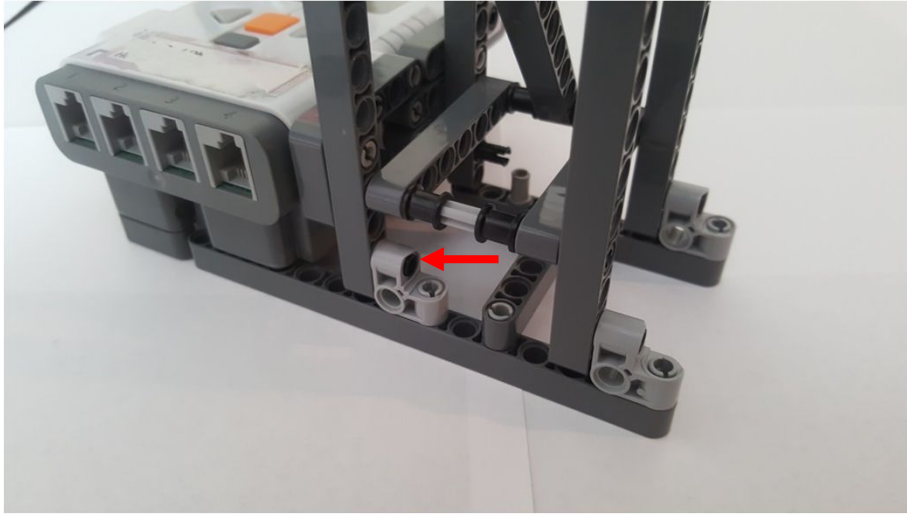
Gather Parts: Attach Pendulum-Truss to the Friction Pins in Base Assembly.



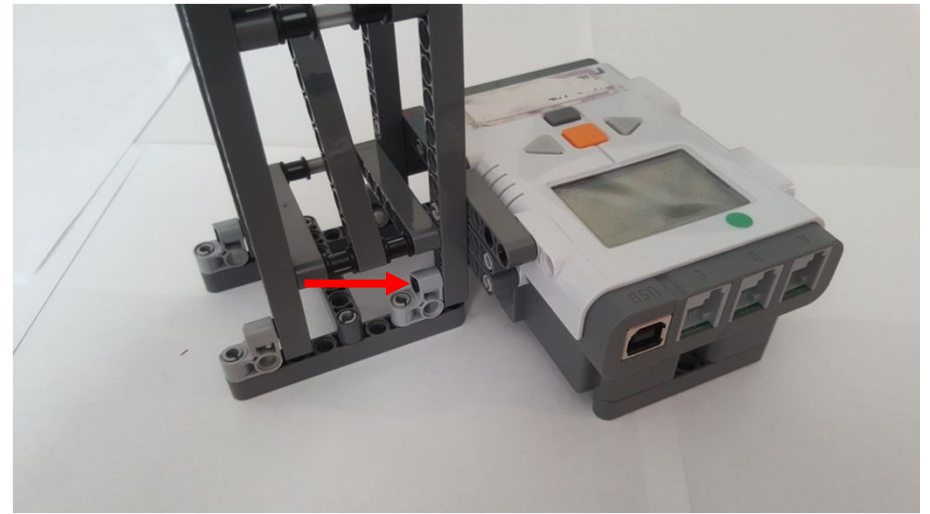
Insert 2 Friction Pins (see Red Arrow)



Attach 2x2 Perpendicular Pin Connectors to Friction Pins. This secures the Pendulum-Truss to Base Assembly



Insert Friction Pin (Red Arrow) and attach one 2x2 Perpendicular Pin Connector



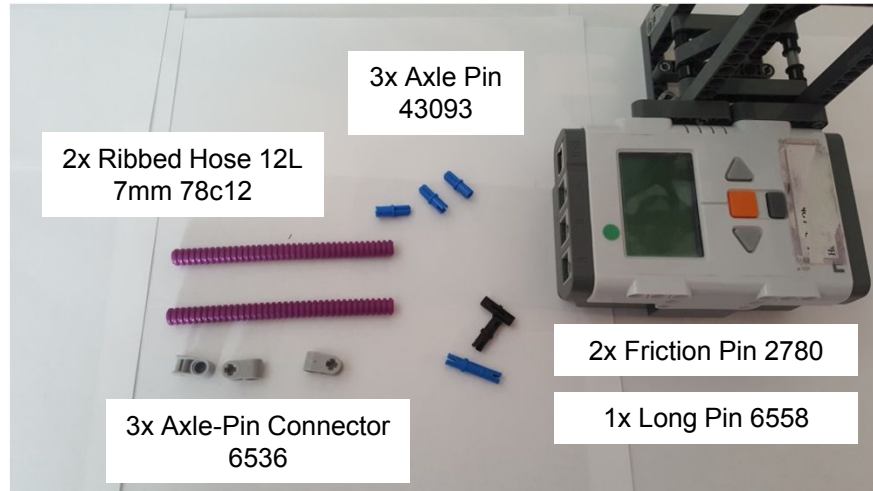
Repeat previous step on other side; Insert Friction Pin (Red Arrow) and attach one 2x2 Perpendicular Pin Connector



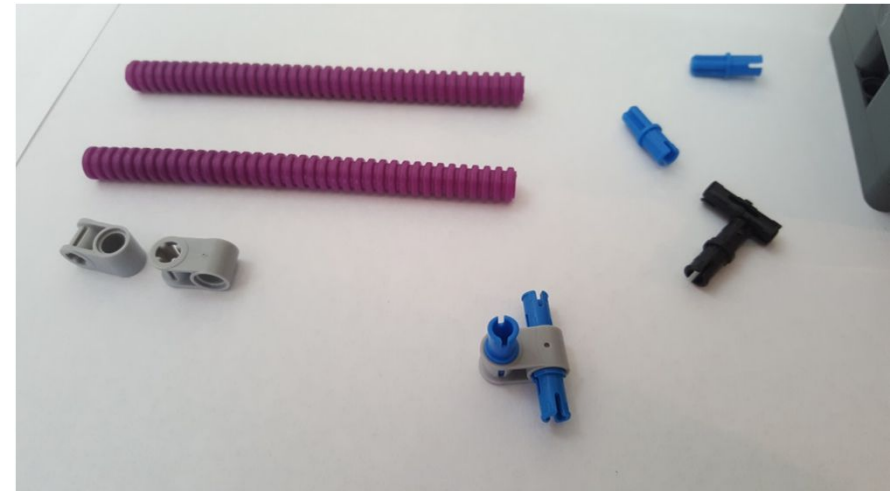
Top View: Note orientation of Brick and Pendulum-Truss

Completed Truss-to-Base Attachment

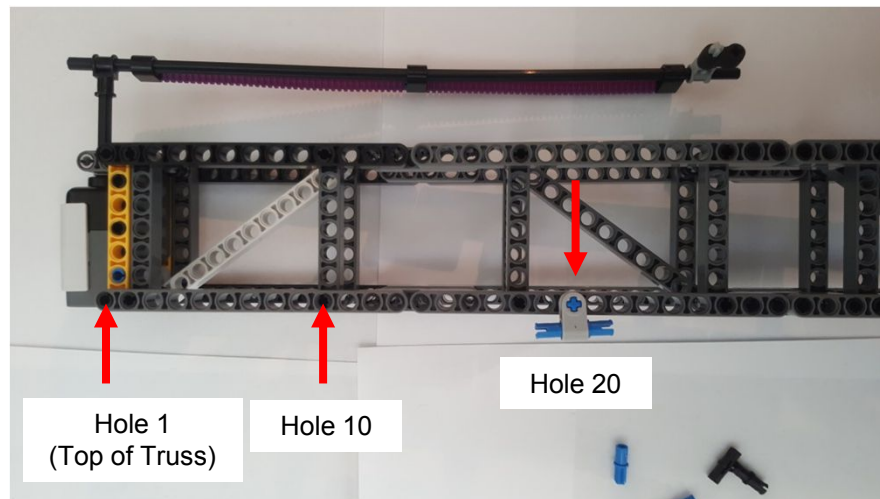
Step F: Wiring Harness to Truss Attachment



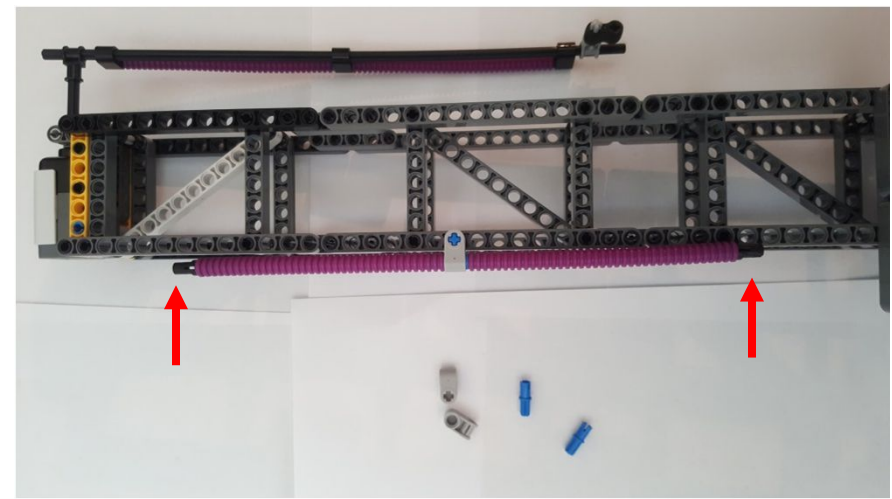
Gather Parts: Note orientation of Truss-to-Base Attachment



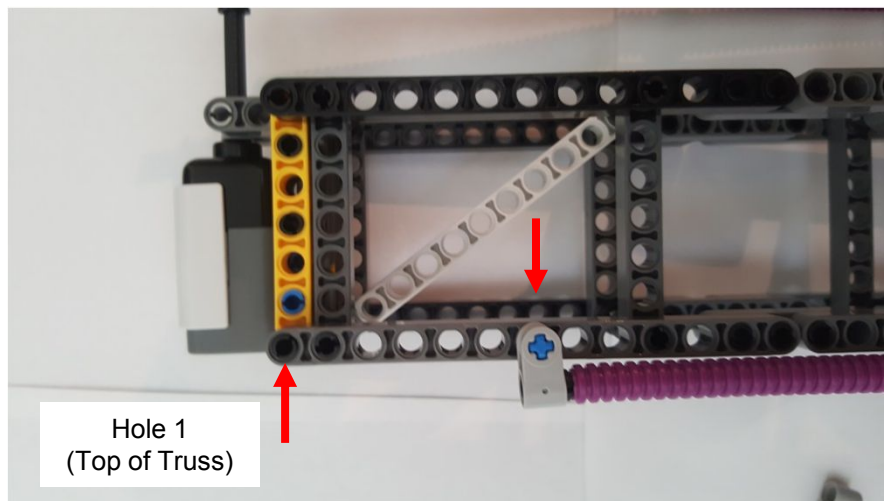
Insert Long Pin into Part 6536 (Axle-Pin Connector). Insert Axle Pin into Connector



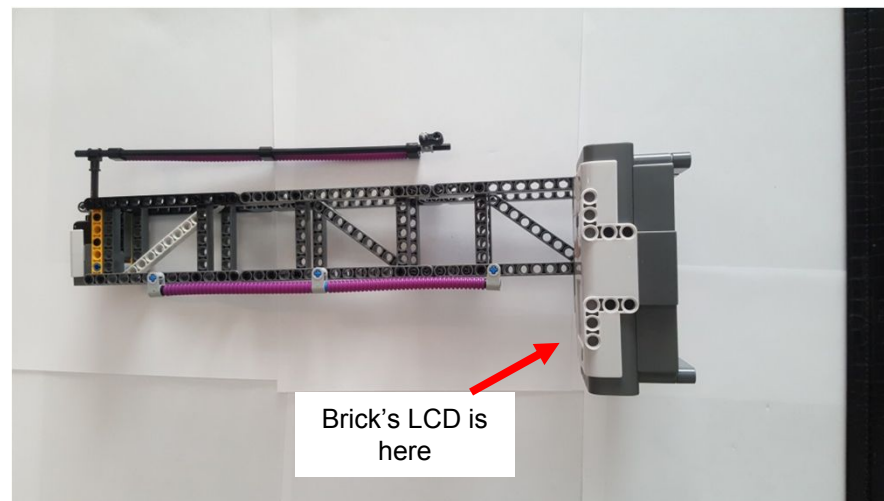
Attach resulting part into Truss. Arrow notes position is 20 holes from top of Truss



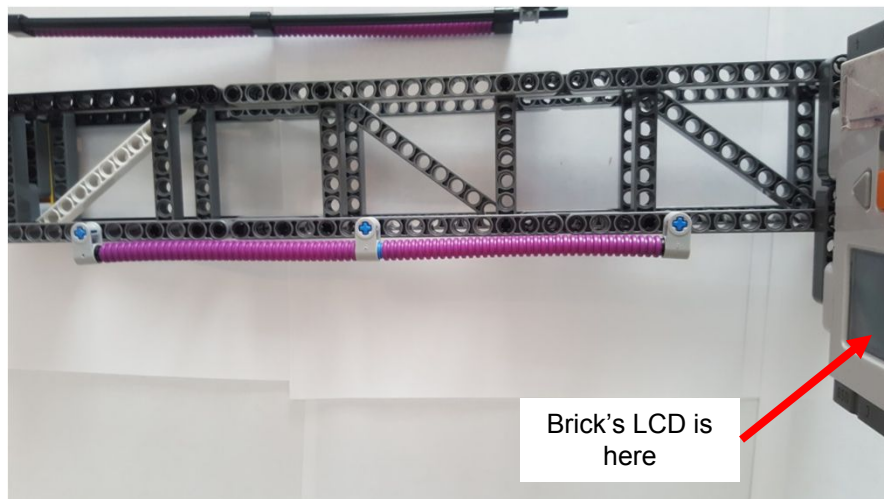
Attach Ribbed Hoses to ends of Long Pin. Attach Friction Pins to both ends of Ribbed Hoses (see Red Arrows)



Insert Axle Pin into Axle-Pin Connector. Attach result to Truss. Red Arrow show 7th hole position from top of Truss



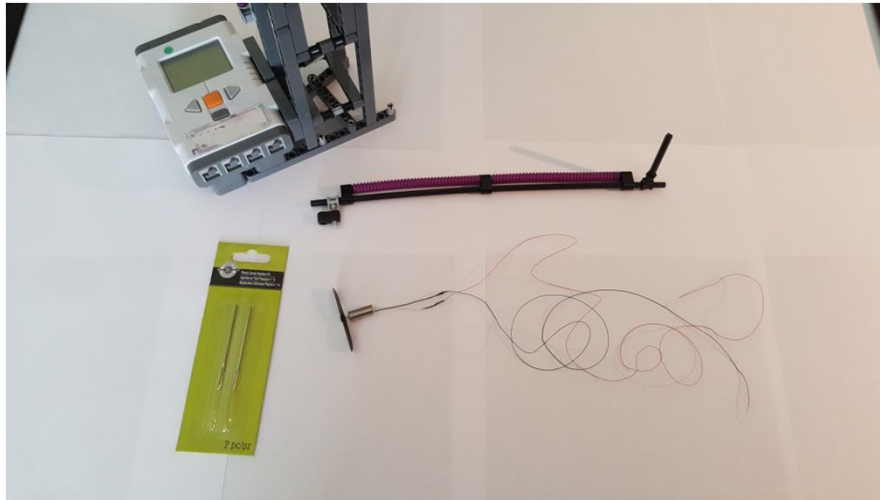
Final Wiring Harness to Truss (Plan View). Ribbed Hoses should be relative straight and aligned to Truss



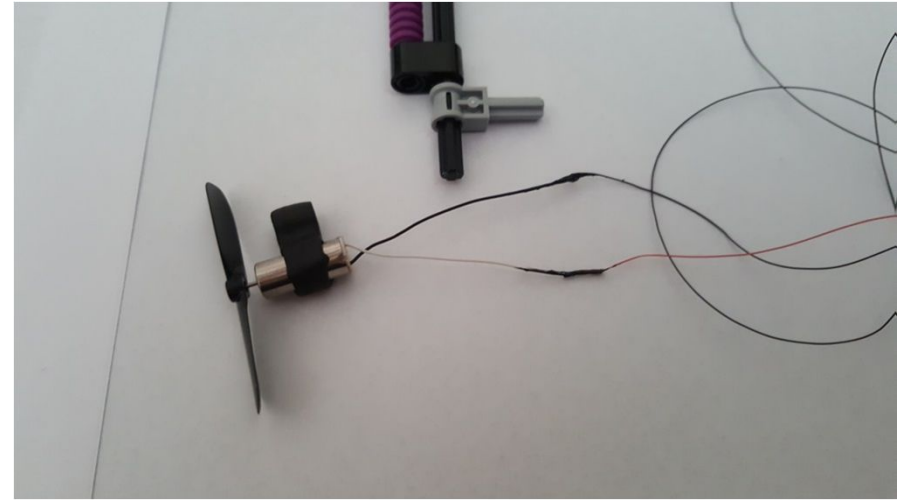
Alternative View: Note orientation of Brick and Wiring Harness

Completed Wiring Harness to
Truss Attachment

Step G: Motor-prop Mount and Wiring



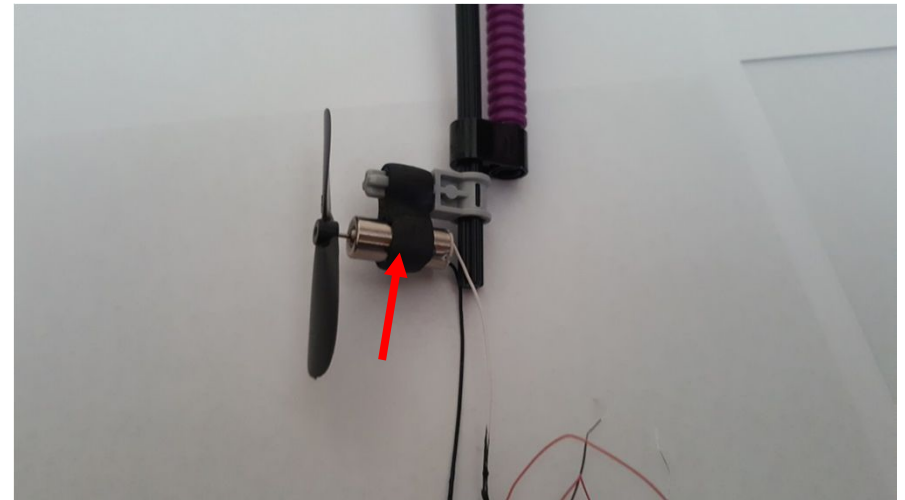
Gather Parts: Pictured are: the Pendulum Arm (detached from the Truss i.e. from Step C), a motor-prop with wire, and a package of #16 Plastic Canvas Needles.



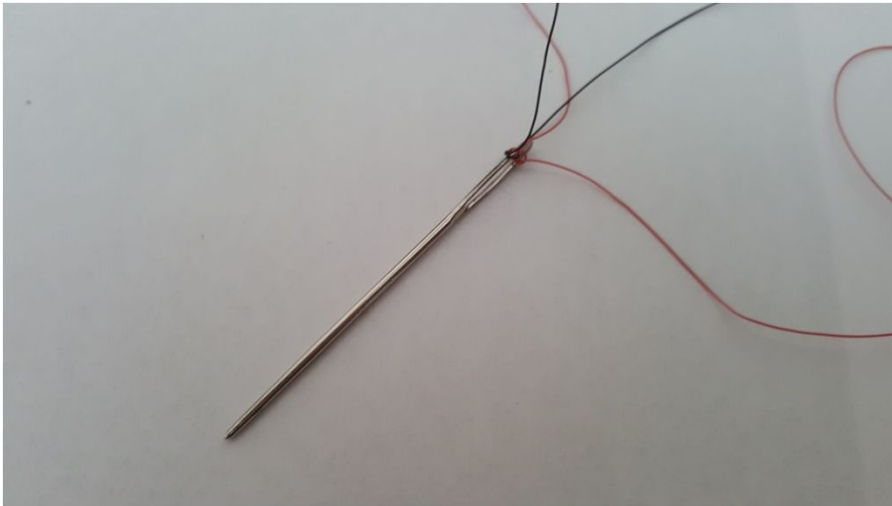
First detach the Rubber Double Axle Connector (45590) from the Pendulum Arm. Then, insert the motor-prop into this Rubber Double Axle Connector. The fit, while tight, provides a stable mount



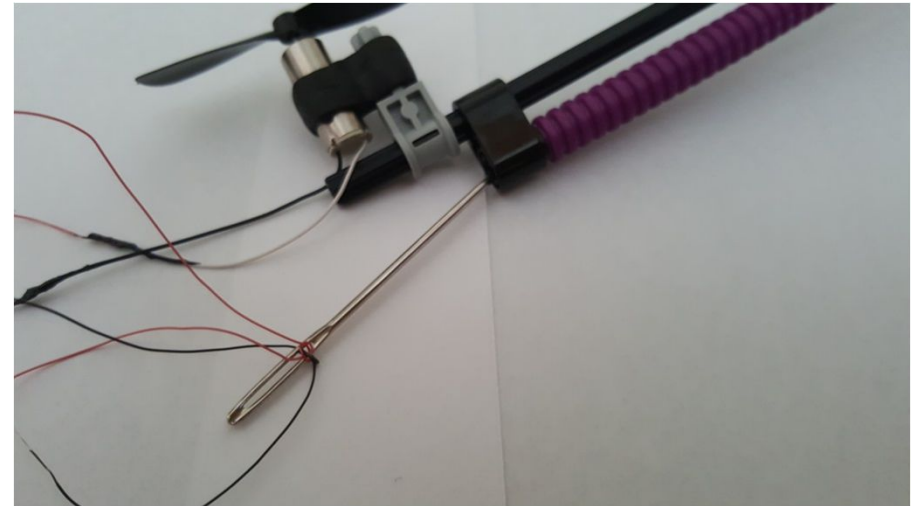
Re-attach the motor-prop to the Pendulum Arm (Red Arrow).



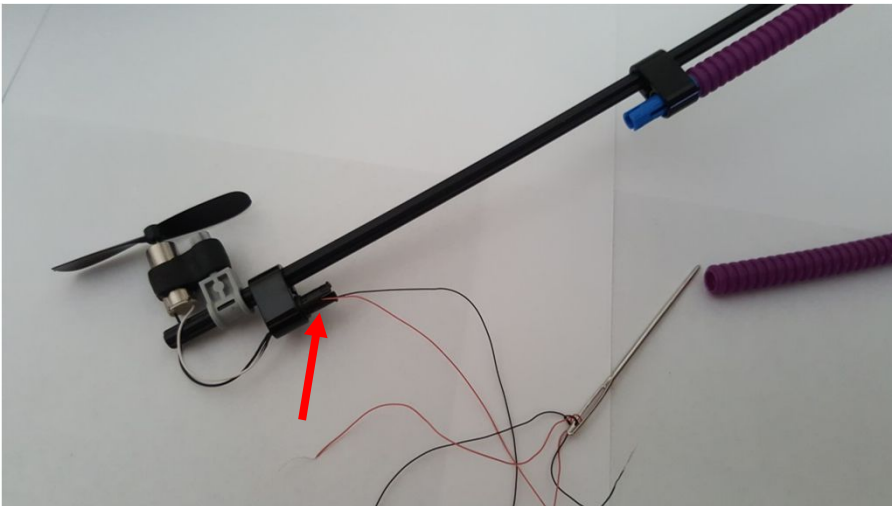
Close-up: Note that motor-prop is in the bottom part of the Rubber Double Axle Connector (Red Arrow)



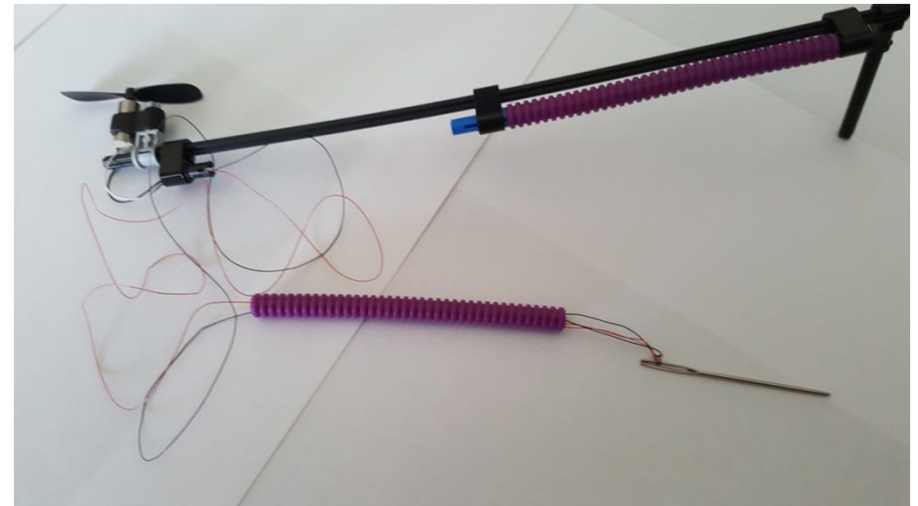
Gather Parts: This motor-prop used 36 AWG wire. A canvas needle will make threading into the Ribbed Hoses and Friction Pins easier



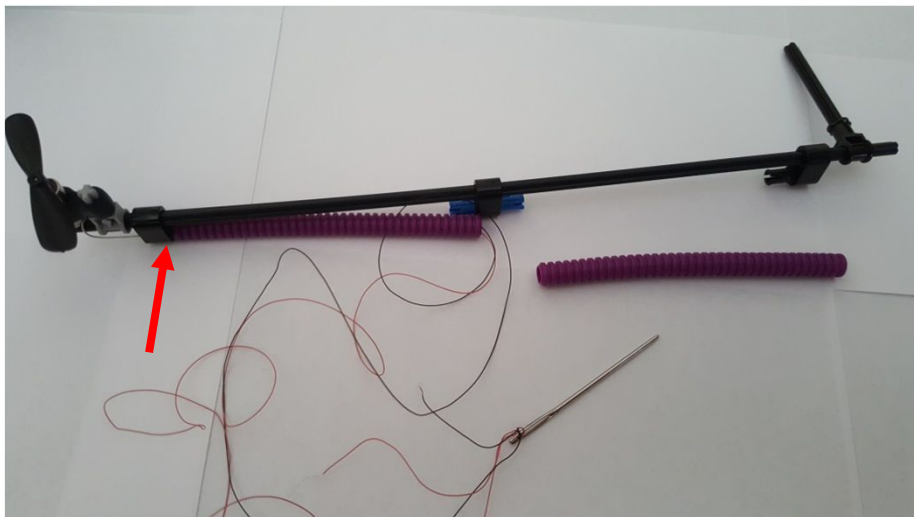
Thread the motor's wires into the 1x2 Pin and Axle Liftarm.



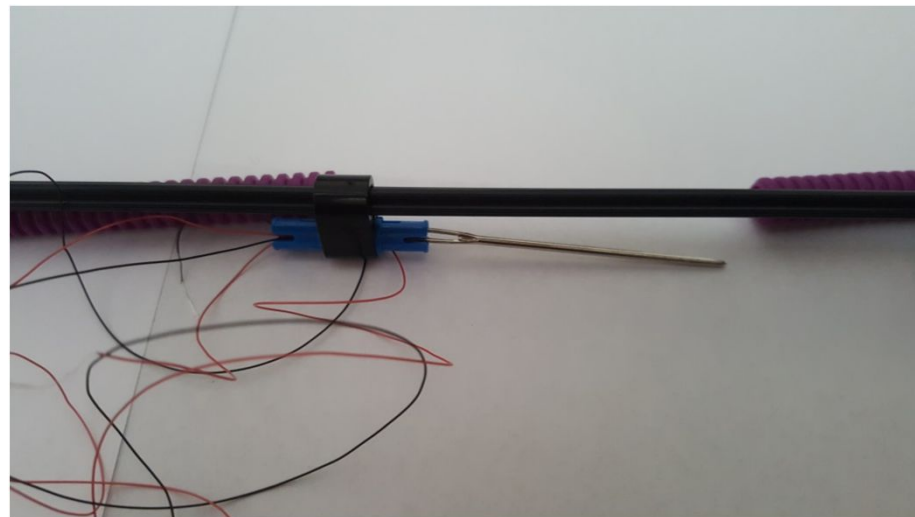
Remove the Ribbed Hose if needed, to pass the motor's wires thru the Friction Pin (Red Arrow)



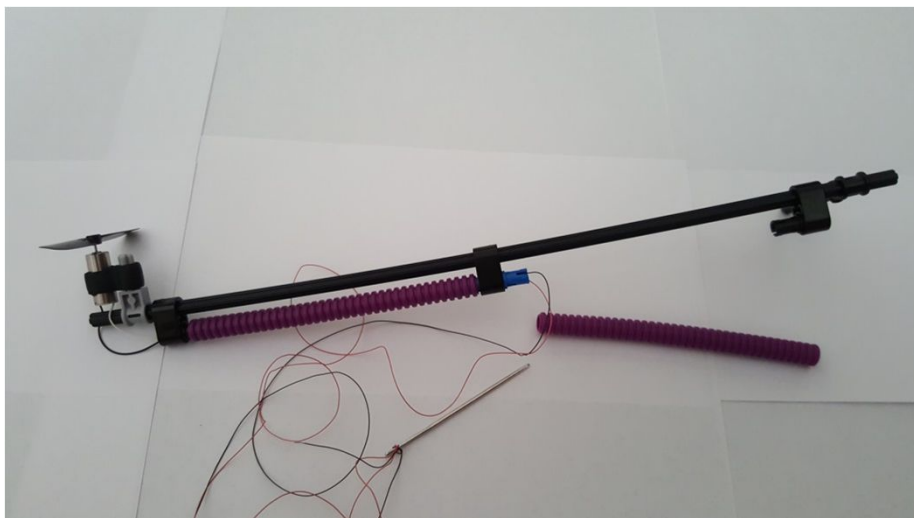
After passing thru the Friction Pin, thread the motor's wires into the Ribbed Hose



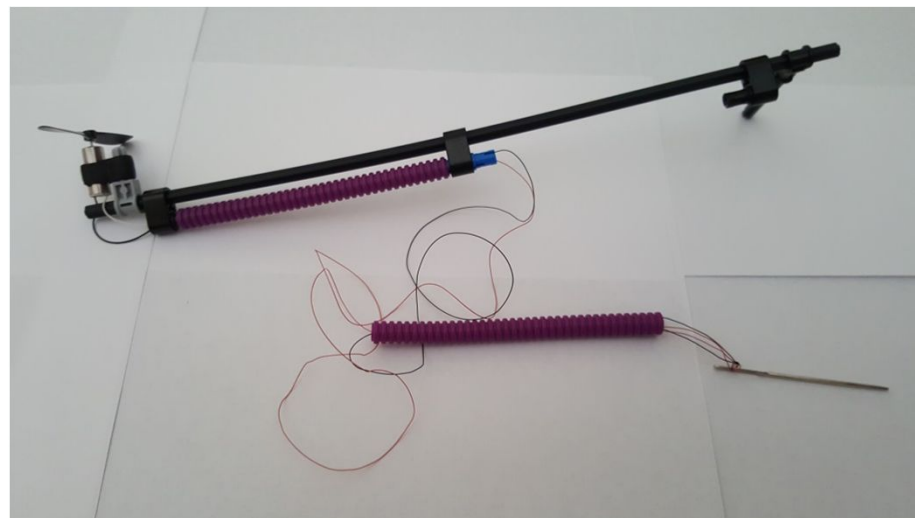
Reconnect the Ribbed Hose to its Friction Pin (Red Arrow), making sure to there's no wire slack or pinched wire



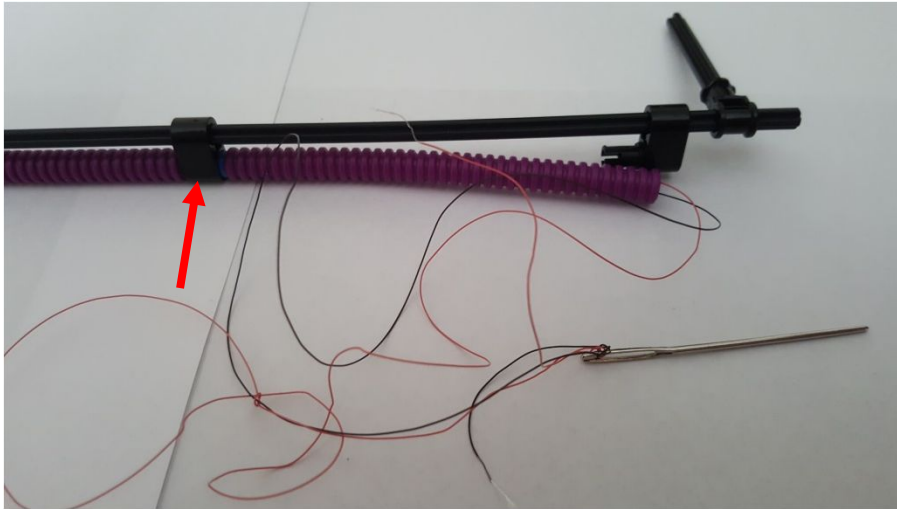
Remove the other Ribbed Hose and thread the motor's wire thru the Long Pin



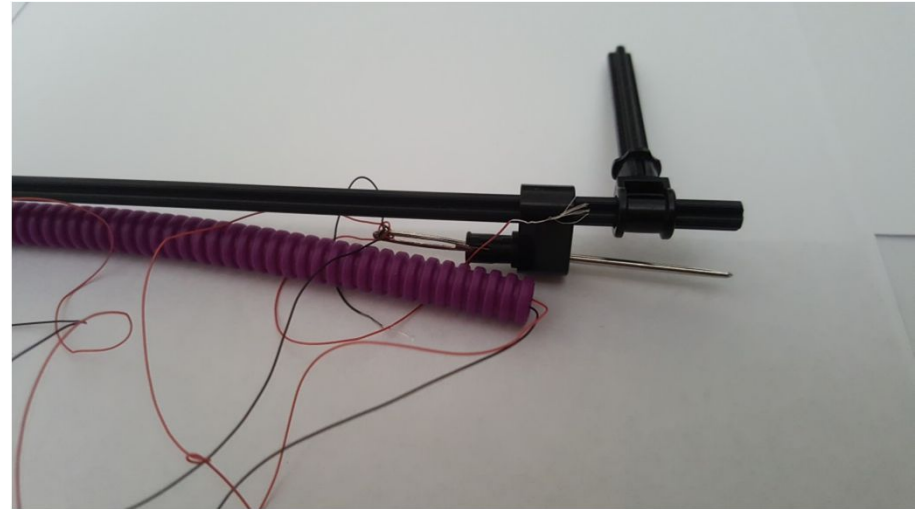
Pull the remaining wire thru the Long Pin



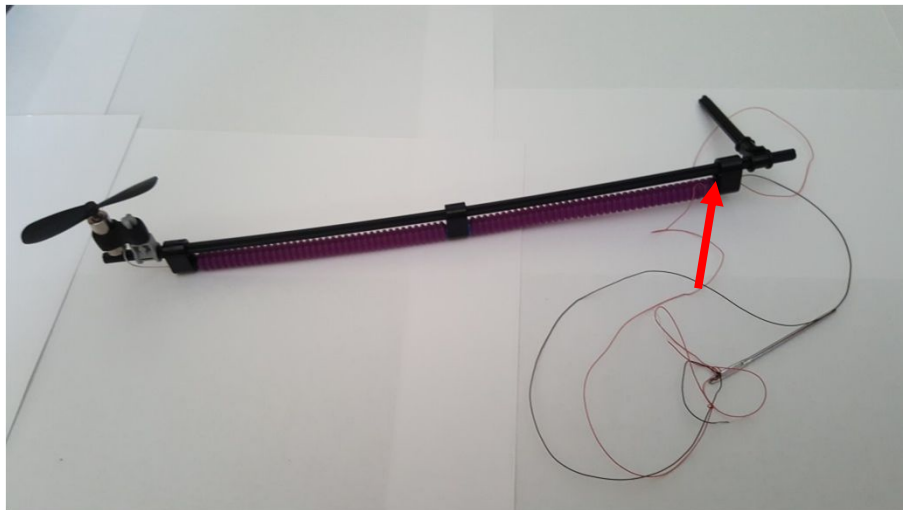
Thread the motor's wire thru the Ribbed Hose



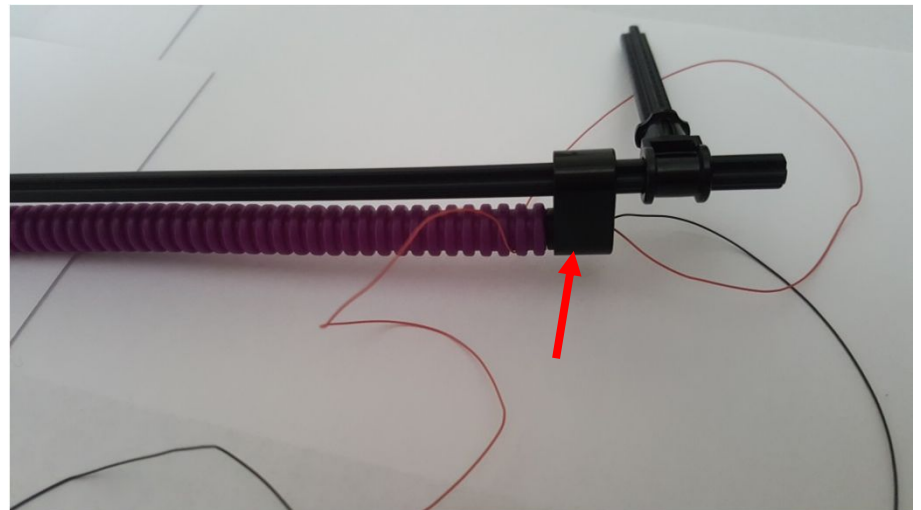
Reconnect the Ribbed Hose to its Long Pin (Red Arrow). Again, make sure to there's no wire slack or pinched wire



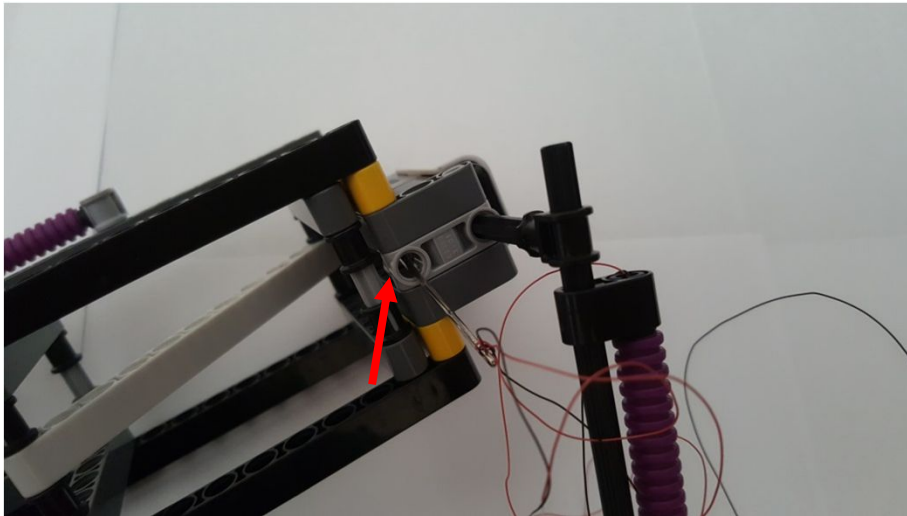
Thread the motor's wires thru the Friction Pin



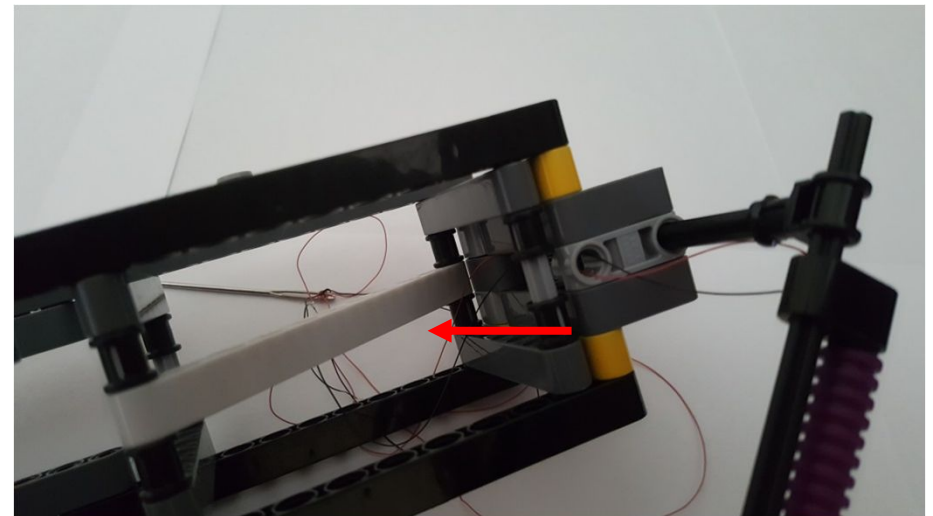
After threading thru, reconnect the Ribbed Hose to the Friction Pin (Red Arrow)



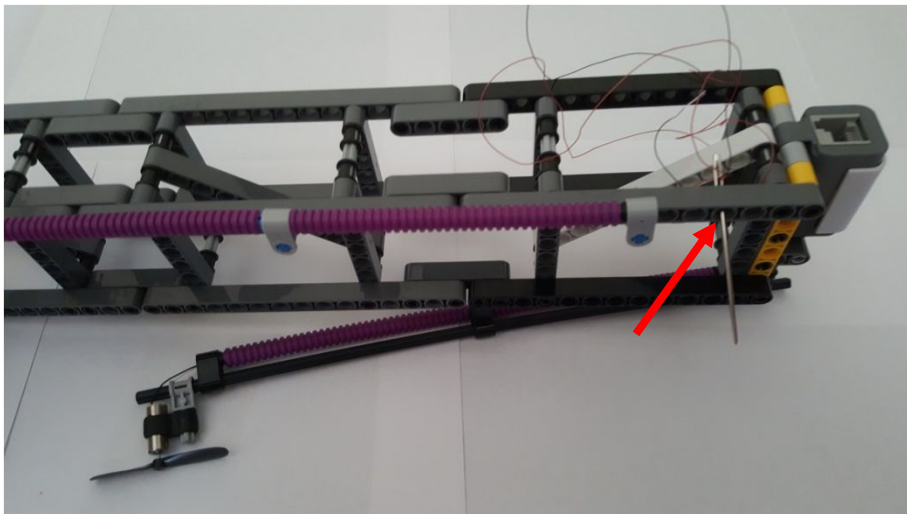
Close-up



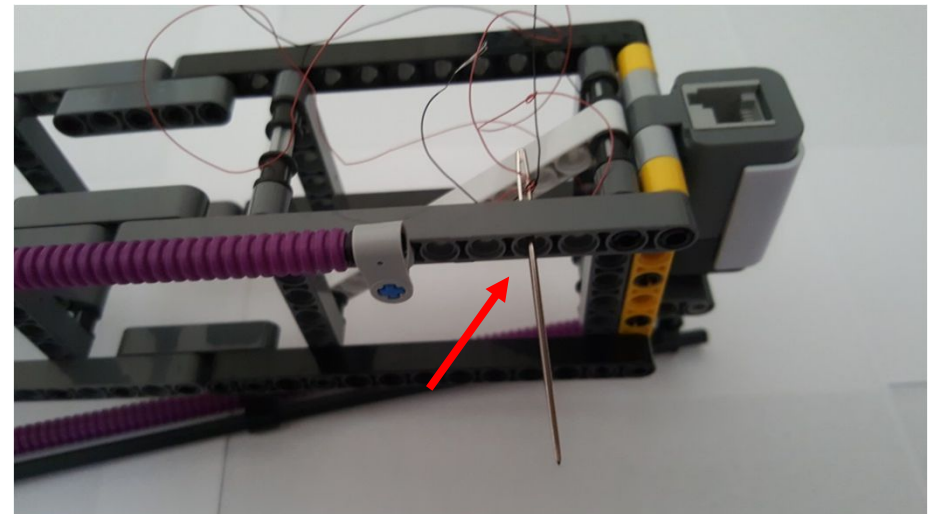
Re-attach Pendulum to Angle Sensor. Thread motor's wire thru bottom part of connector (Red Arrow)



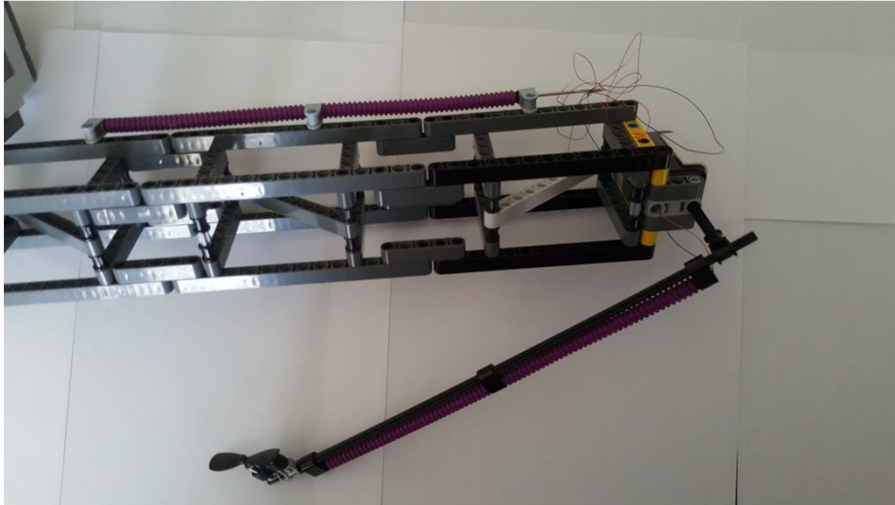
Pass needle below the Angle Sensor mount (Red Arrow), pulling motor's wire and reducing slack



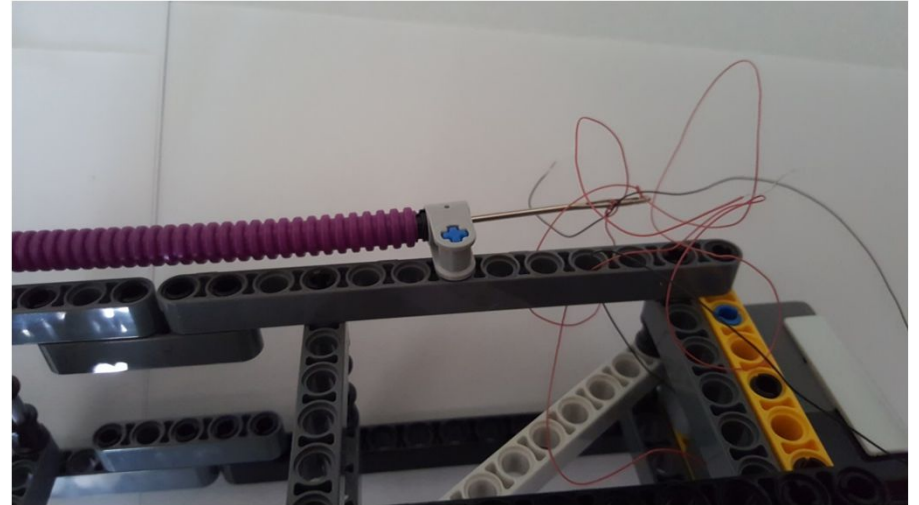
Pass needle thru the Beam's hole (Red Arrow).



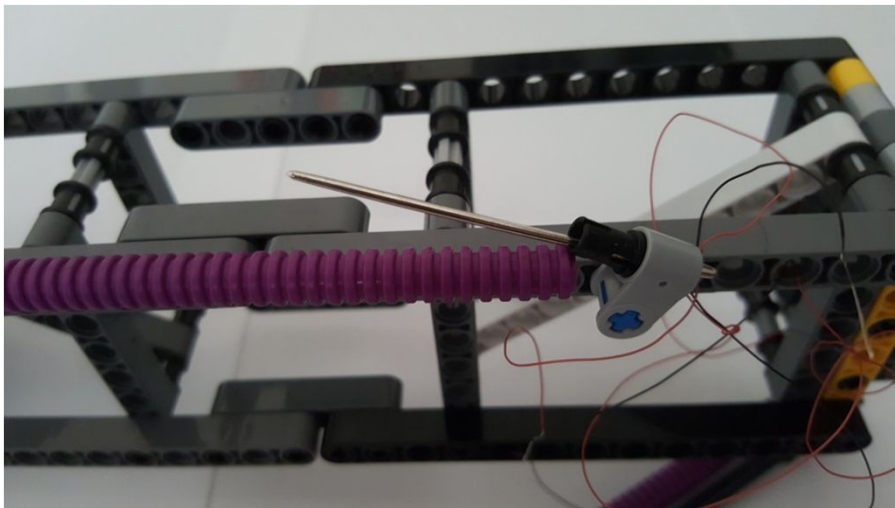
Close-up (Red Arrow).



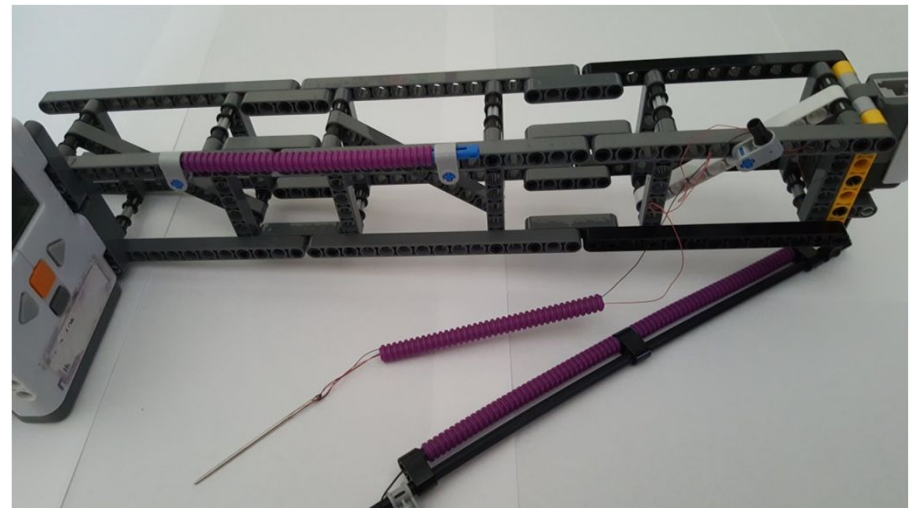
Next, thread thru the Axle-Pin Connector



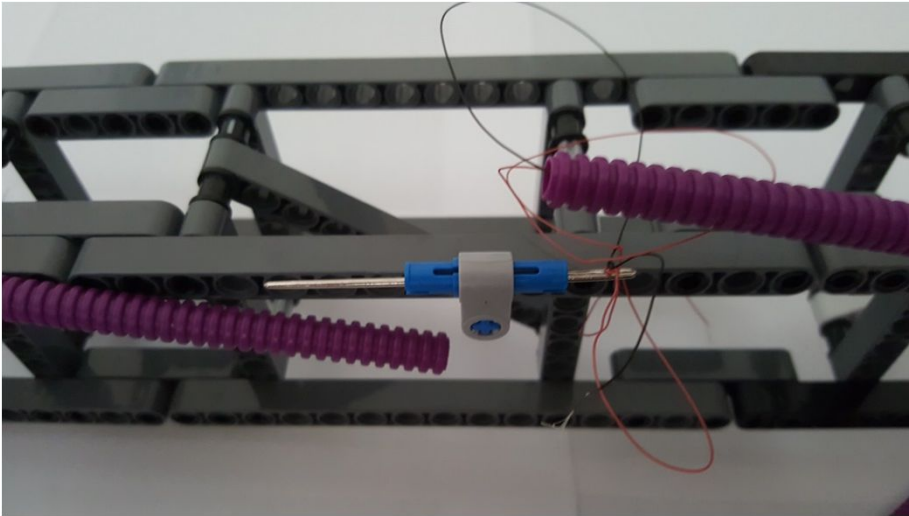
Close-up



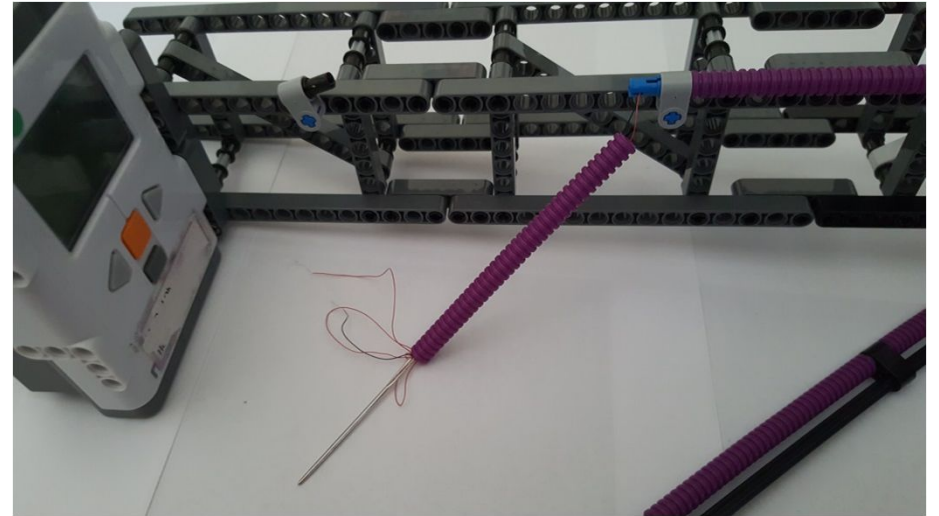
Remove the Ribbed Hose. Thread motor's wire thru the Friction Pin



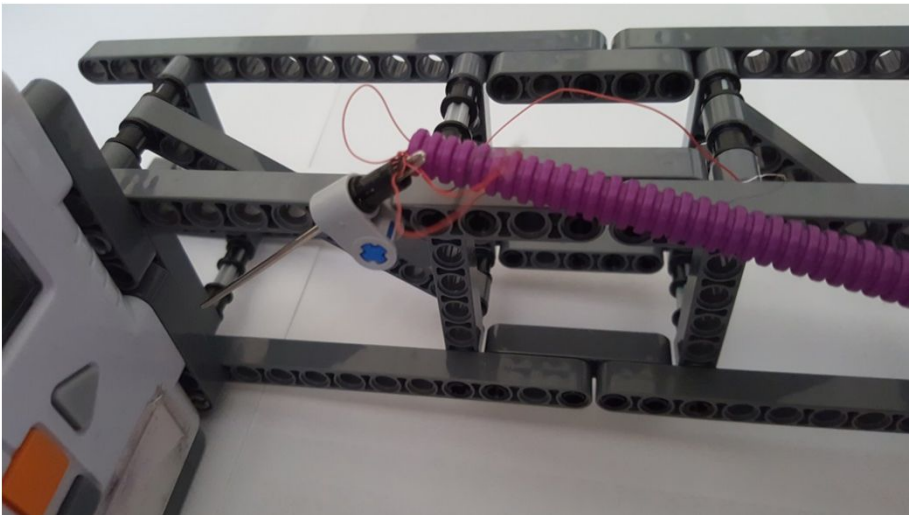
Thread thru the Ribbed Hose



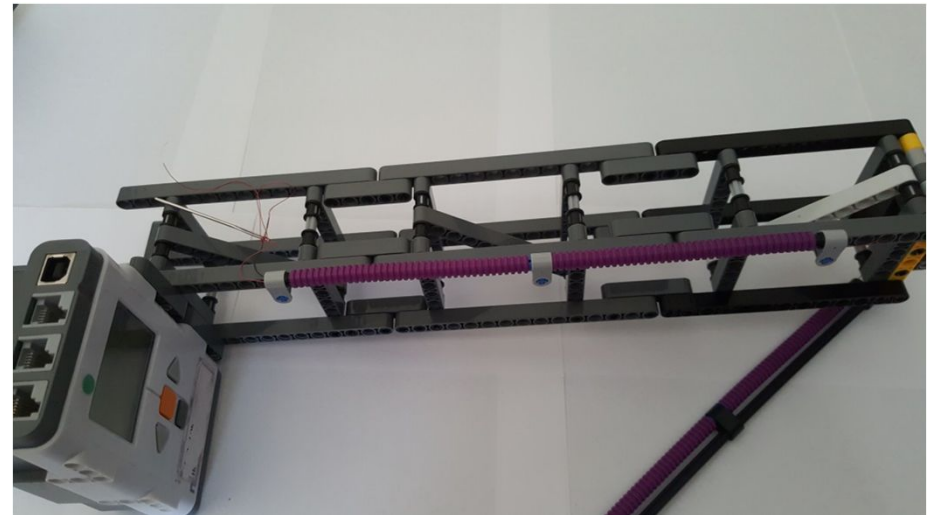
Re-attach Ribbed Hose. Thread thru Long Pin



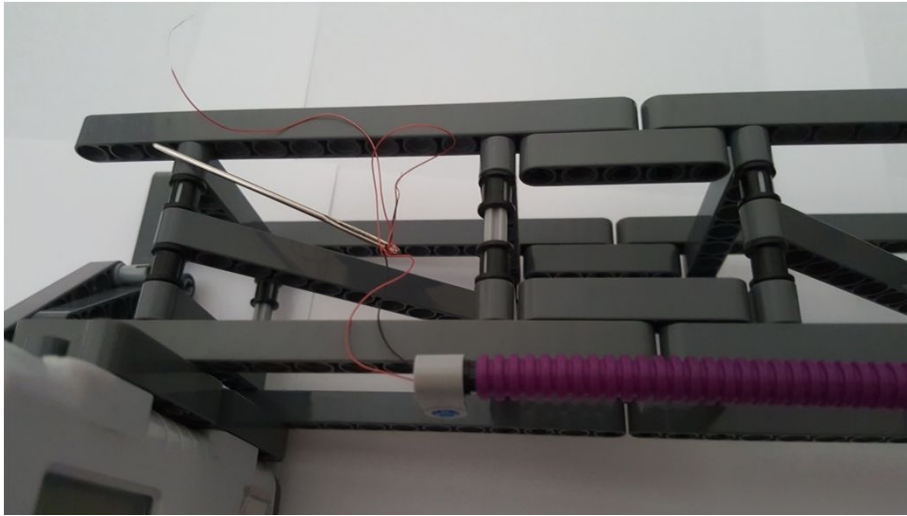
Detach other Ribbed Hose and thread motor's wire thru it



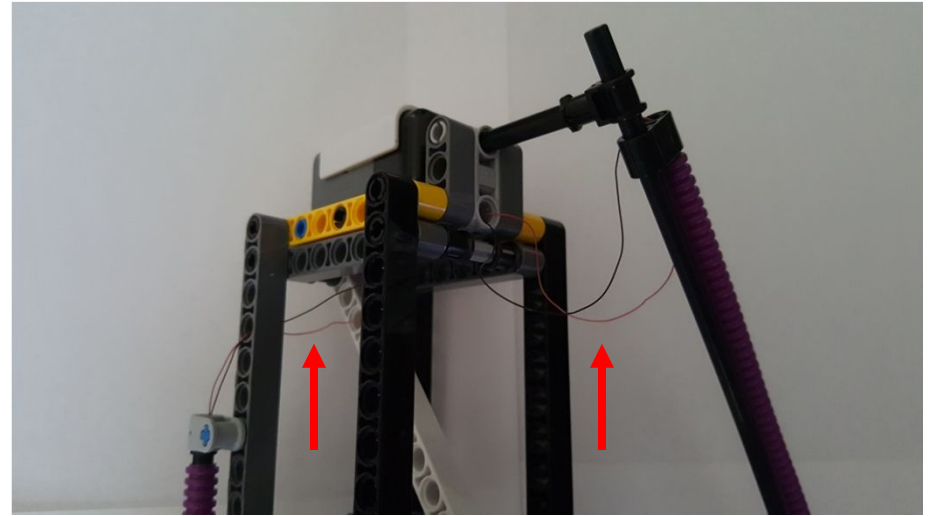
Re-attach Ribbed Hose to Long Pin. Thread motor's wire thru Friction Pin and Axle-Pin Connector



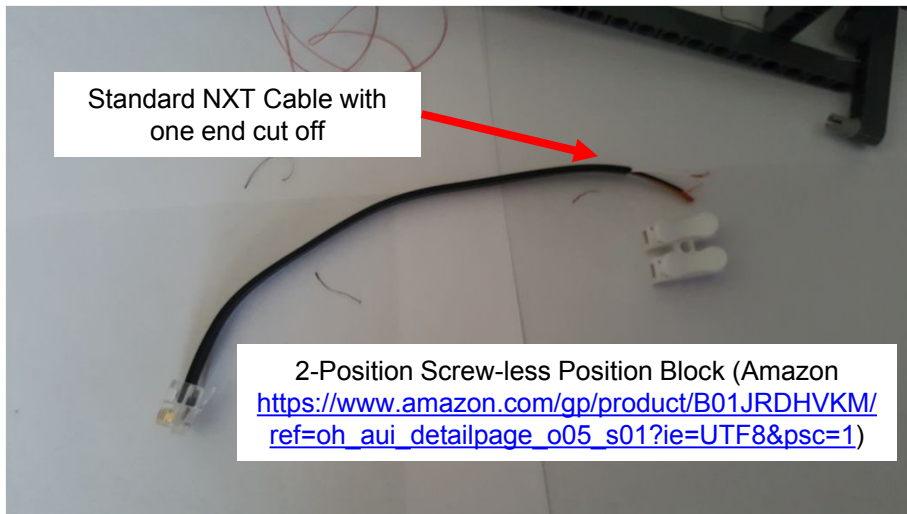
Re-attach Ribbed Hose to Friction Pin. Make sure there's no slack or pinching of the motor's wire



Completion – motor's wire exits the Axle-Pin



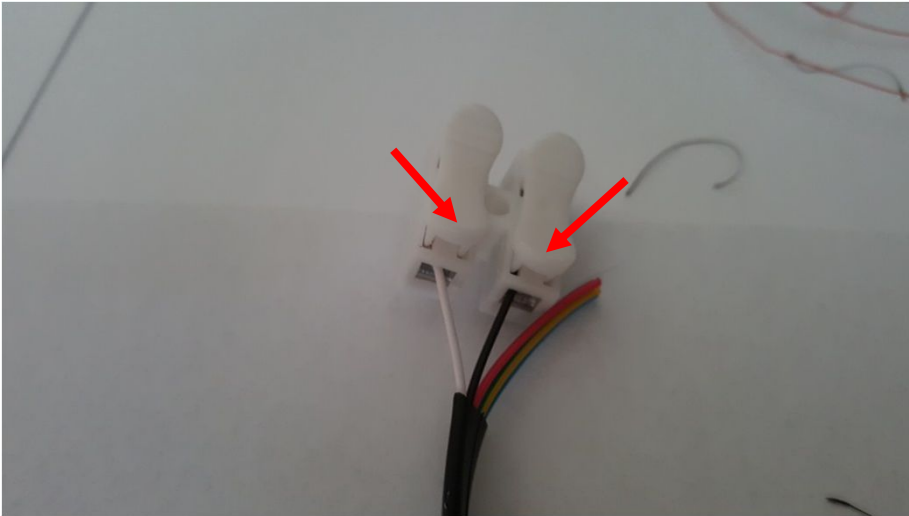
Completed wiring thru harness. Leave some slack (Red Arrows) in the motor's wire so that the Pendulum can swing freely



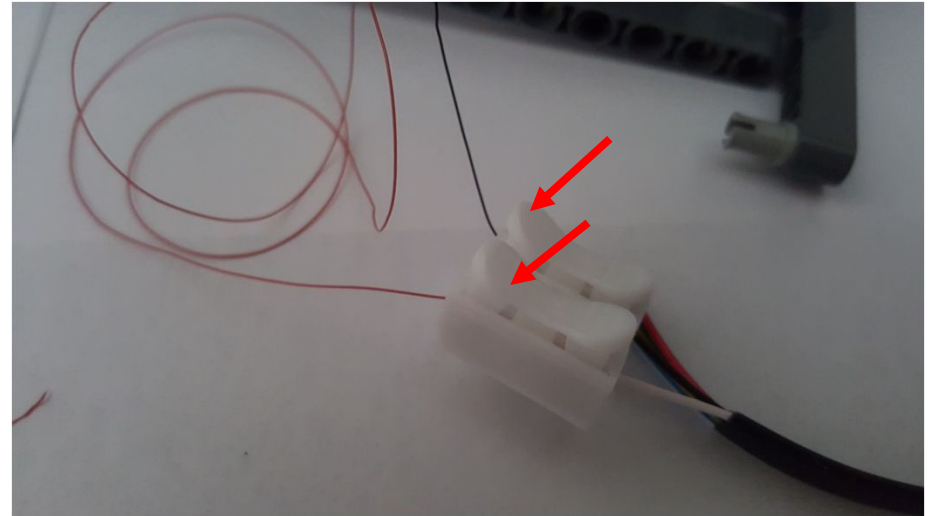
Gather Parts: Shown is a spliced NXT cable and a 2-position Terminal Block



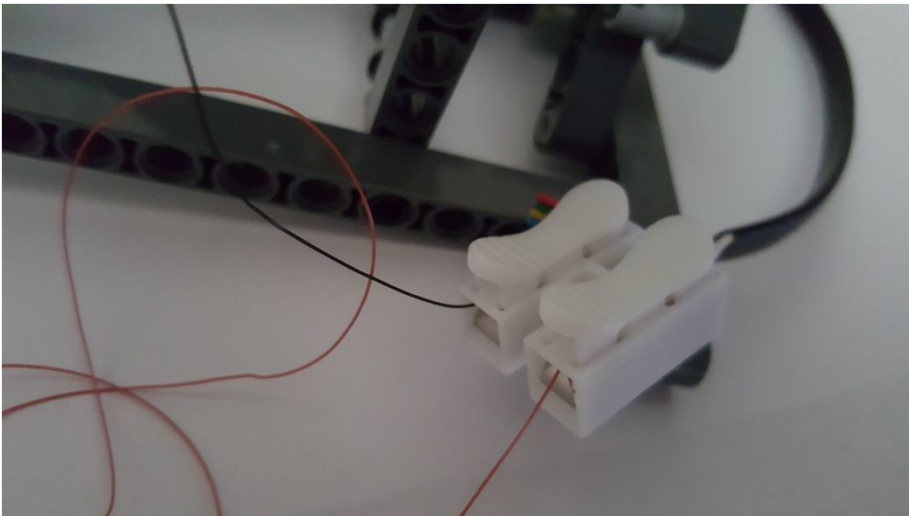
Alternative view: Only the Black and White wires in the NXT Cable will be used. Hence they are stripped



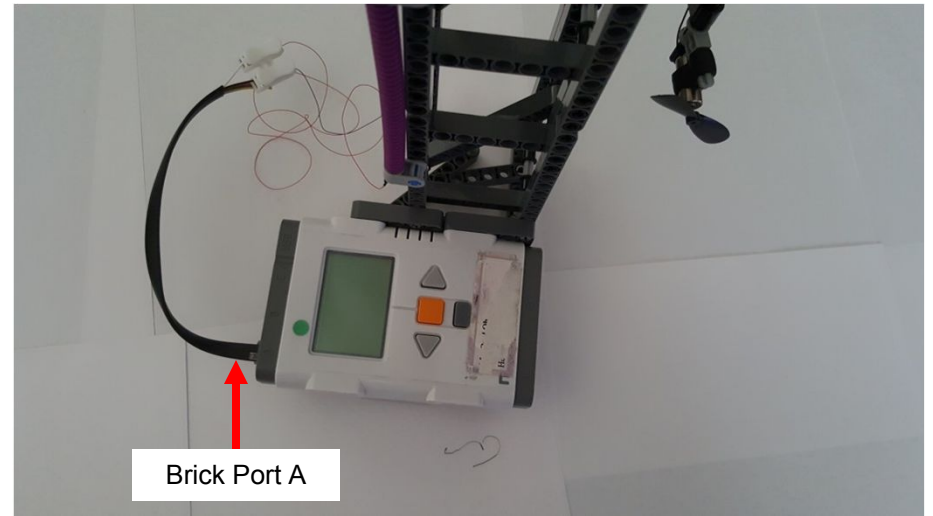
Press down on the 2-Position Terminal Block (Red Arrows) and insert the NXT Cable's Black and White wires



On the opposite end of the 2-Position Terminal Block (Red Arrows), push and insert the Motor-Prop's wires

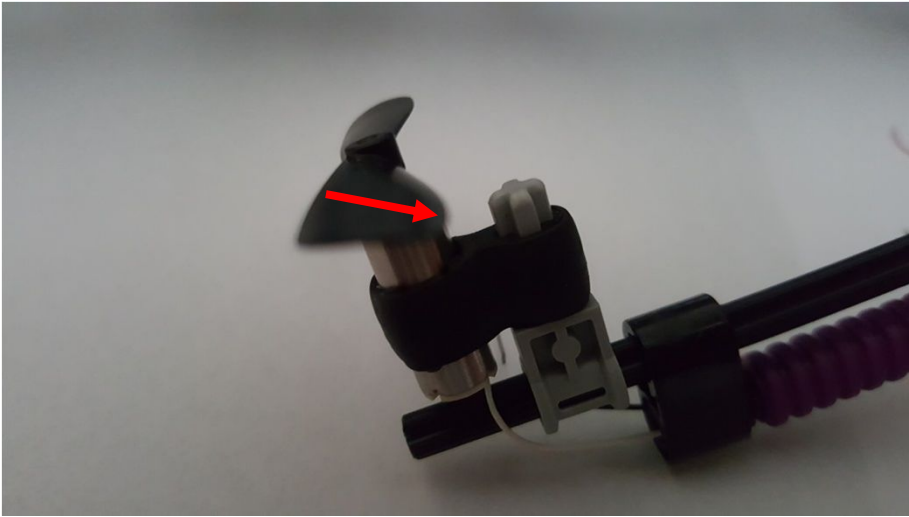


For this particular motor-prop, the red and black wires are connected the NXT Cable's white and black wires. This polarity will be check when the motor is powered

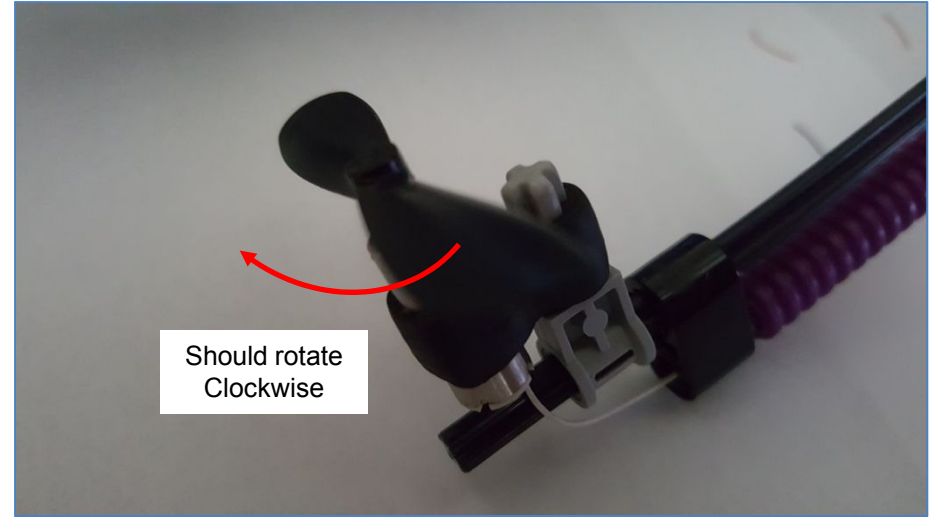


Brick Port A

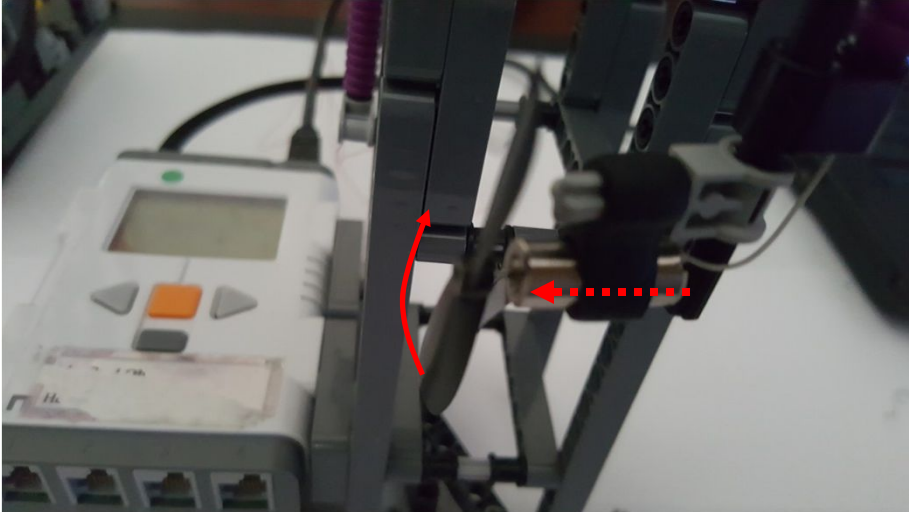
Insert the NXT Cable into the Brick's Port A (Red Arrow)



Close-up of Prop. Note the profile (Red Arrow) shows blade sloping downwards

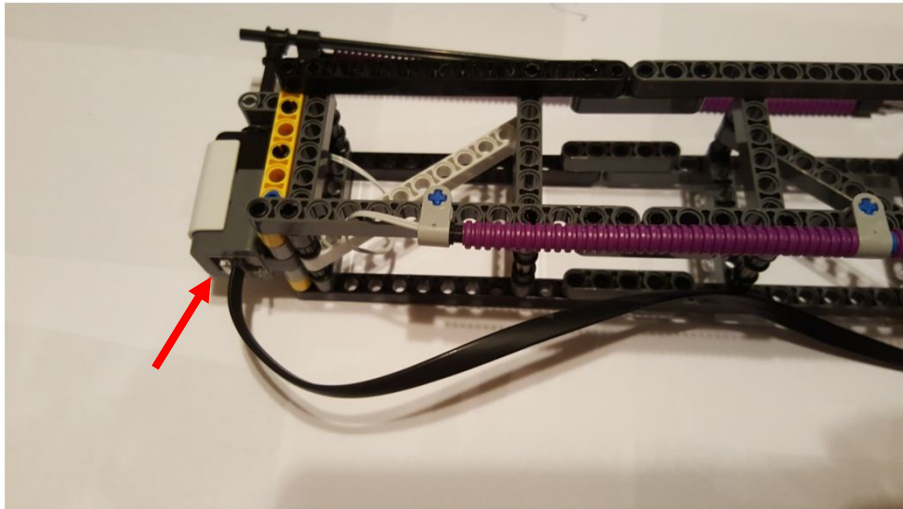


Looking into the prop, the blade should rotate clockwise

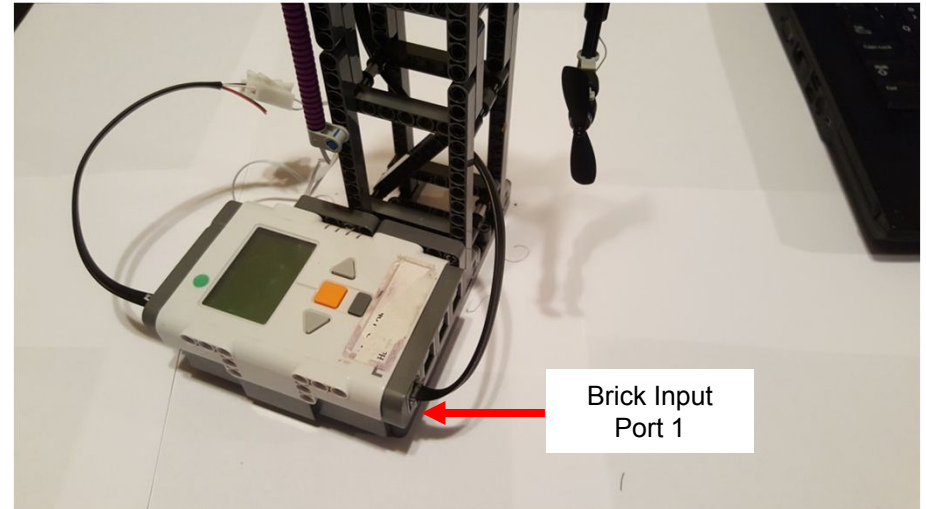


Alternative View. If motor rotates clockwise (Red Arrow), the blade “cut” into the air and Pendulum will lift towards Brick (Dash Red Arrow)

Viewed from this perspective, the Pendulum at rest will be $\theta = 0$ degrees. When the motor-prop rotates (Red Arrow direction), the Pendulum will rise (Dash Red Arrow) and θ will increase positively



Lastly, connect one end of a Long NXT cable into the Angle Sensor (Red Arrow)



Connect the other end of the Long NXT cable into Input Port 1 (Red Arrow) of the Brick

Completed Motor-Prop Mounting
and Wiring

**Congratulations! LEGO DCP Build Completed and Ready
for Testing and Experimentation**