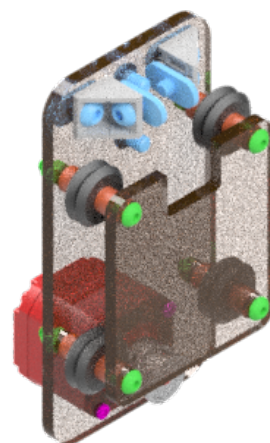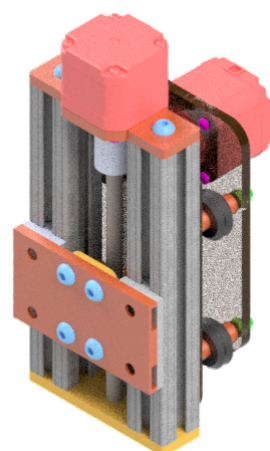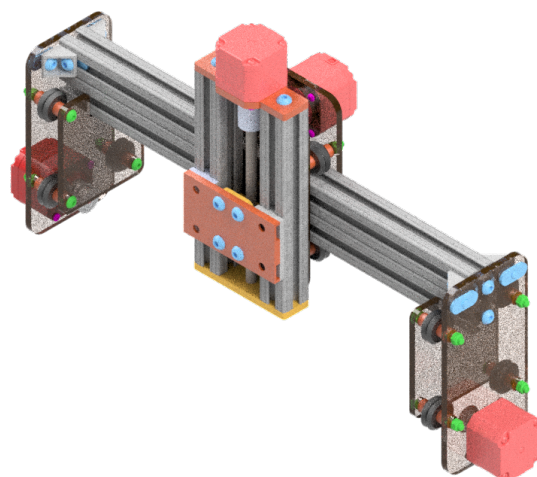1) Y-Axis Slide Assembly

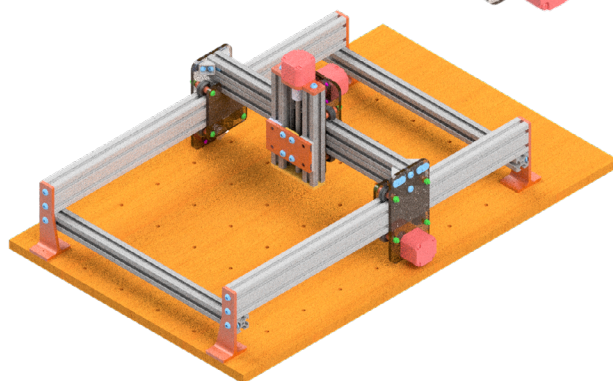x2

2) X/Z-Axis Slide Assembly

3) Gantry Assembly

4) Final Assembly

5) Electronics Routing

1) Y-Axis Slide Assembly

Label	Description	Qty.
A	Y Plate Outer	2
B	Y Plate Inner	2
C	Small Bracket	4
D	NEMA 17	2
E	Belt Pulley	2
F	T-Slot Nut	8
G	M5 Locknut	8
H	M3 x 10mm Bolt	8
I	0.25" Cap Screw	8
J	Spacer	16
K	M5 x 45mm Bolt	8
L	Delrin Wheel	8

A

B

C

D

E

F

G

H

I

J

K

L
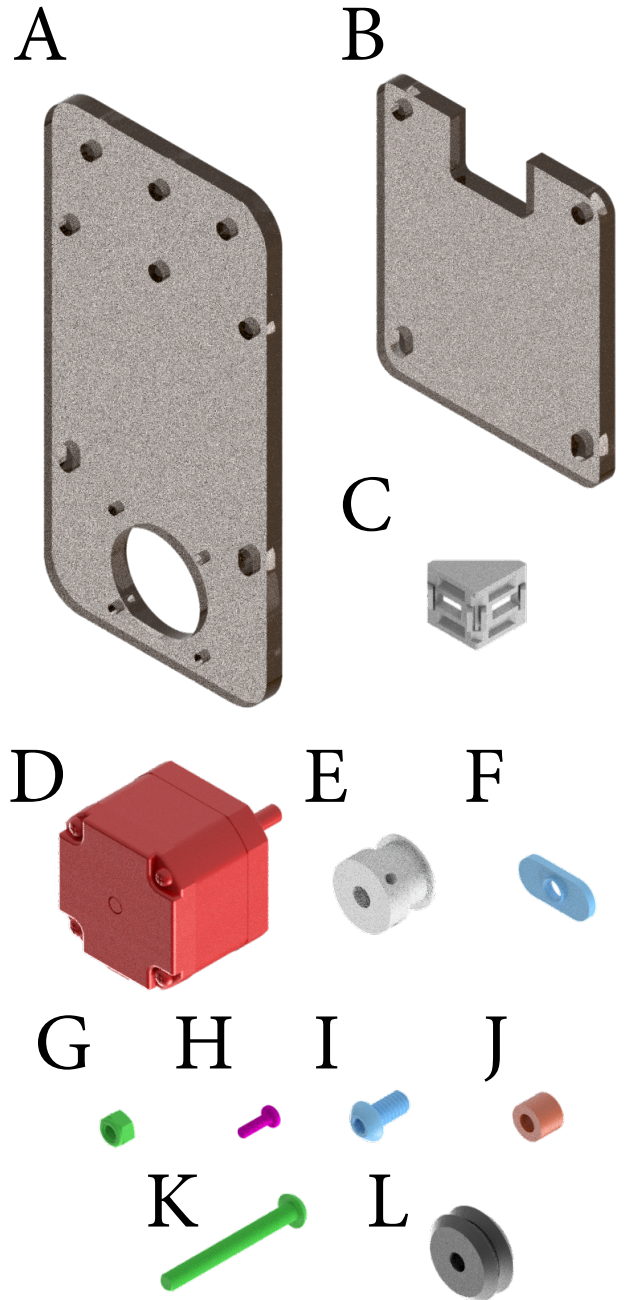
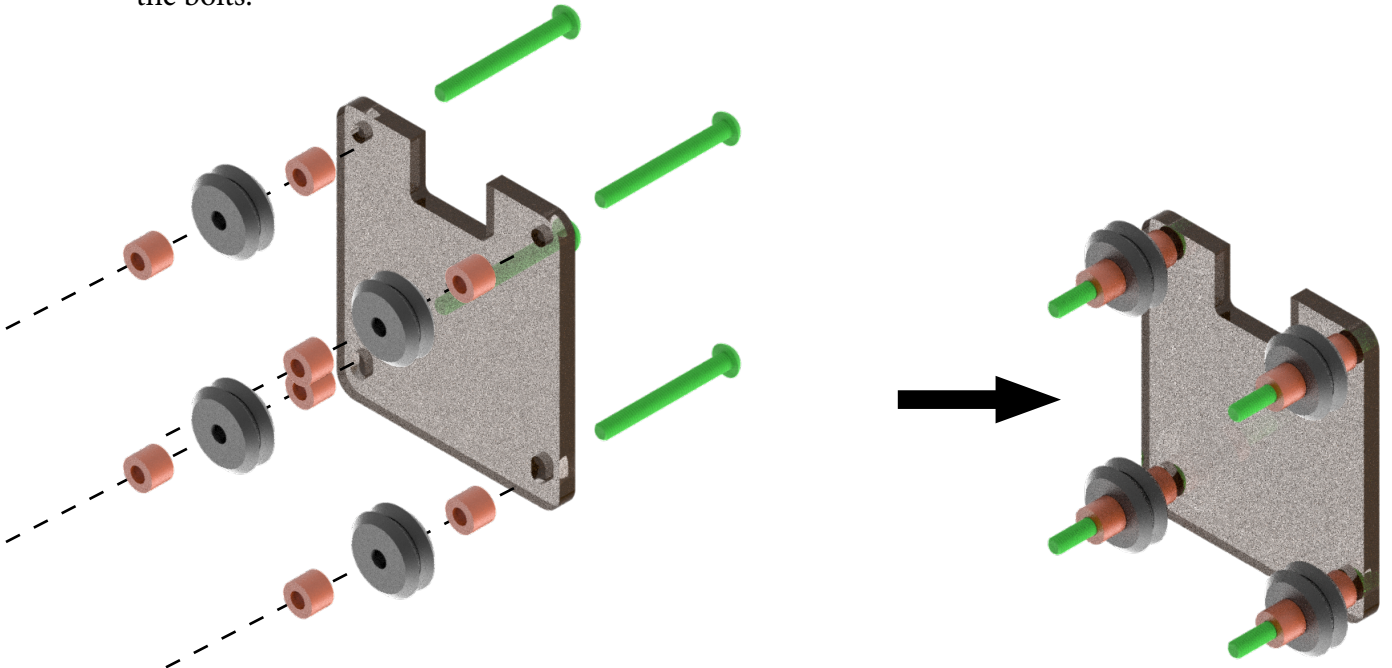**1.1** Attach a **NEMA 17** motor to **Y Plate Outer** using (4) **M3 x 10mm Bolts**. Attach the **Belt Pulley** to the motor shaft.
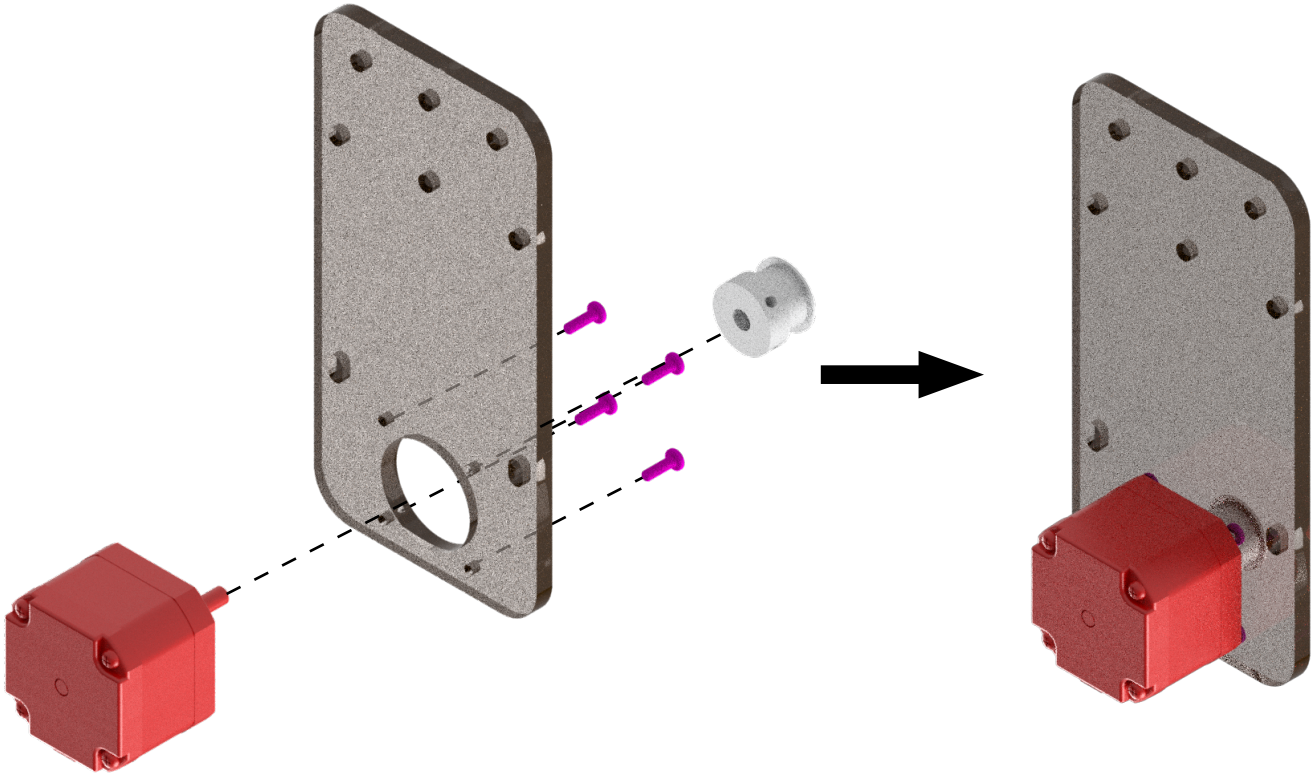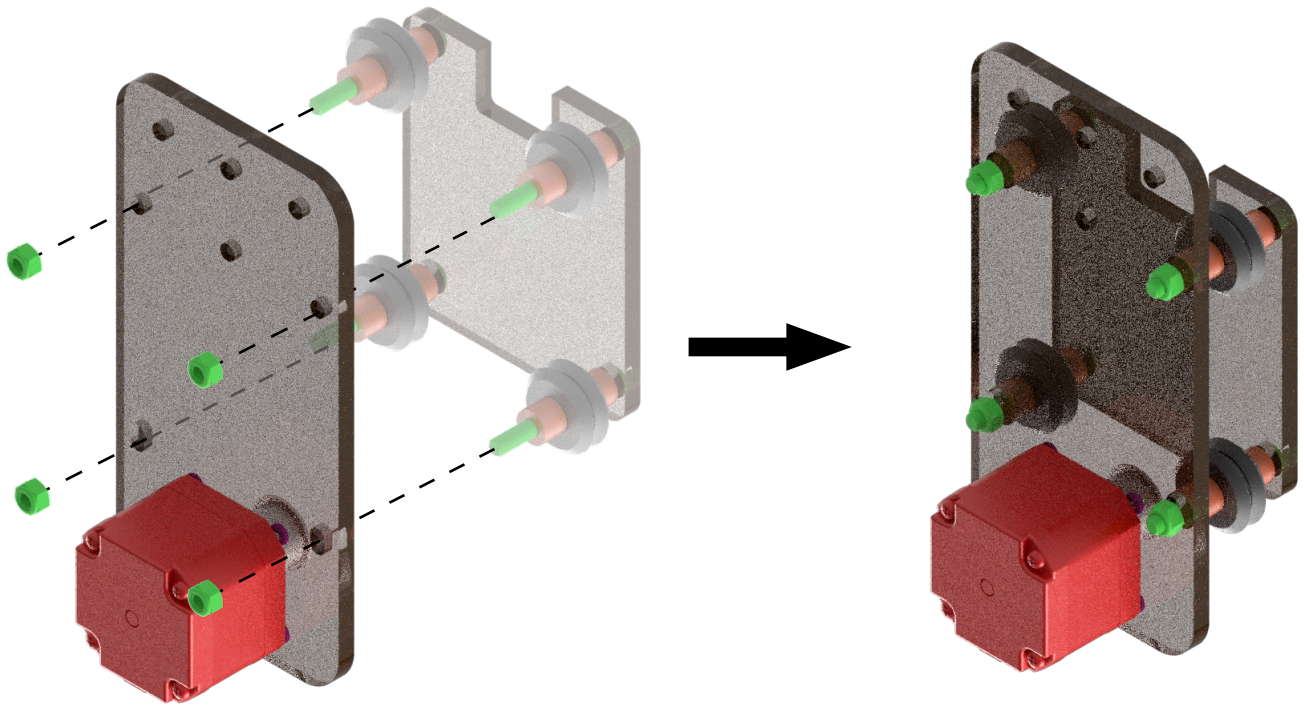
1.2 Assembly (4) **M5 x 45mm Bolts** through **Y Plate Inner**. Put (1) **Spacer**, (1) **Delrin Wheel** and (1) **Spacer** on the other end of the bolts.
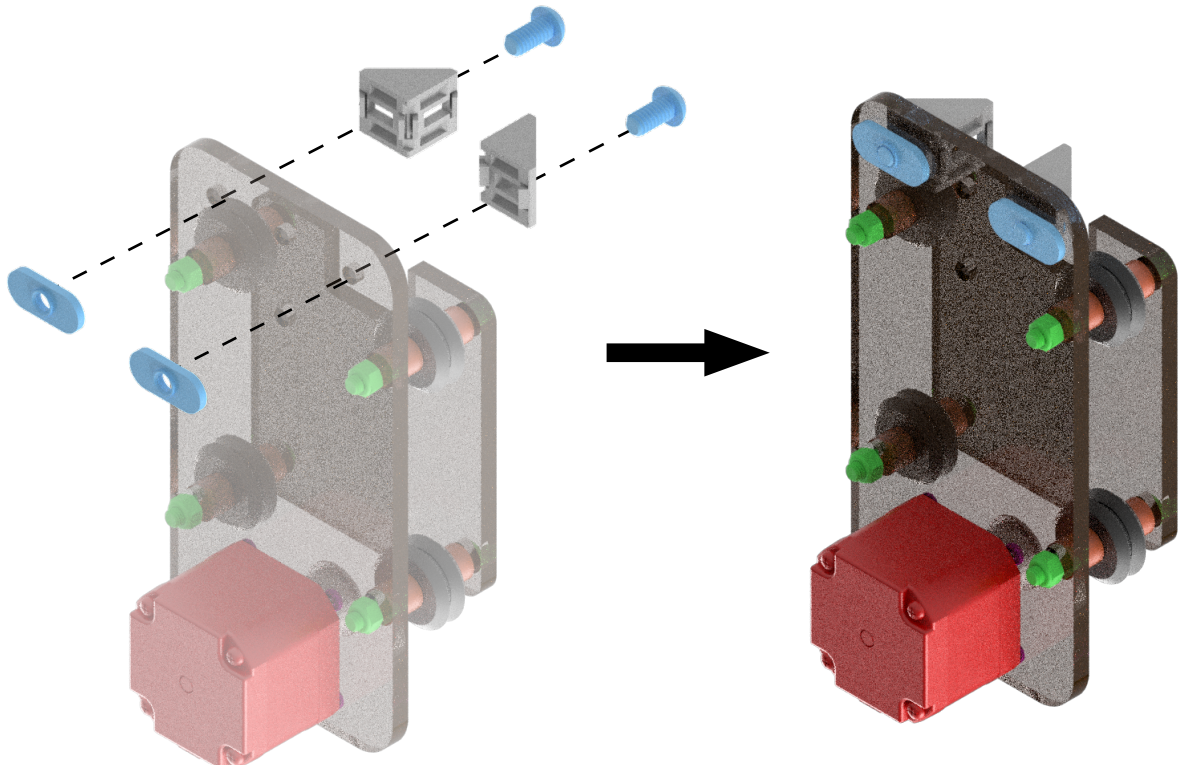
1.3 Attach the assemblies from Steps 1.1 and 1.2 using (4) **M5 Locknuts**. These will be tightened further later on so the wheels ride freely on the extrusions.
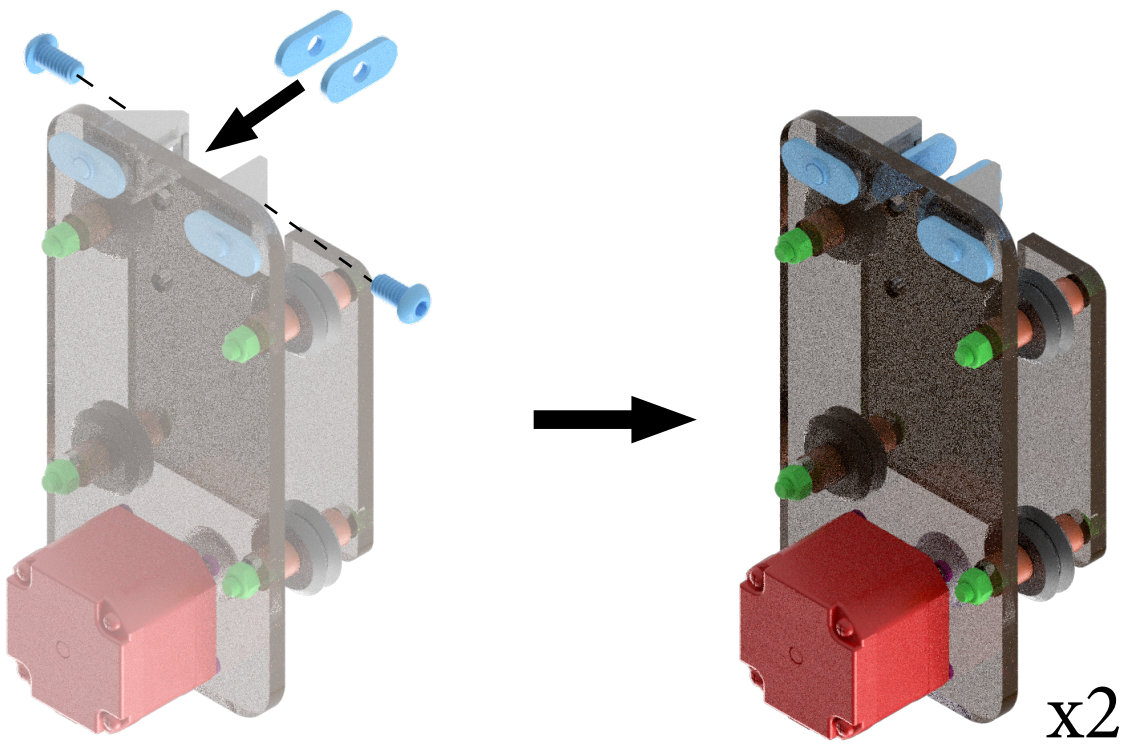
1.4 Use (2) **0.25" Cap Screws** and (2) **T-Slot Nuts** to attach (2) **Small Brackets**.

1.5 Use (2) **0.25" Cap Screws** and **T-Slot Nuts** for the other bracket openings. Repeat these steps so you have two assemblies.

x2

2) X/Z-Axis Slide Assembly

Label	Description	Qty.
A	X Plate Outer	1
B	X Plate Inner	1
C	5mm to 8mm Coupler	1
D	NEMA 17	2
E	Belt Pulley	1
F	T-Slot Nut	5
G	M5 Locknut	4
H	M3 x 10mm Bolt	8
I	0.25" Cap Screw	13
J	Spacer	8
K	M5 x 45mm Bolt	4
L	Delrin Wheel	4
M	Z Plate	1
N	Z Rod Bottom Hold	1
O	Z Slide	1
P	Linear Slide Bearing Profile	2
Q	Adapter	1
R	1010 x 6" Extrusion	2
S	8mm Threaded Rod	1
T	8mm Hex Nut	1
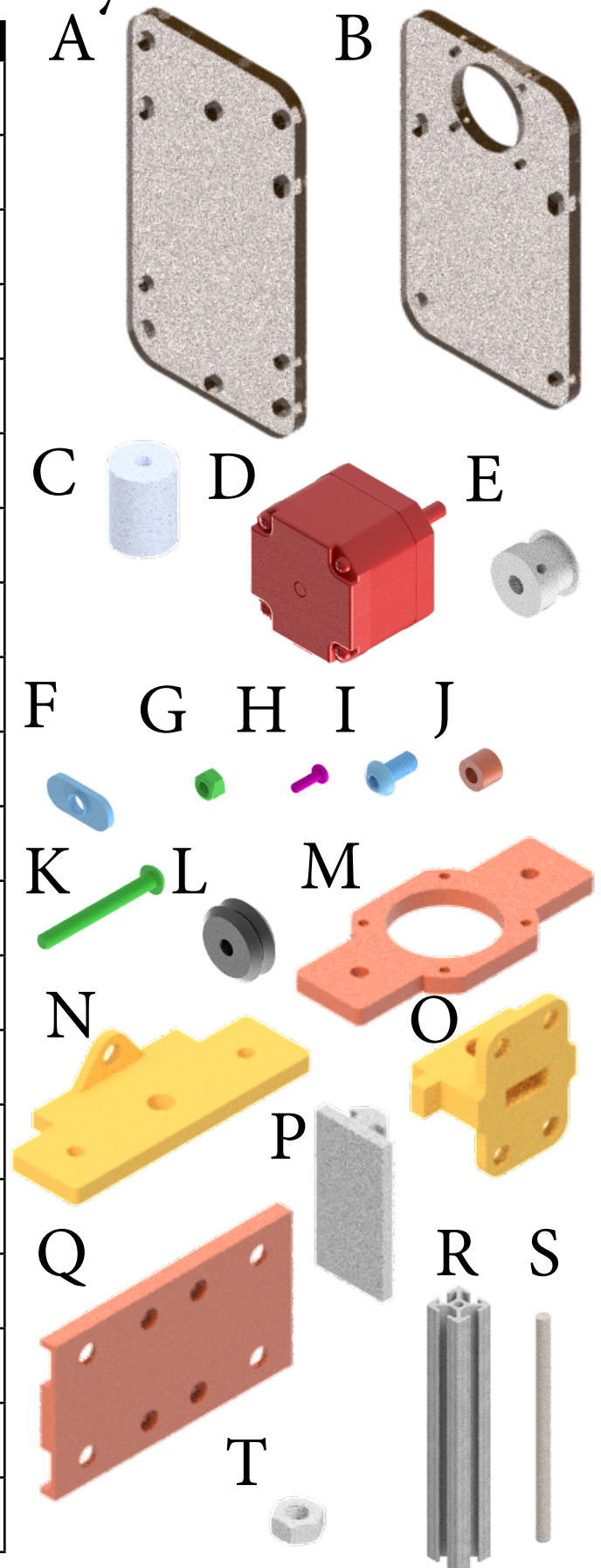
2.1 Assembly (4) **M5 x 45mm Bolts** through (1) **Spacer**, (1) **Delrin Wheel** and (1) **Spacer** and into **Y Plate Inner**.
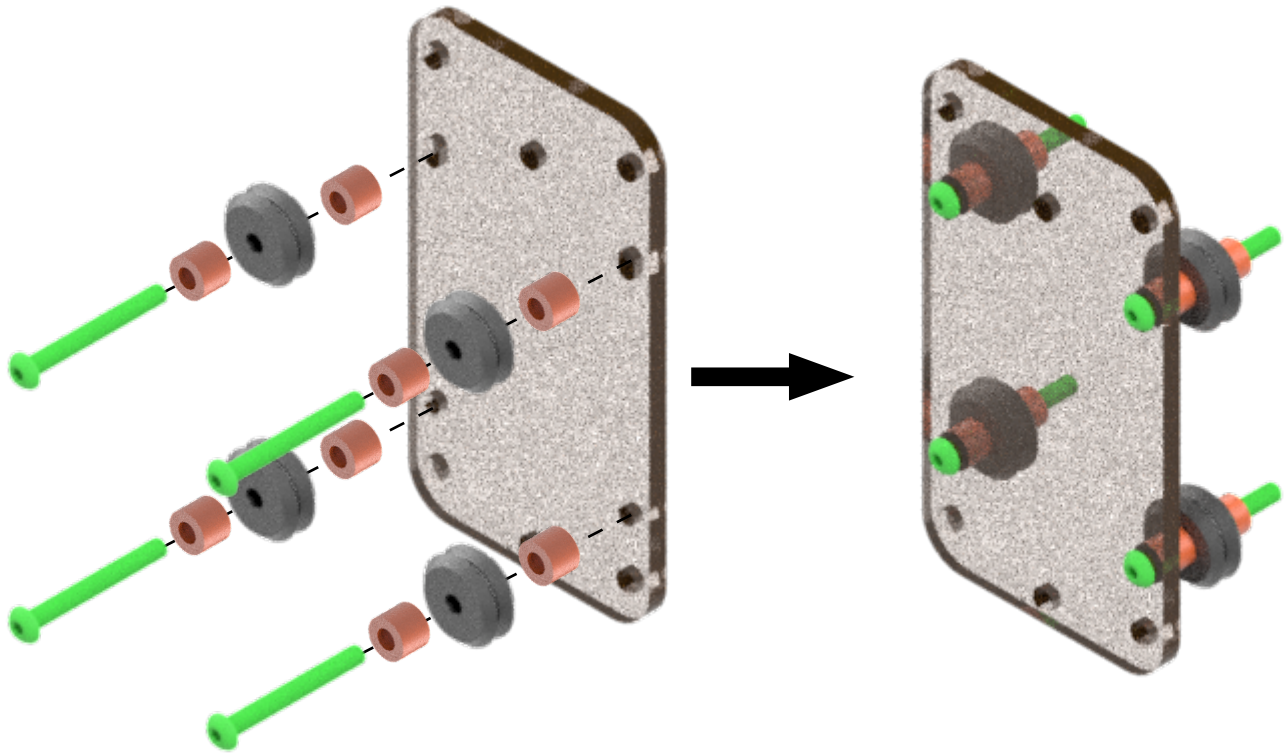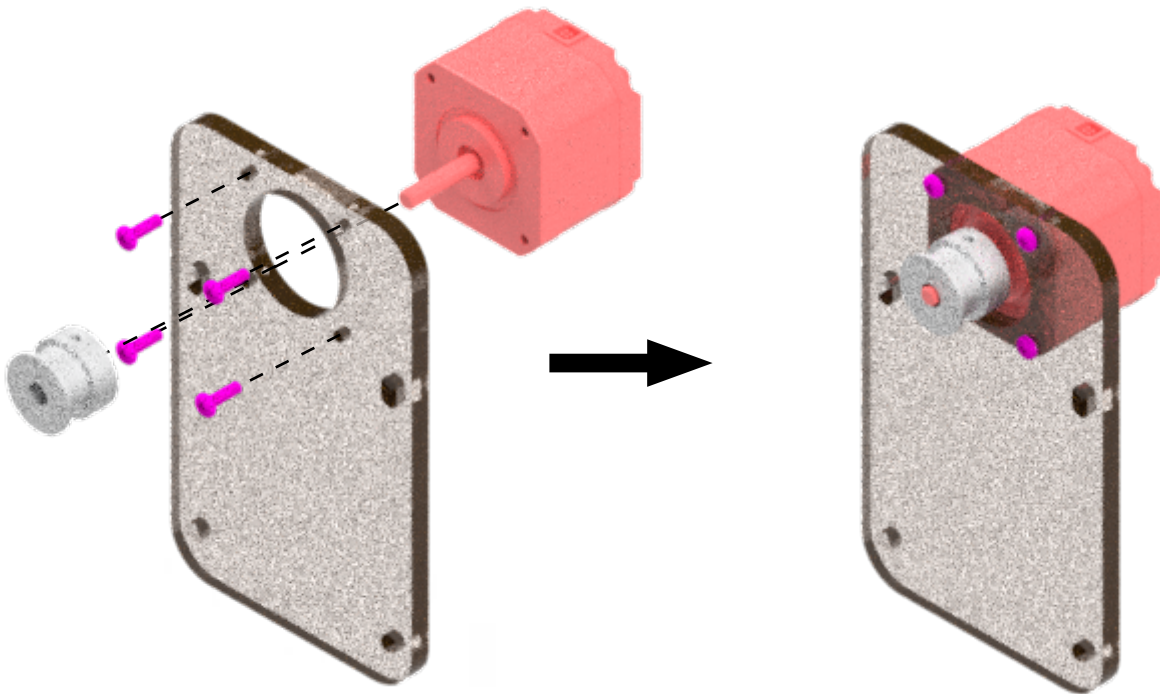
2.2 Assembly (5) **0.25" Cap Screws** through the assembly from Step 2.1 and fasten **T-Slot Nuts** to the other side. These will be tightened later.
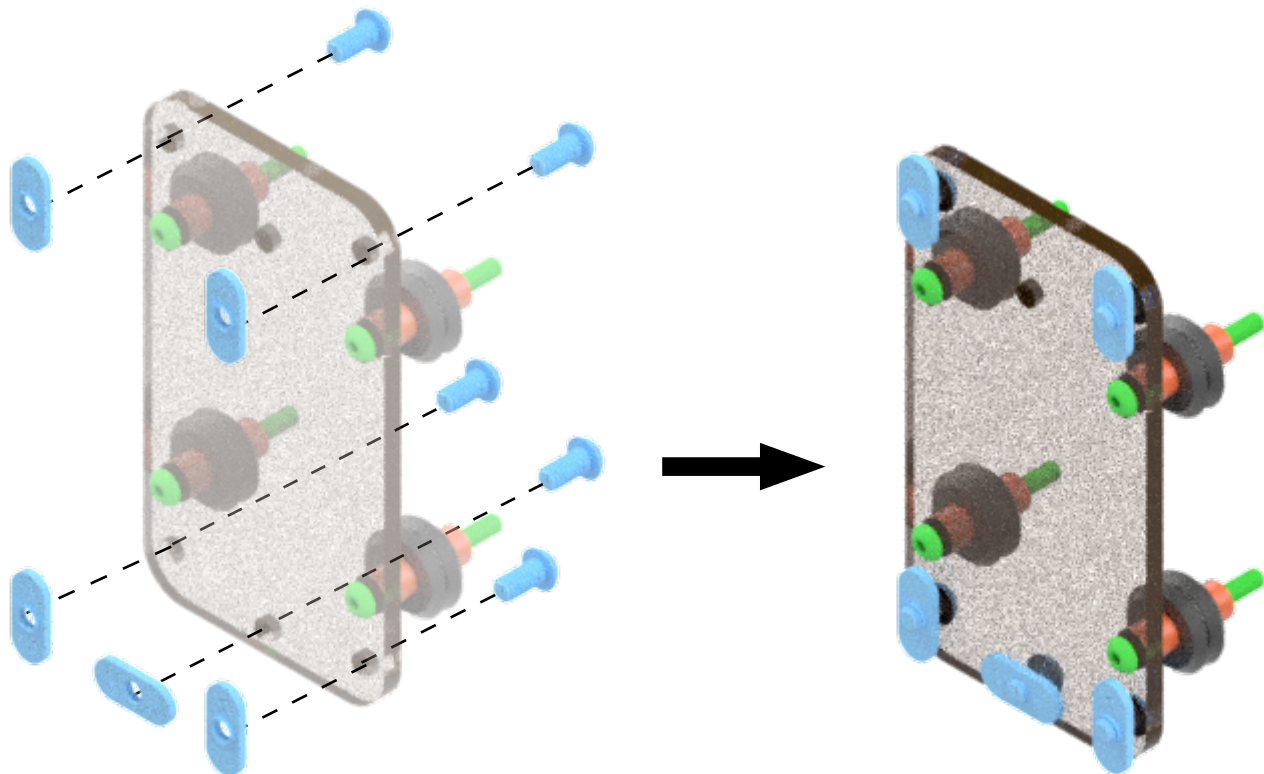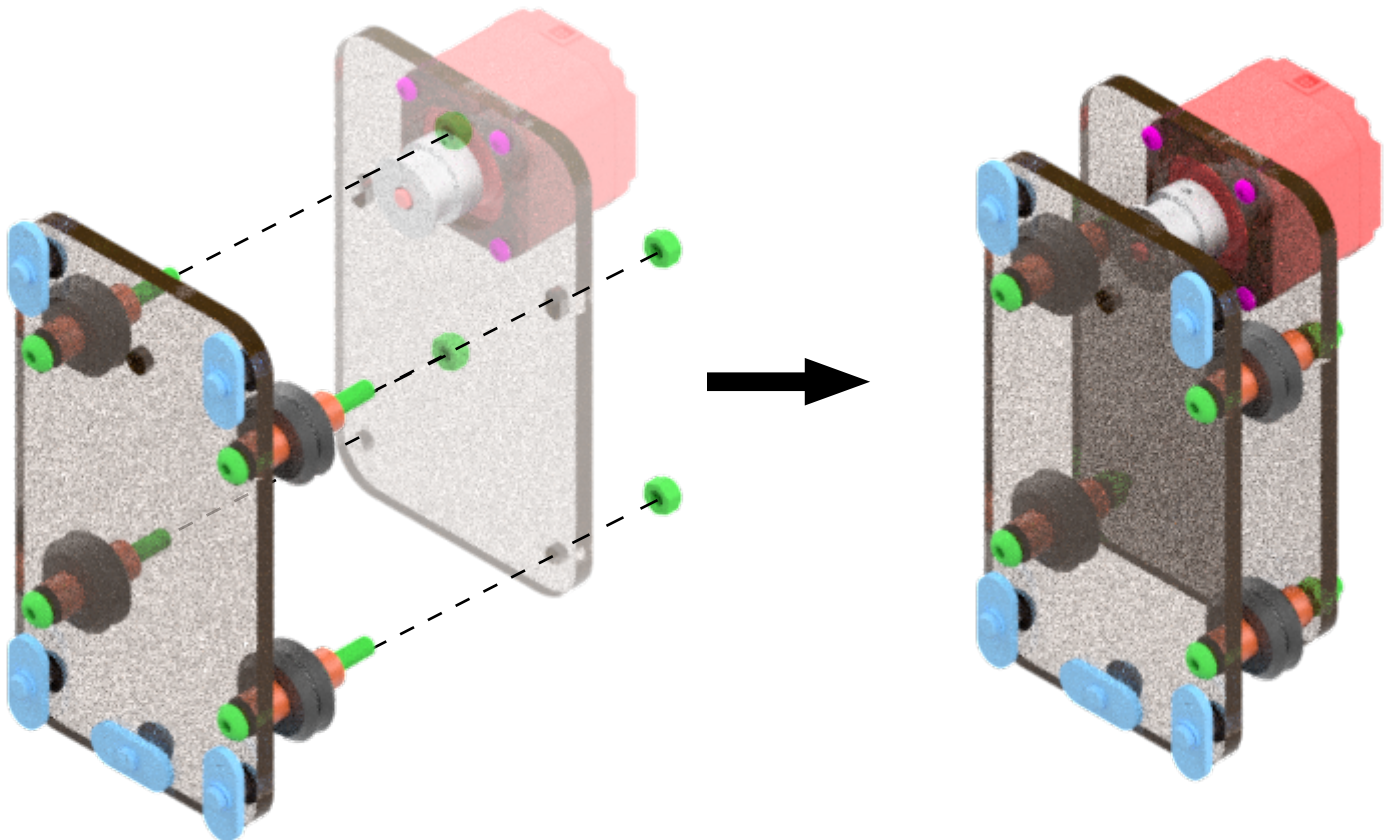
2.3 Attach (1) **NEMA 17** motor to **X Plate Inner** using (4) **M3 x 10mm Bolts**. Attach the **Belt Pulley** to the motor shaft.
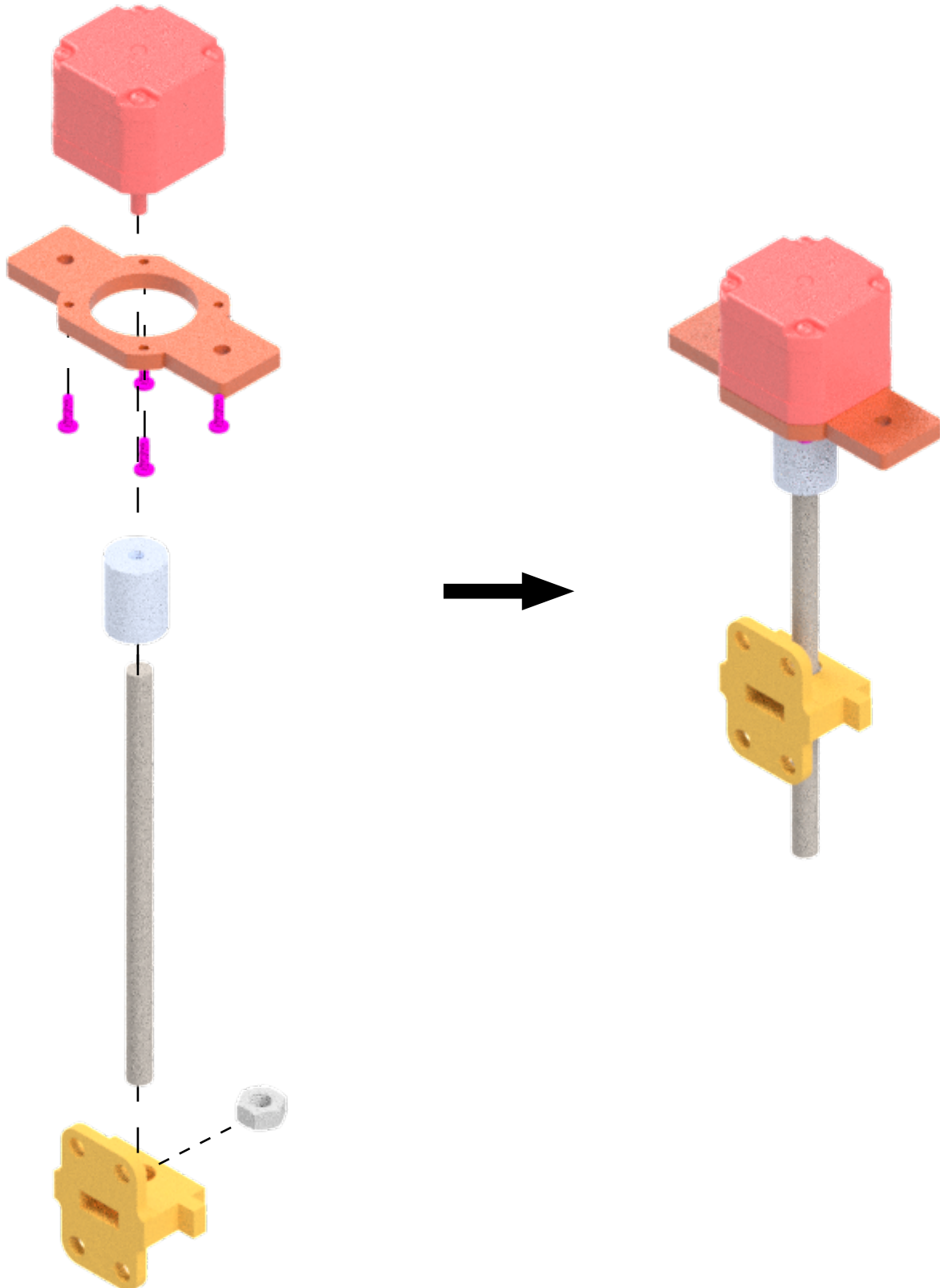
2.4 Attach the assemblies from Steps 2.2 and 2.3 using (4) **M5 Locknuts**. These will be tightened further later on so the wheels ride freely on the extrusions.

2.5 Attach (1) **NEMA 17** motor to **Z Plate** using (4) **M3 x 10mm Bolts**. Attach one end of the **5mm to 8mm Coupler** to the motor shaft and the other to the **8mm Threaded Rod**. Put the **8mm Hex Nut** through the **Z Slide** and thread onto the rod.
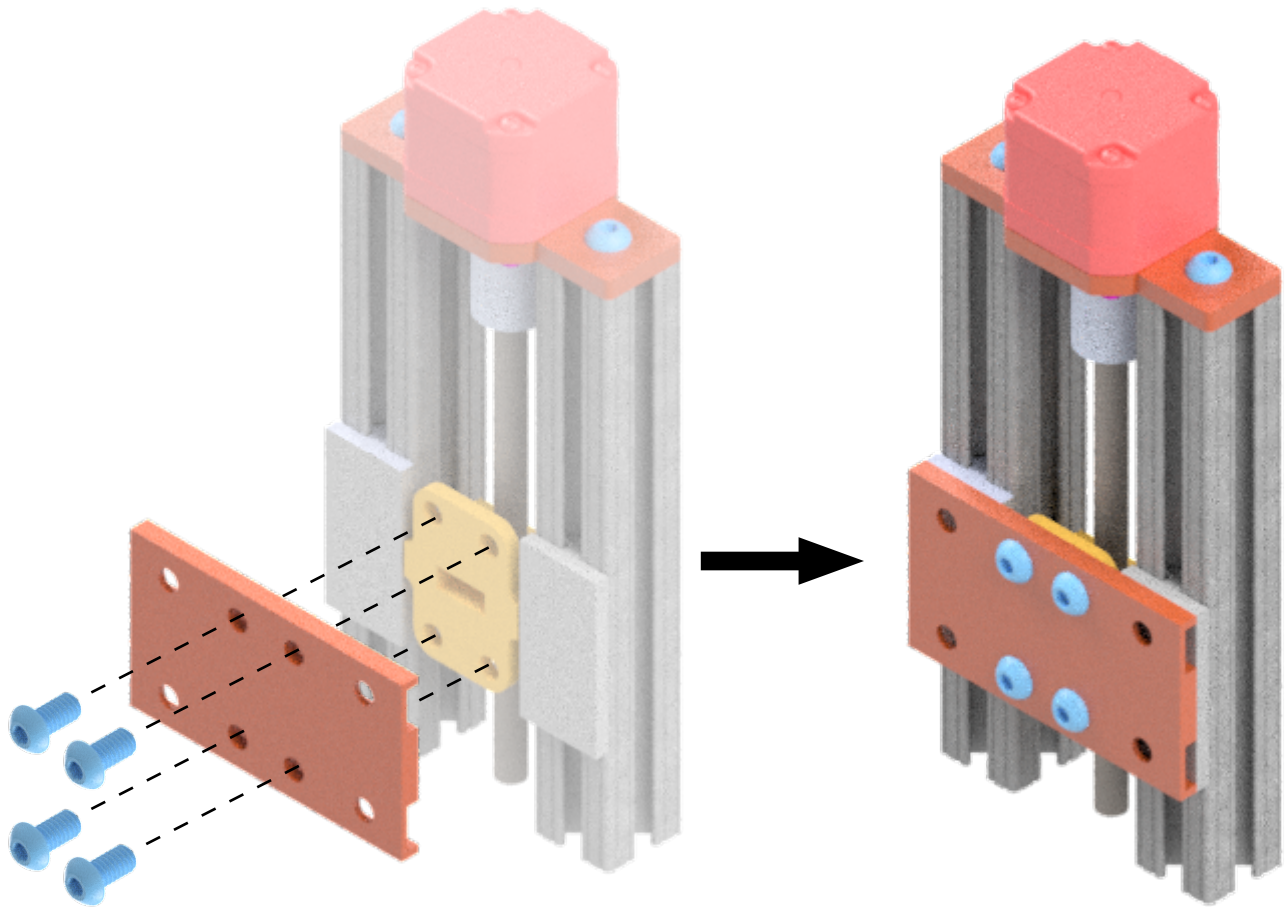
2.6 Slide (2) **Linear Slide Bearing Profiles** into (2) **1010 x 6" Extrusions**. Attach to the assembly from Step 2.5 using (2) **0.25" Cap Screws**. Make sure the Z Slide slides into the extrusion slots.
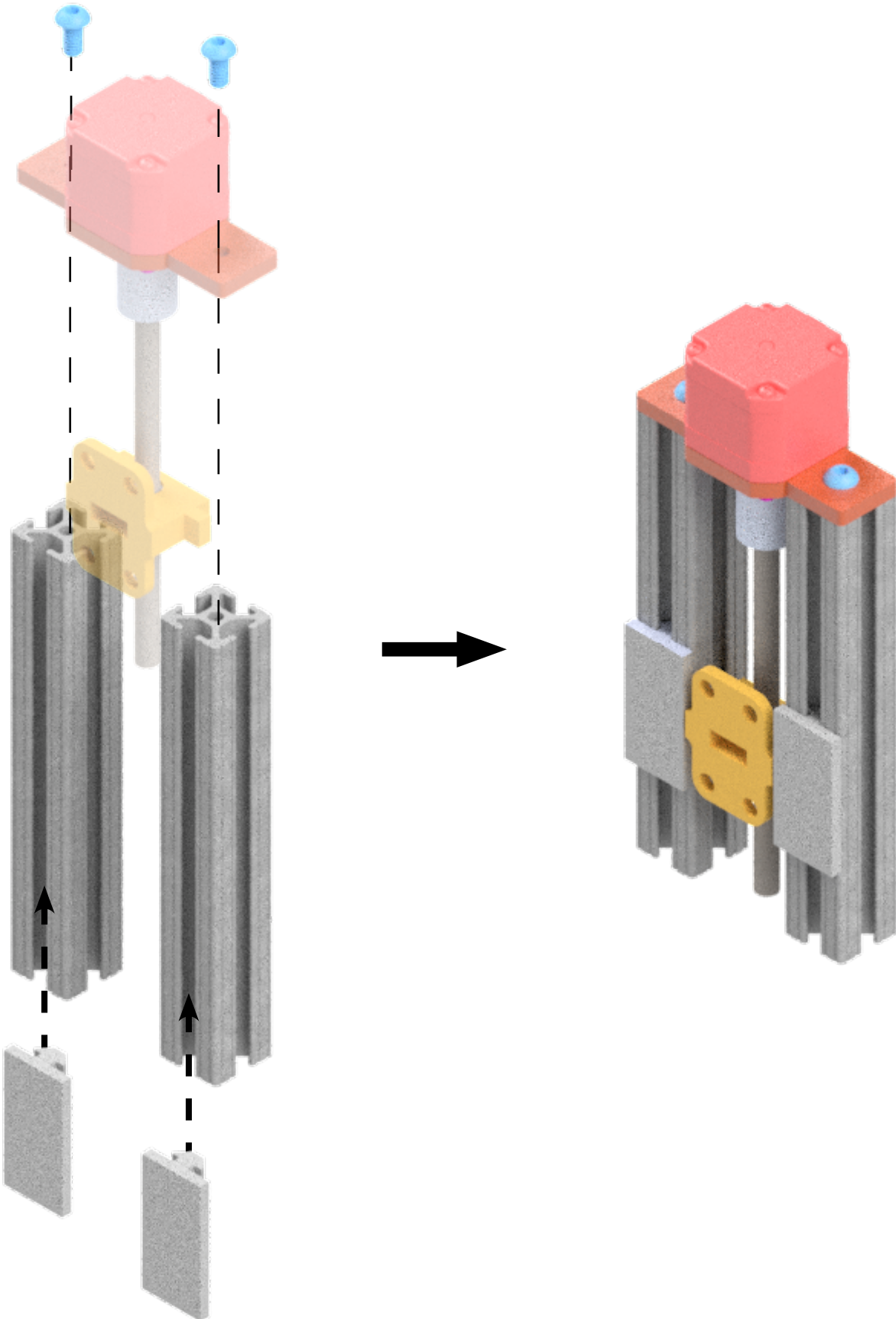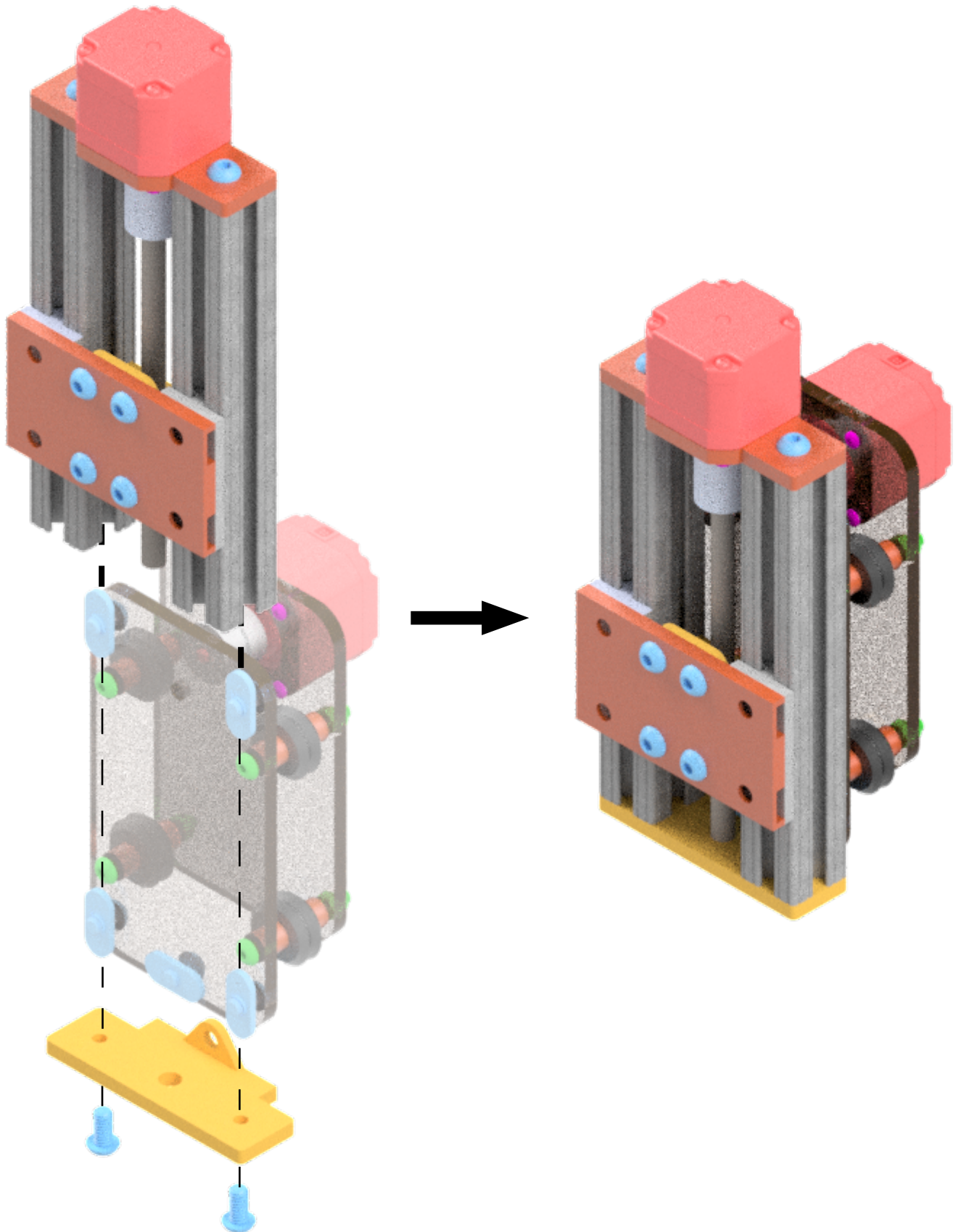
2.7 Attach the **Adapter** to the Z Slide using (4) **0.25" Cap Screws** and **T-Slot Nuts**. Also use hot glue to attach the Adapter to the Linear Slide Bearing Profiles.
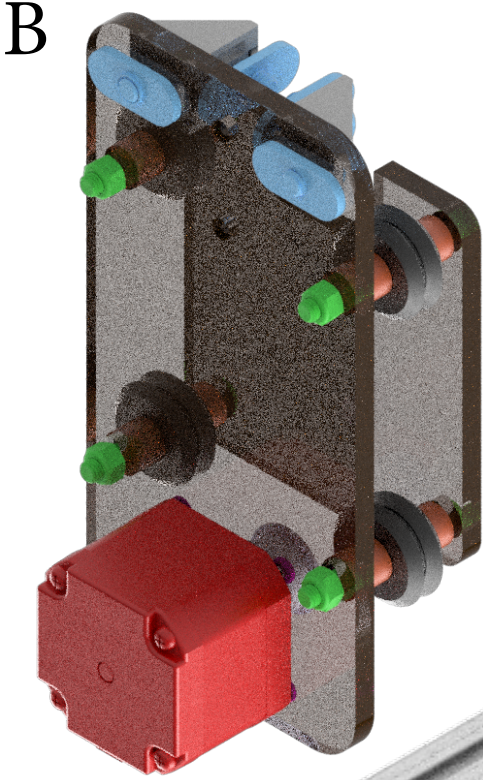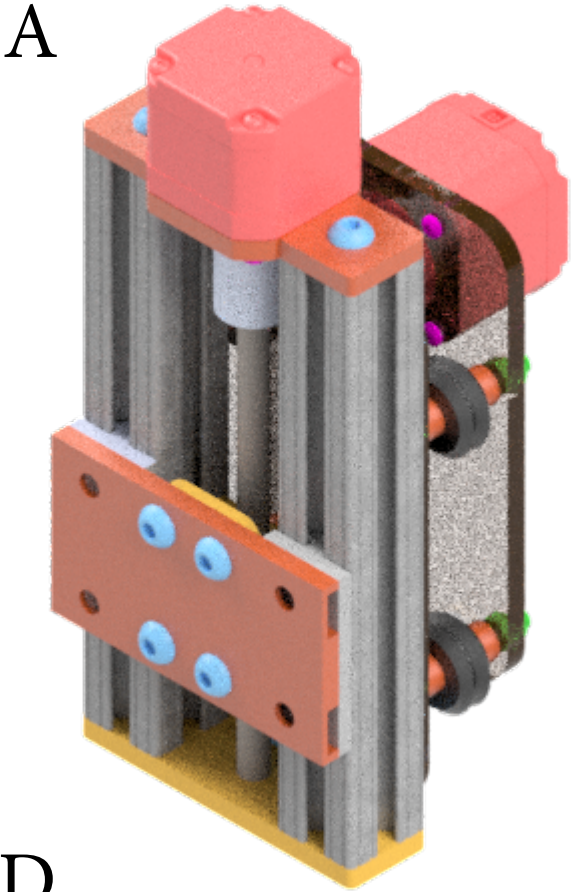
2.8 Slide the assembly from Step 2.4 onto the assembly from Step 2.7. Attach **Z Bottom Rod Hold** to the bottom of the extrusions using (2) **0.25" Cap Screws**.

3) Gantry Assembly
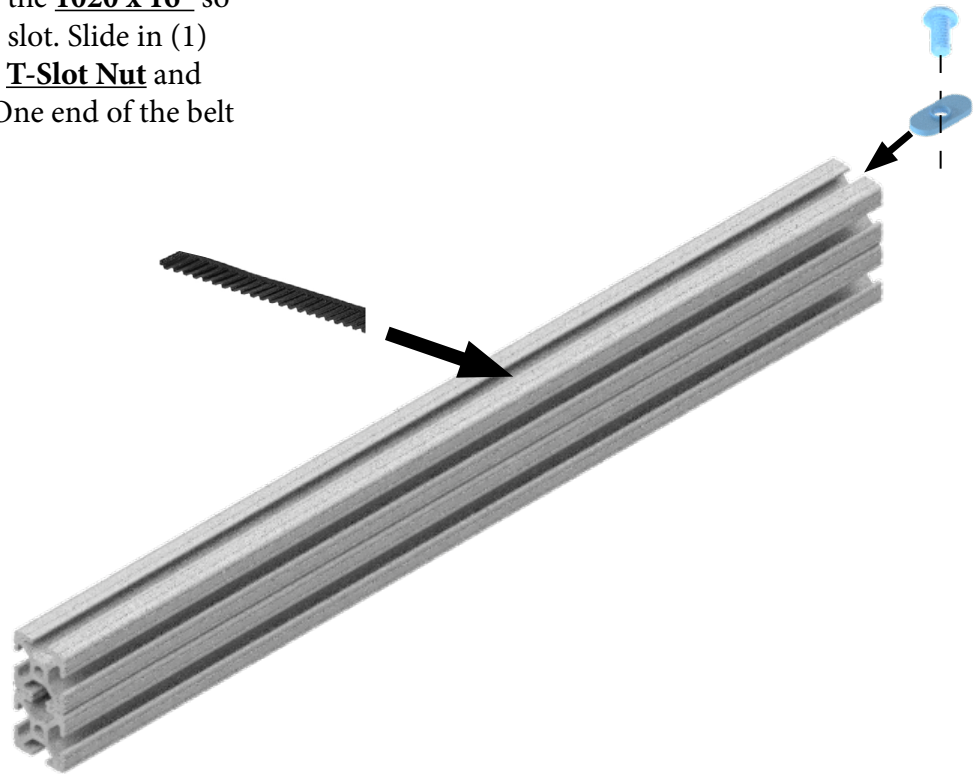
| Label	Description	Qty.
A	X/Z Slide Assembly	1
B	Y Slide Assembly	2
C	T-Slot Nut	2
D	0.25" Cap Screw	6
E	1020 x 16" Extrusion	1
F	20" Belt	1

A

B

C

D

E

F

3.1 Slide the **20" Belt** into the **1020 x 16"** so it lays in the extrusion slot. Slide in (1) **0.25" Cap Screw** with **T-Slot Nut** and tighten near the end. One end of the belt is now fixed.
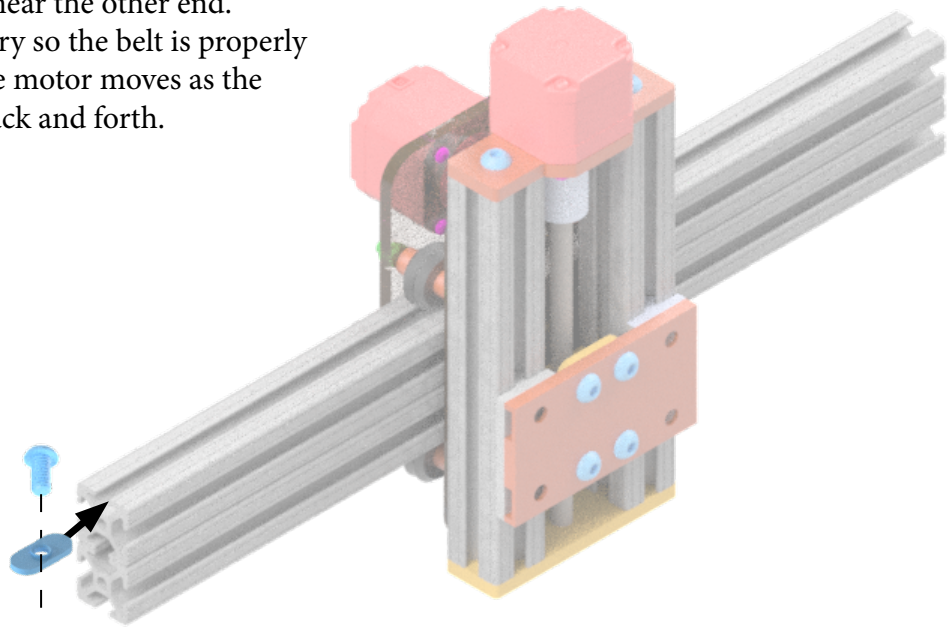
3.2 Slide the **X/Z Slide Assembly** onto the extrusion and loop the belt so it goes under the wheels but around the belt pulley. Adjust the wheels so the extrusion moves freely but doesn't wiggle too much. The belt should be aligned in the middle of the belt pulley.
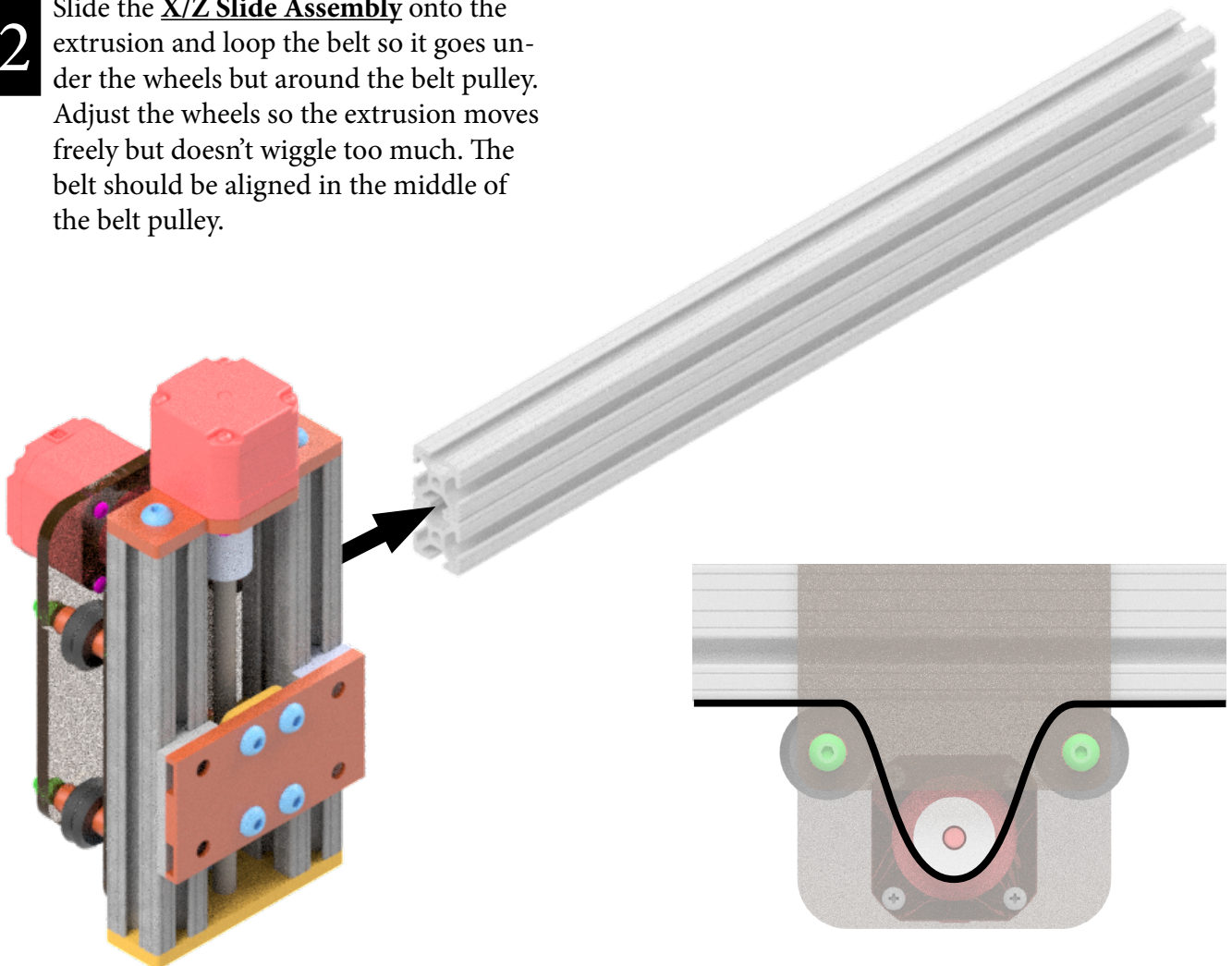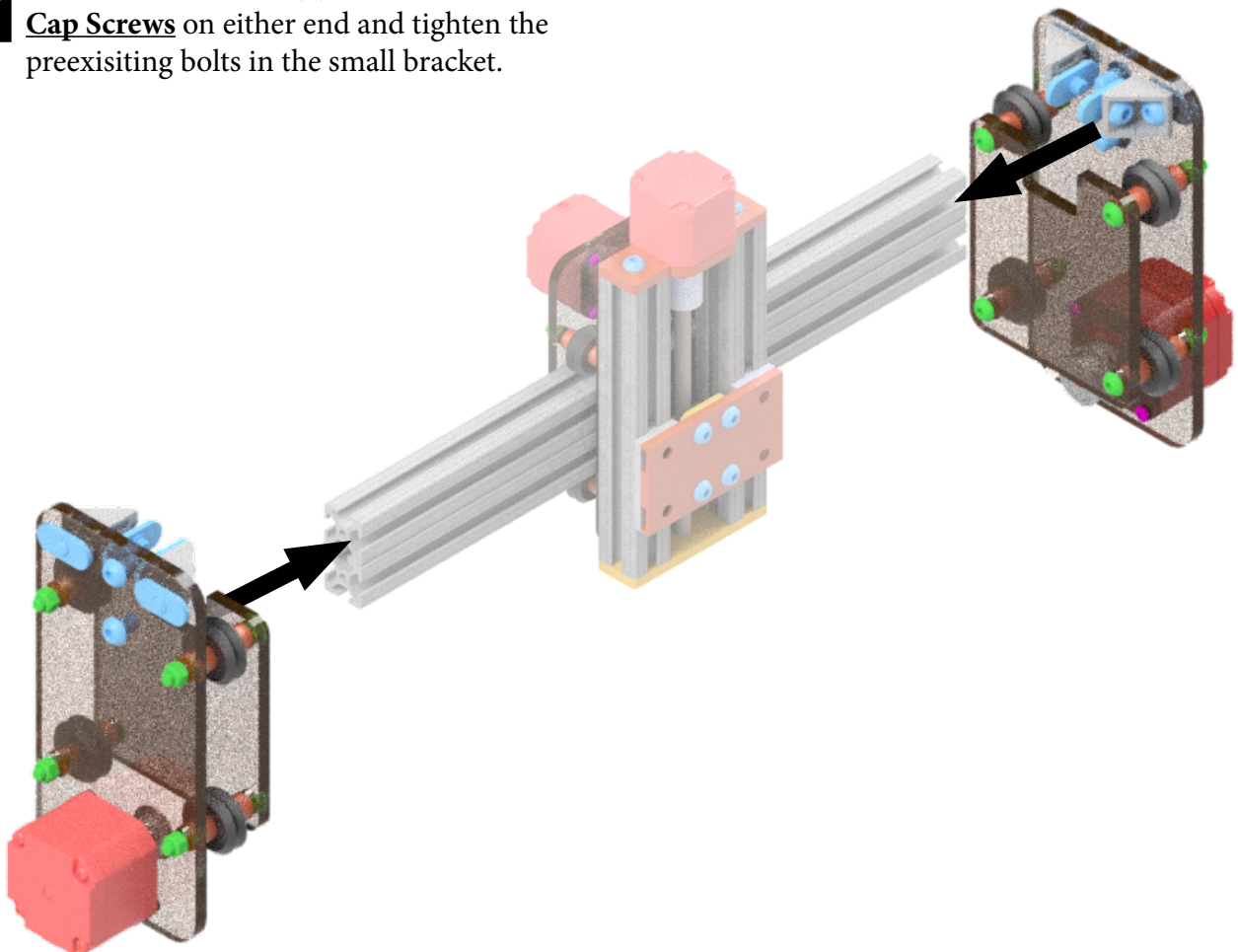
3.3 Slide in (1) **0.25" Cap Screw** with **T-Slot Nut** and tighten near the other end. Adjust as necessary so the belt is properly tensioned and the motor moves as the slide is pushed back and forth.

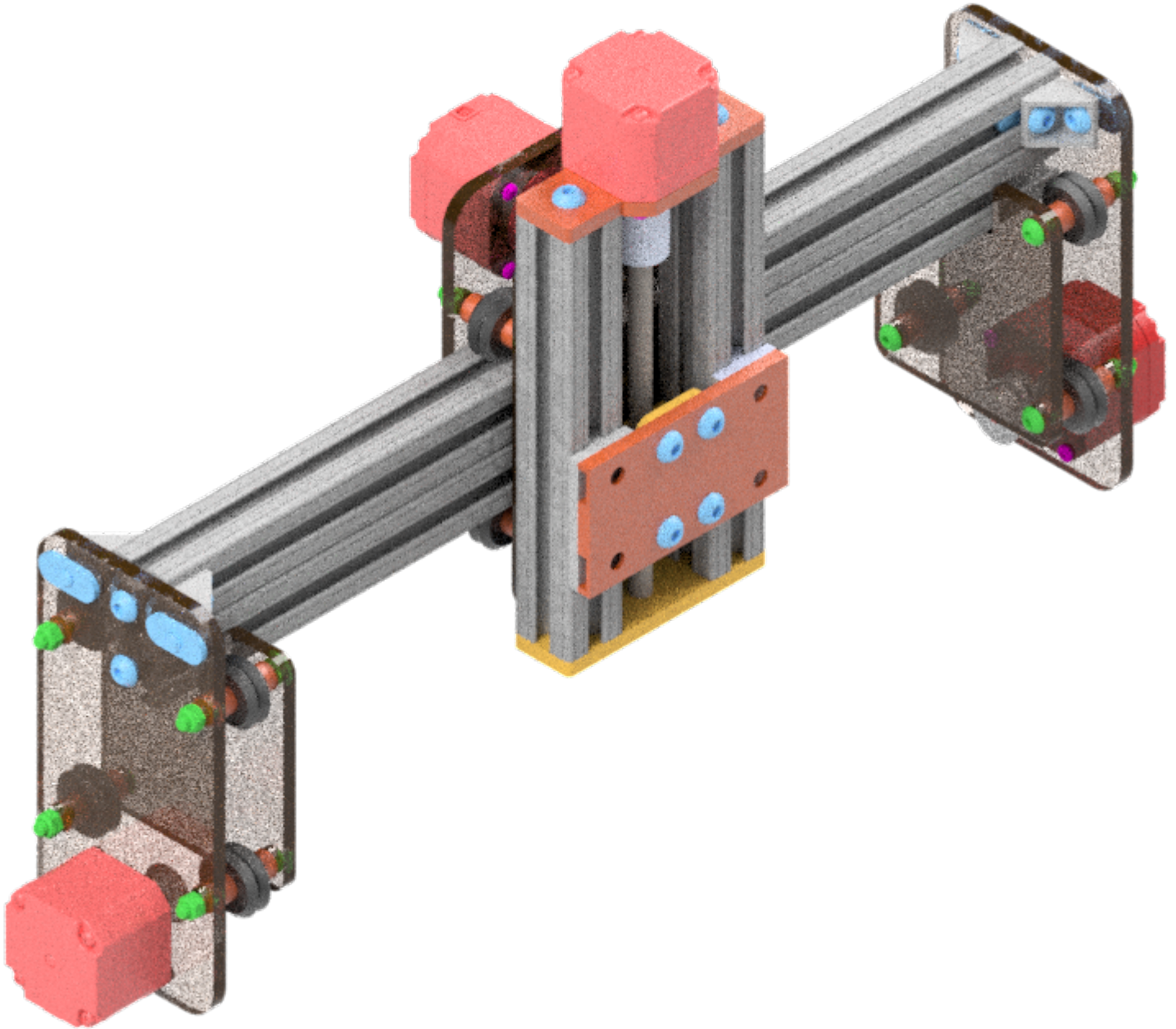**3.4** Slide in **Y Slide Assemblies** to either end of the extrusion. Use (2) additional **0.25" Cap Screws** on either end and tighten the preexisiting bolts in the small bracket.
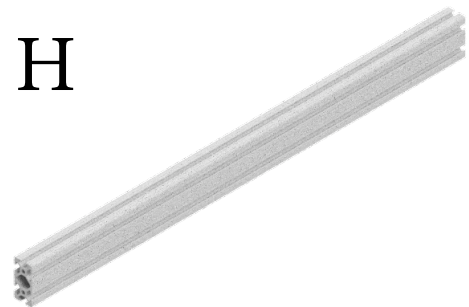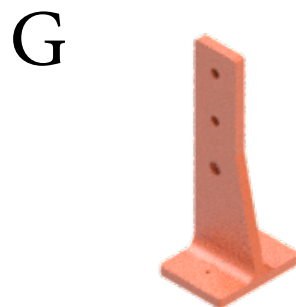
3.5 Make sure all bolts are tightened and the belt runs smoothly for the X/Z Slide Assembly.

4) Final Assembly

Label	Description	Qty.
A	Gantry Assembly	1
B	Wasteboard	1
C	T-Slot Nut	16
D	0.25" Cap Screw	16
E	1010 x 16" Extrusion	2
F	25" Belt	2
G	Leg Plate	4
H	1020 x 24" Extrusion	2
I	#6 x 1/2" Screw	8

A

C   D

B

E

F   G   H
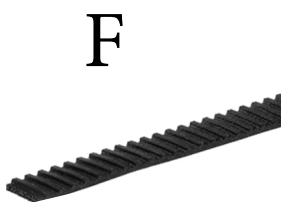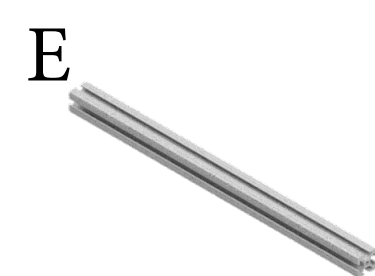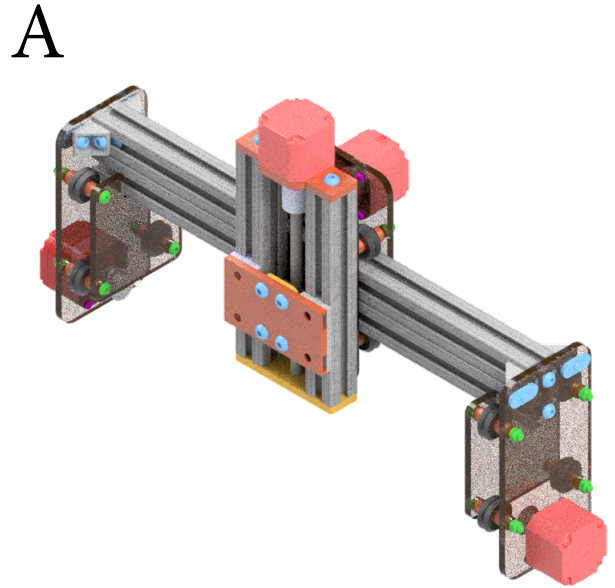
4.1 Attach (4) **Leg Plates** to the **Wasteboard** using (2) **#6 x 1/2" Screws** for each leg. Make sure they're all squared and perpendicular to the edges.
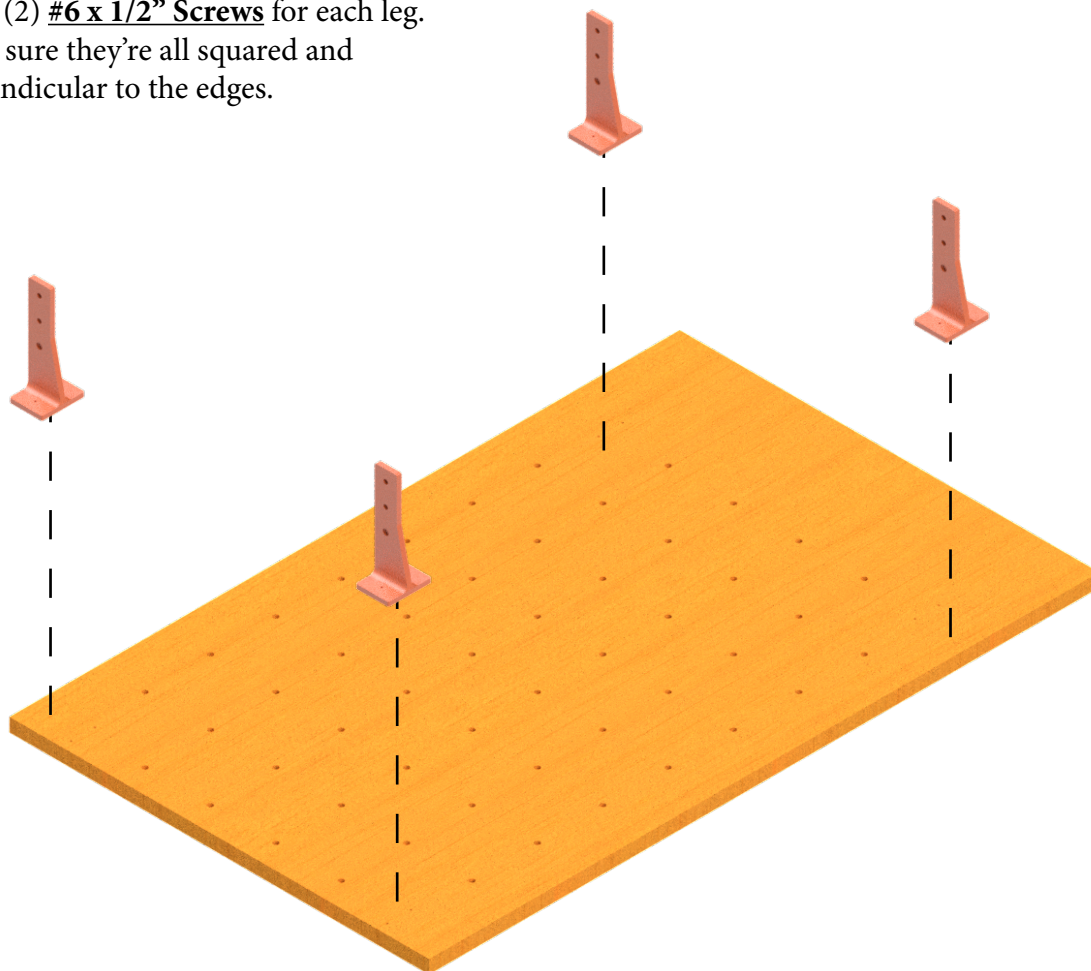
4.2 Slide the **25" Belt** into the **1020 x 24"** so it lays in the extrusion slot. Slide in (1) **0.25" Cap Screw** with **T-Slot Nut** and tighten about 2" away from the end. One end of the belt is now fixed. Repeat for the second extrusion.

x2

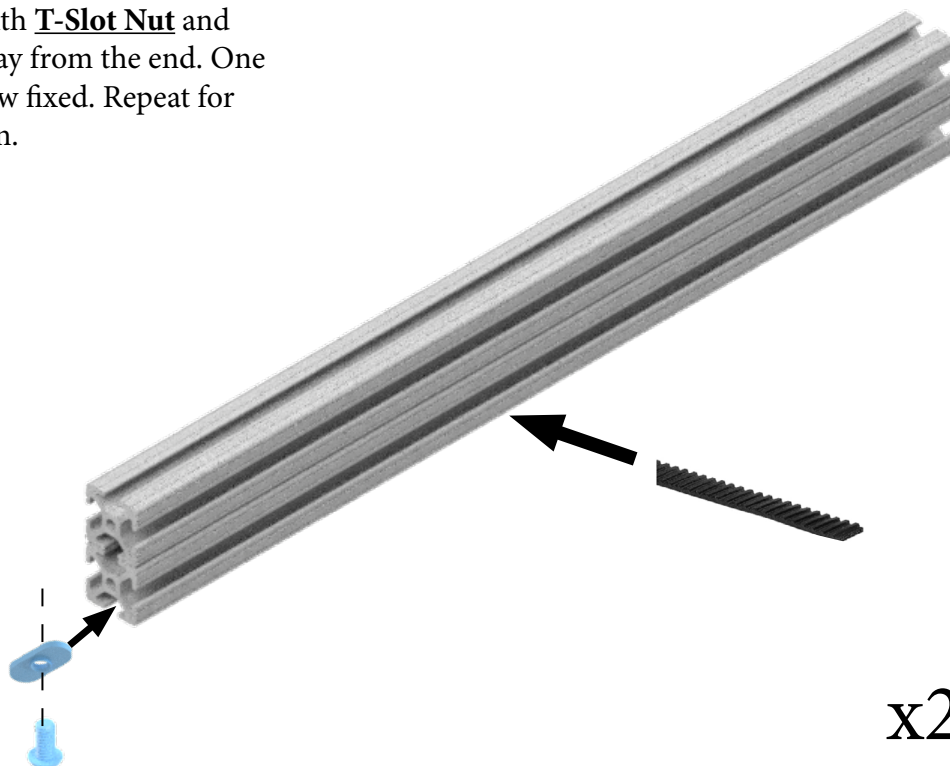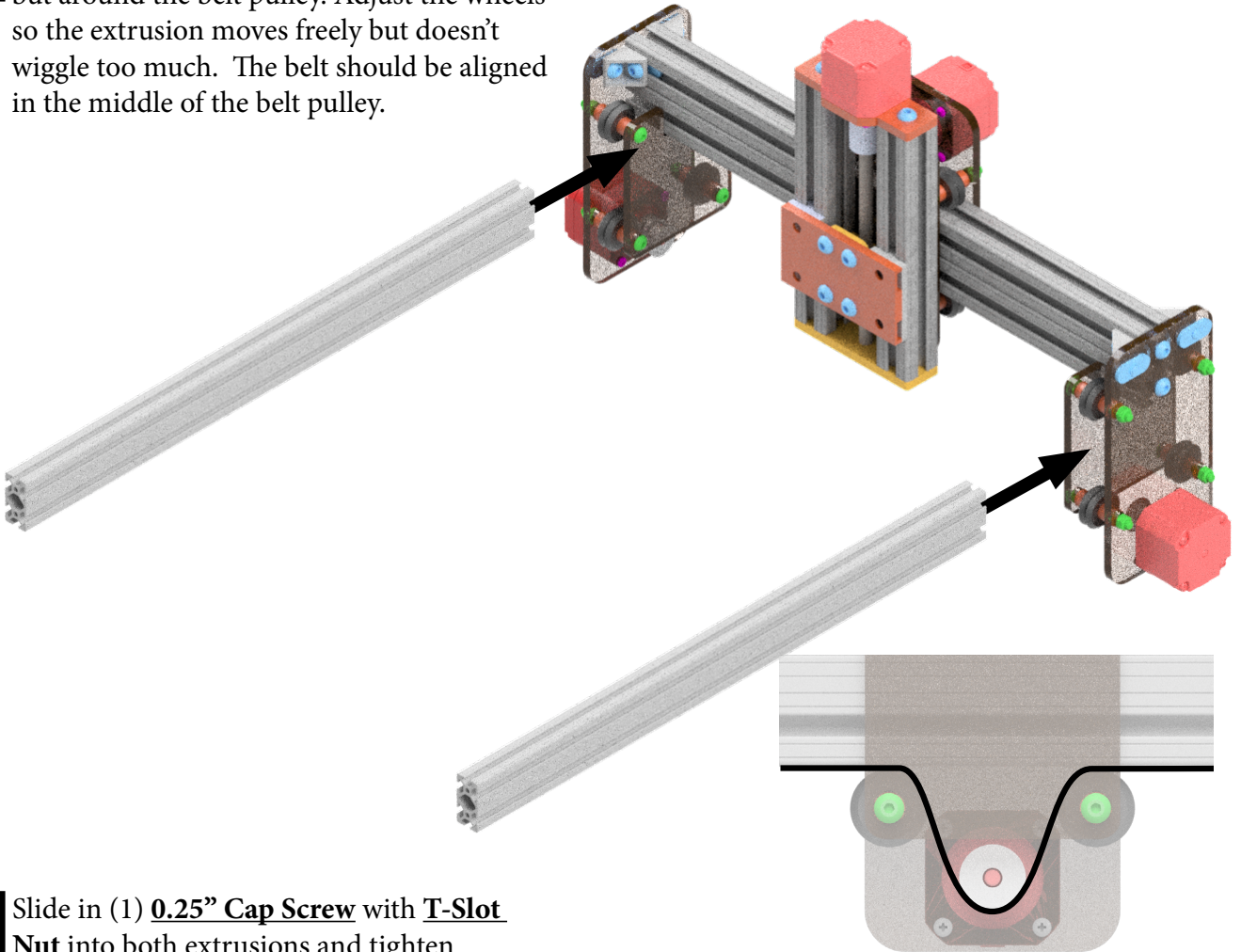**4.3** Slide the **Gantry Assembly** onto the extrusion and loop the belt so it goes under the wheels but around the belt pulley. Adjust the wheels so the extrusion moves freely but doesn't wiggle too much. The belt should be aligned in the middle of the belt pulley.

4.4 Slide in (1) **0.25" Cap Screw** with **T-Slot Nut** into both extrusions and tighten about 2" away from the other end. Adjust as necessary so the belt is properly tensioned and the motor moves as the gantry is pushed back and forth.
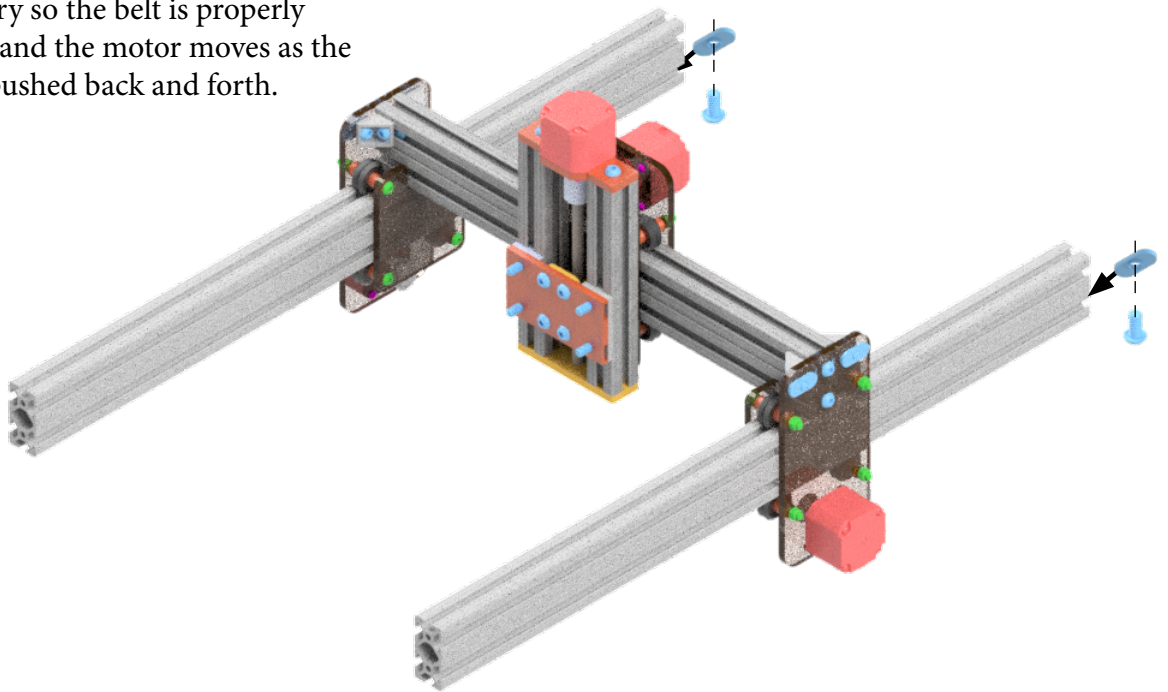
4.5 Slide the assembly from Step 4.4 into place between the legs on the wasteboard. Use (2) **0.25" Cap Screws** on each leg to attach the leg to the extrusions. Place (1) **0.25" Cap Screw** and **T-Slot Nut** through the bottom leg holes. Do not fully tighten.
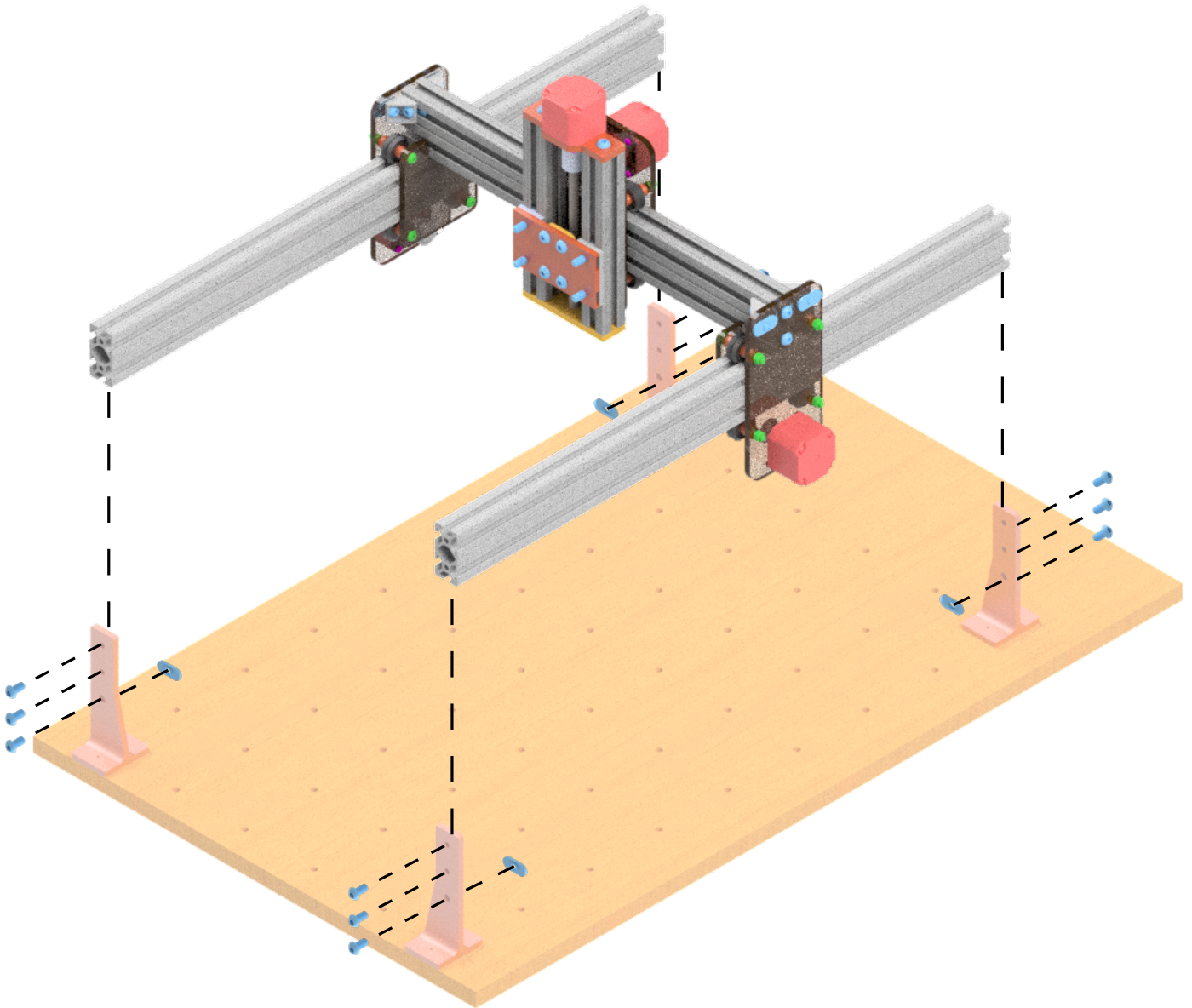
4.6 Slide (2) **1010 x 16" Extrusions** onto the bottom **T-Slot Nuts** and tighten once in place.
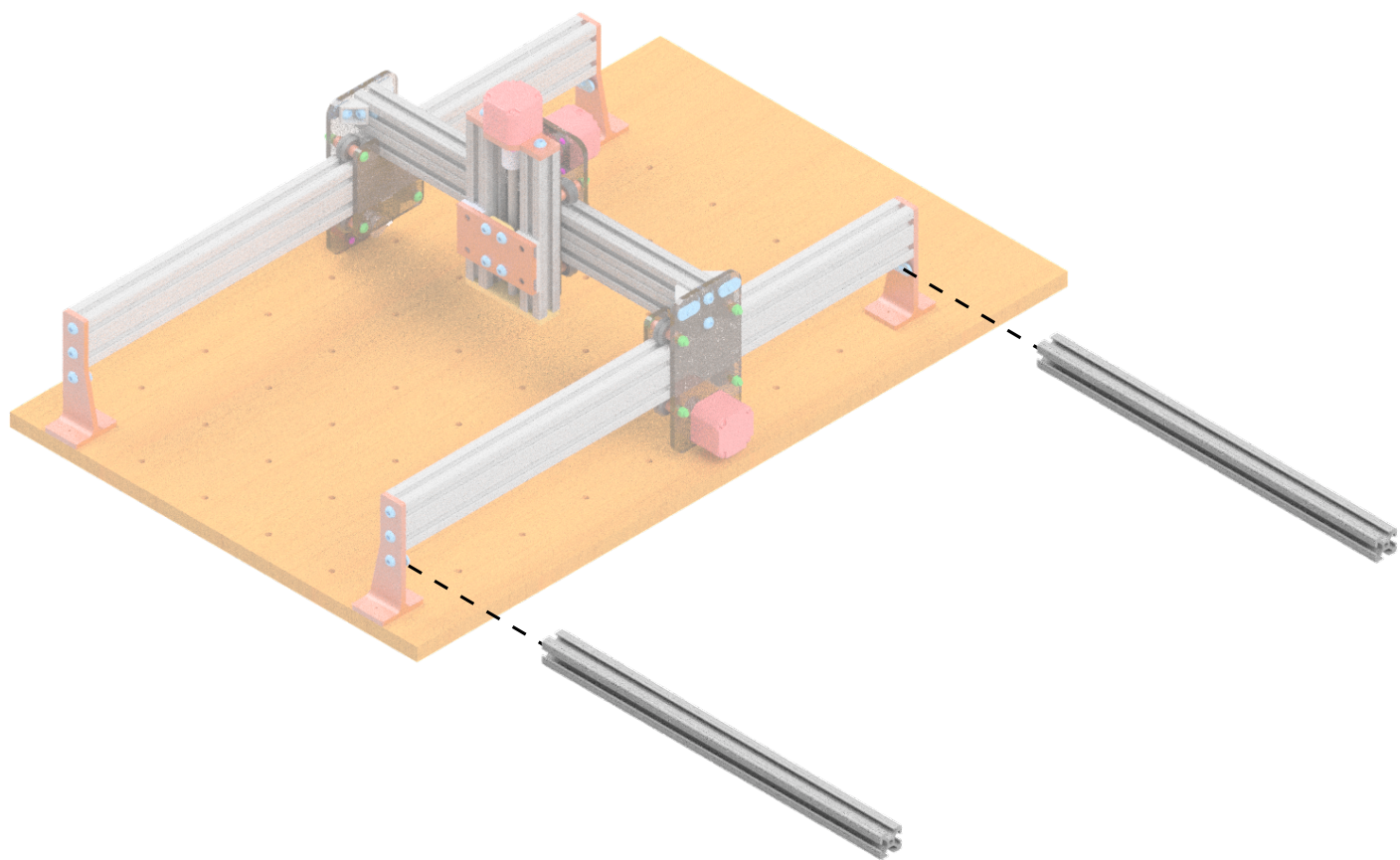
4.7 Make sure the slides move freely and engage the belts. Check to make sure the frame is square and tighten all bolts.

5a) Electronics Routing
Option A: Arduino on X/Y Slide

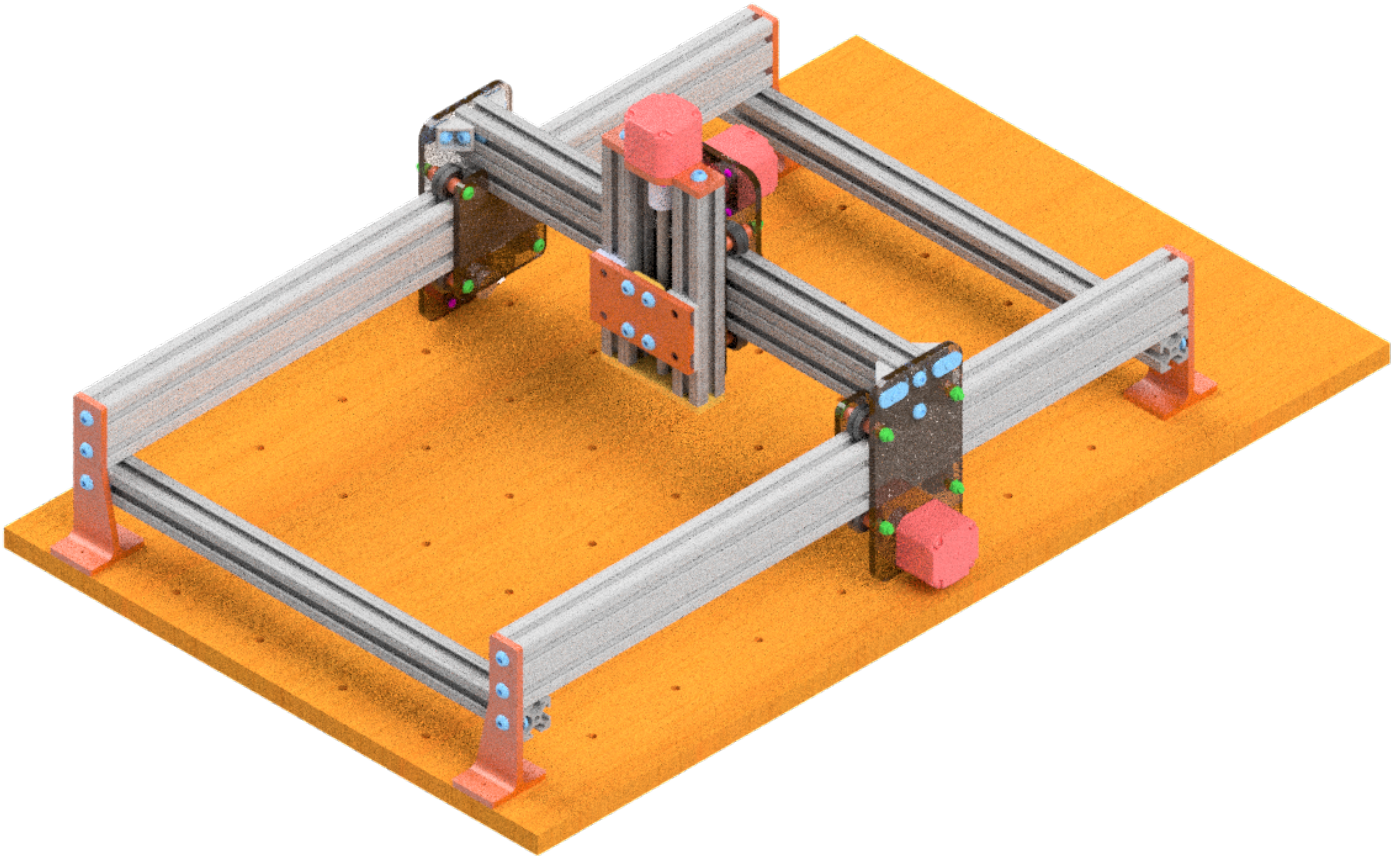| Label	Description	Qty.
A	CNC Frame	1
B	Arduino Uno + CNC Shield	1
C	Limit Switch	3
D	24V Power Supply	1
E	Wire Holder + Lid	1
F	Miscellaneous Wires	As Required
G	Computer Fan (optional)	1
H	Fan Holder (optional)	1
I	Old Extension Cord (1 optional)	2
J	2 Channel 5V DC Relay	1

E
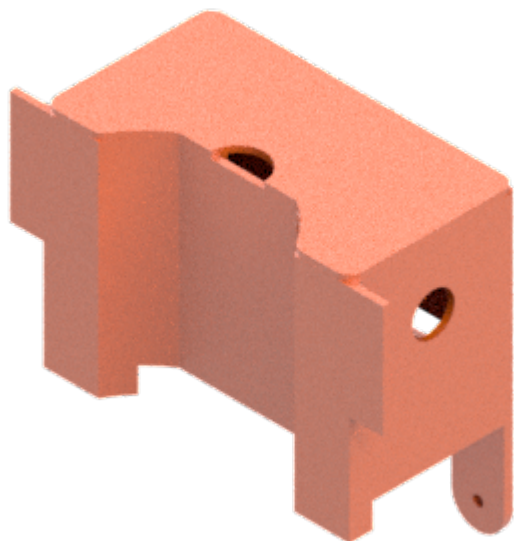
H
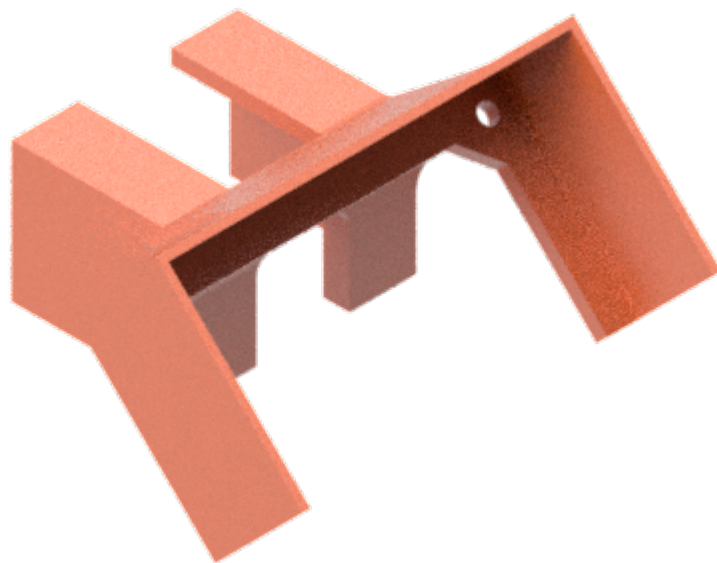
5.1a The electronics routing is mainly up to user preference. I placed my **Arduino + CNC Shield** on the back of the X/Z Slide using a command strip. You could also place it on one of the Y Slides, but make sure you have enough wire length and slack in the lines.
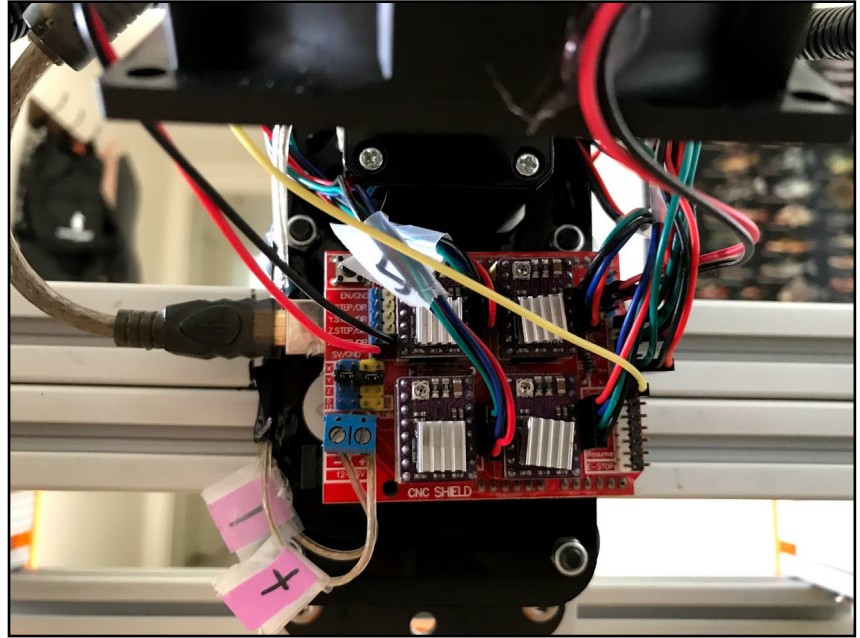

5.2a Place a **Limit Switch** to detect the end of each axis in the positive directions. I used hot glue to keep them in place. Make sure the switches can be activated when the gantry moves. You may need to place small items to trigger the switches (I used spare Legos as shown).
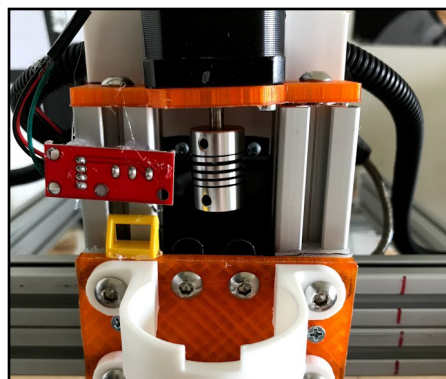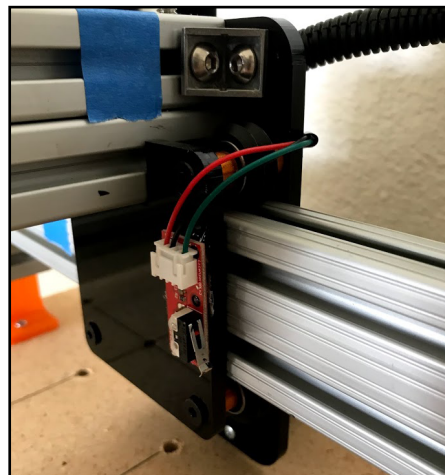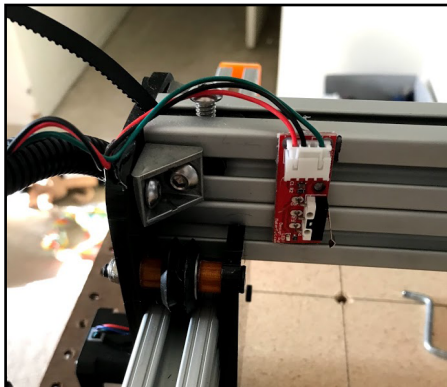
5.3a Fix the **Power Supply** to your wasteboard so it's out of the way. Strip an **Old Extension Cord** (the one with a ground) and attach to the Power Supply terminals (Live, Neutral, GND). Plug into a surge protector to make sure it turns on.

5.4a Make sure the power supply is off and unplugged. Use some wire to run the + and - ends power connections to the Arduino. When the power supply is on the Arduino should light up.

+ To Arduino

- To Arduino

Live

Neutral

GND
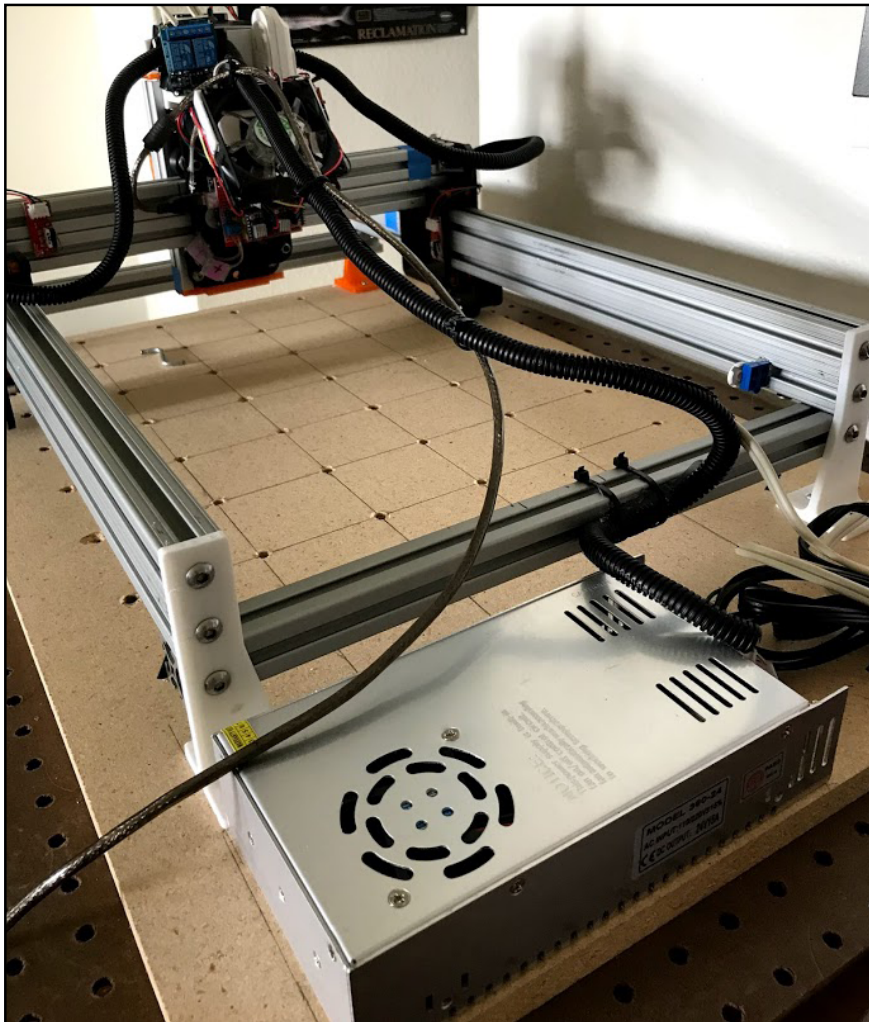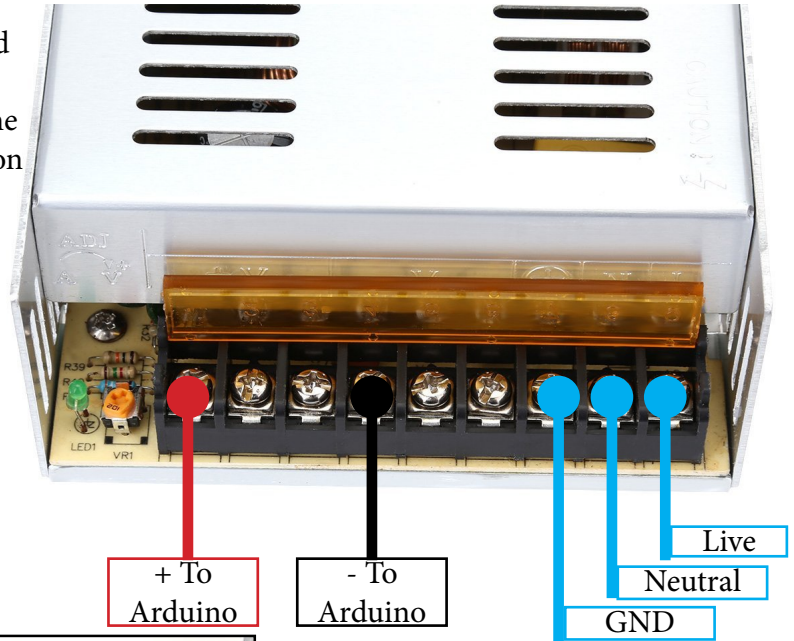
5.5a Attach the **Wire Box + Lid** to the top of the X/Z Slide using hot glue. This is optional but helps manage the cables and cleans it up a bit.

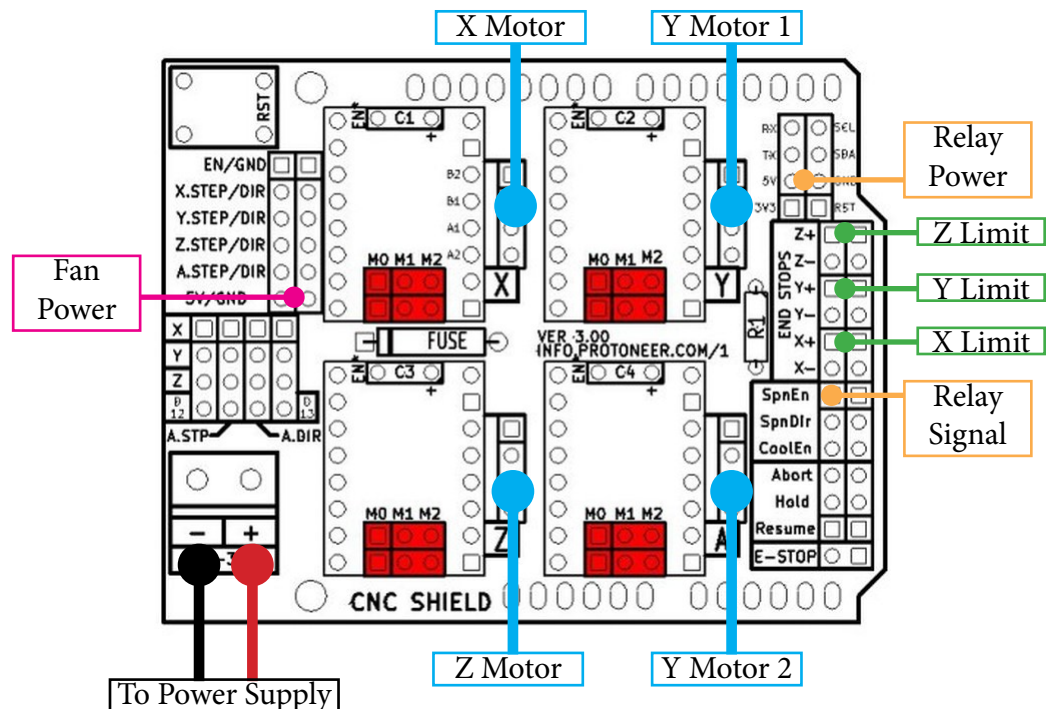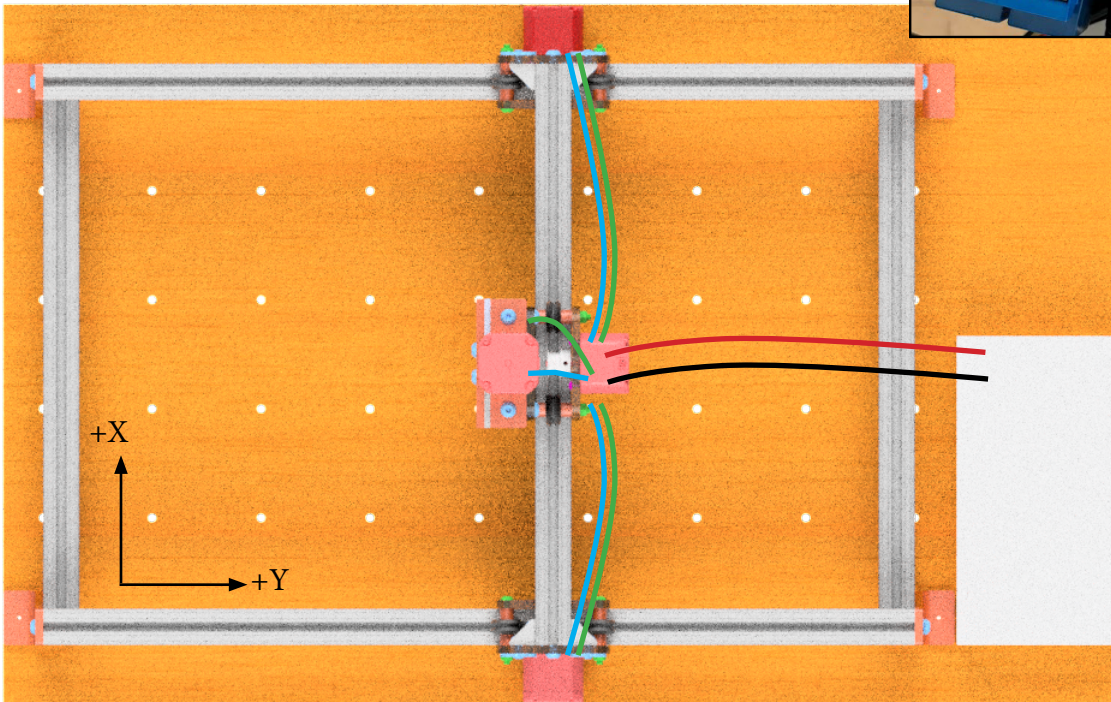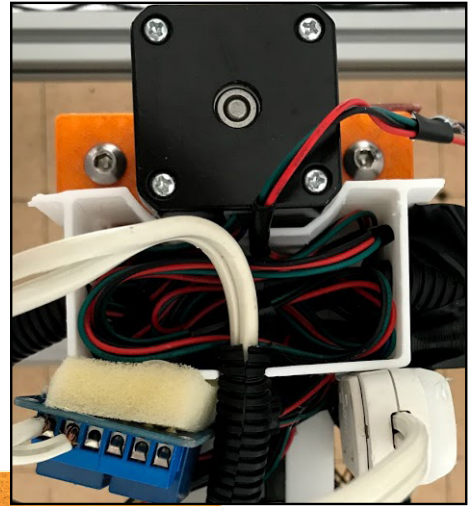**5.6a** Route cables for the motors and limit switches to go through the Wire Box and into the Arduino. Coil any excess cable in the Wire Box and close the lid. I used a small flexible hosing to encase all routed wires. A drag chain works as well.

+X

+Y

X Motor

Y Motor 1

Relay Power

Z Limit

Y Limit

X Limit

Relay Signal

Fan Power

EN/GND
X.STEP/DIR
Y.STEP/DIR
Z.STEP/DIR
A.STEP/DIR
5V/GND

RST

C1

C2

B2
B4
A4
A2

M0 M1 M2

X

M0 M1 M2

Y

RX
TX
5V
3V3

Z+
Z-
Y+
Y-
X+
X-

SpnEn
SpnDir
CoolEn
Abort
Hold
Resume
E-STOP

SEL
SDA

RST

END STOPS

R1

X
Y
Z
D12

D13

A.STP

A.DIR

FUSE

C3

VER 3.00
INFO.PROTONEER.COM/1

C4

M0 M1 M2

Z

M0 M1 M2

A

− +

CNC SHIELD

To Power Supply

Z Motor

Y Motor 2

5.7a (OPTIONAL) I used another **Old Extension Cord** (one without a ground) and combined it with a **2 Channel 5V DC Relay** to provide controlled power to my tool.
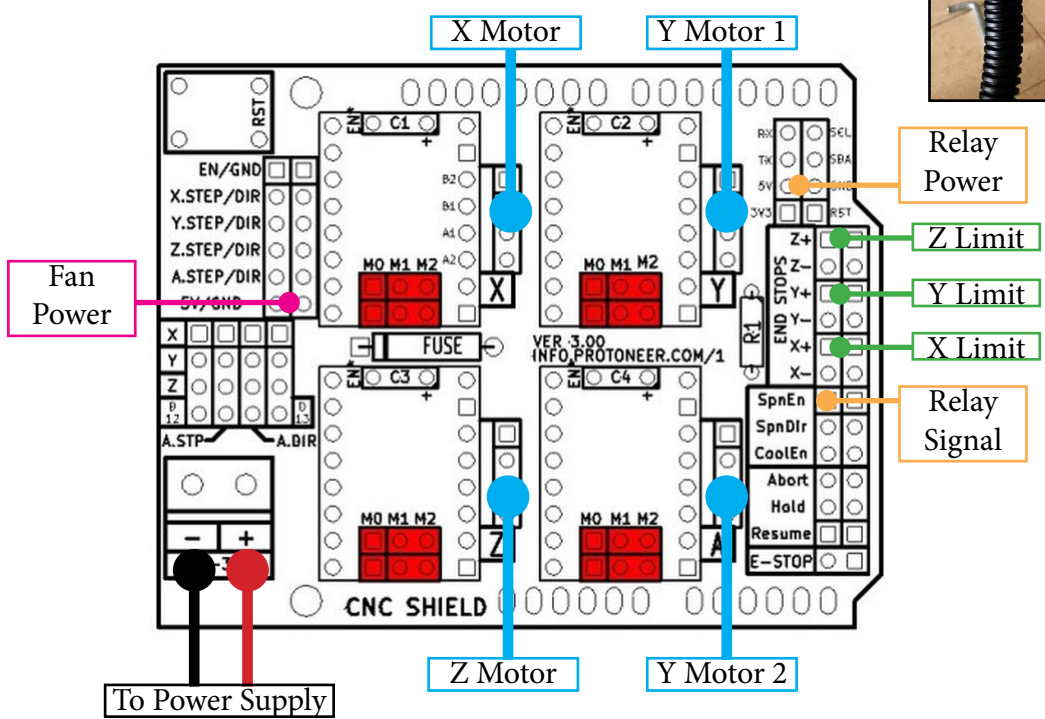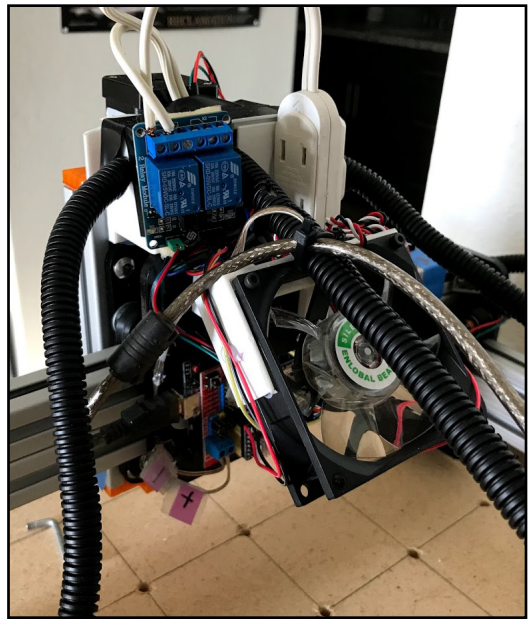

Relay 5V
Relay Signal
Relay GND

Extension Cord Out
Extension Cord In
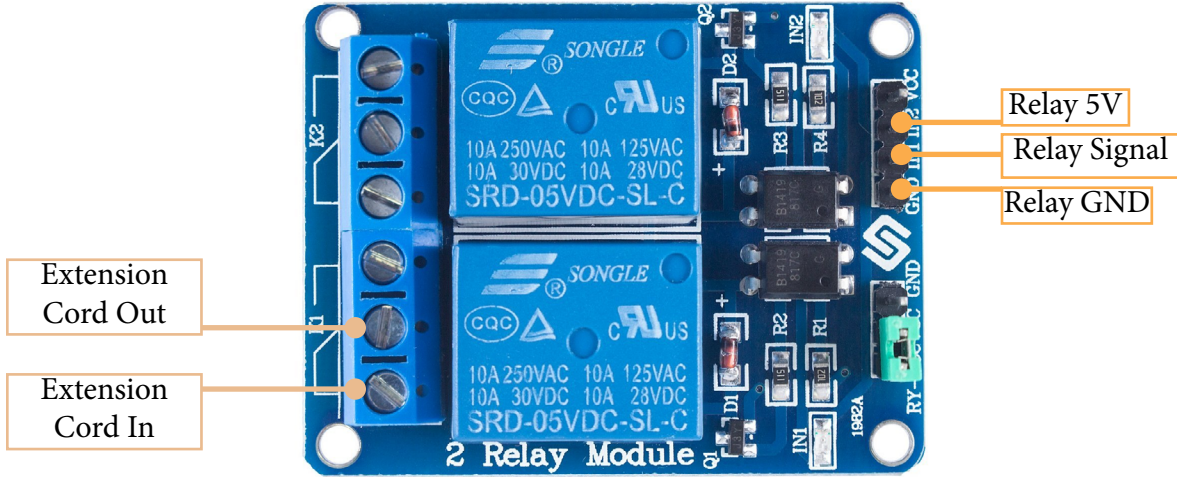
5.8a (OPTIONAL) I also used a fan to help cool down the Arduino as it runs. Use hot glue to fix the **Fan Holder** to the top of the x-axis motor. Use hot glue or small screws to attach the **Computer Fan** to the Fan Holder. Connect the fan to the Arduino.

X Motor
Y Motor 1
Relay Power
Z Limit
Y Limit
X Limit
Relay Signal
Fan Power

Z Motor
Y Motor 2
To Power Supply

5b) Electronics Routing
Option B: Arduino on Wasteboard

Label	Description	Qty.
A	CNC Frame	1
B	Arduino Uno + CNC Shield	1
C	Limit Switch	3
D	24V Power Supply	1
E	Arduino Enclosure	1
F	Miscellaneous Wires	As Required
G	Computer Fan (optional)	1
H	Drag Chain	1
I	Old Extension Cord (1 optional)	2
J	2 Channel 5V DC Relay	1
K	0.25" Cap Screw	1
L	Cut T-Slot Nut	1
M	#6 x 1/2" Screw	6

E
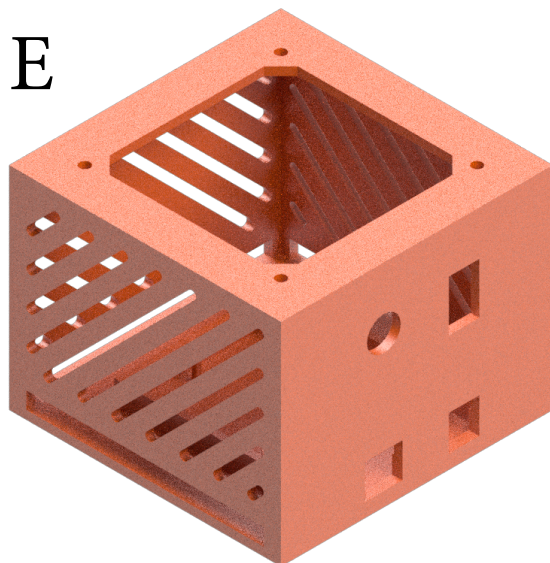
5.1b The second placement option, and my preferred location, is to have the Arduino on the wasteboard. This option does require soldering of the wires for the motors and limit switches since the included cables aren't long enough.
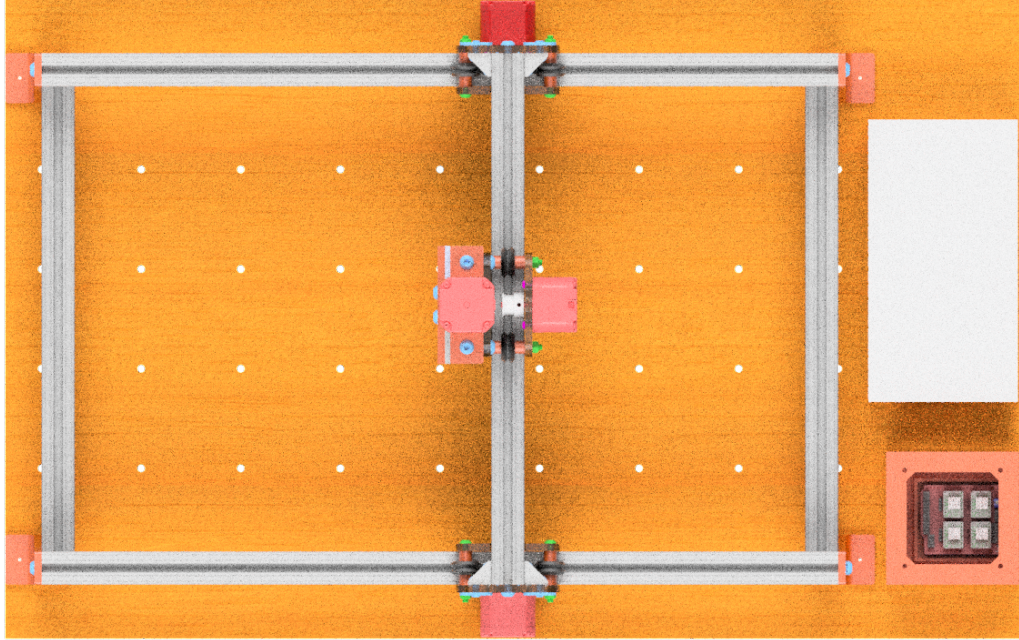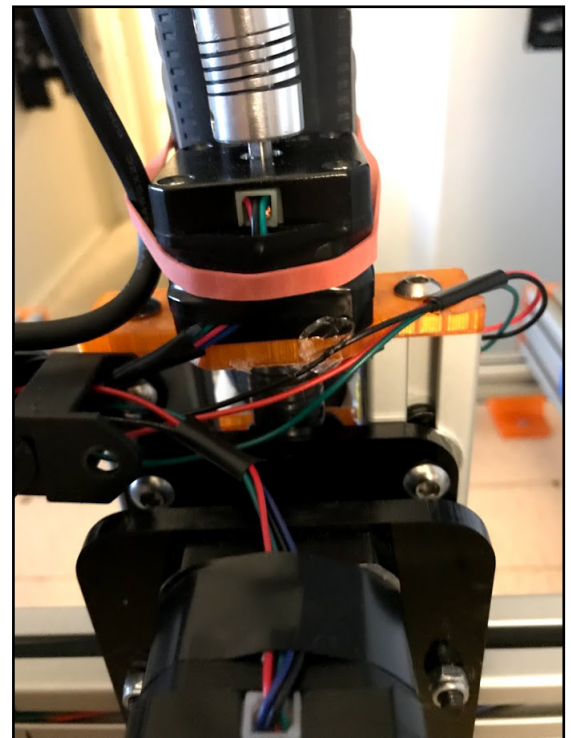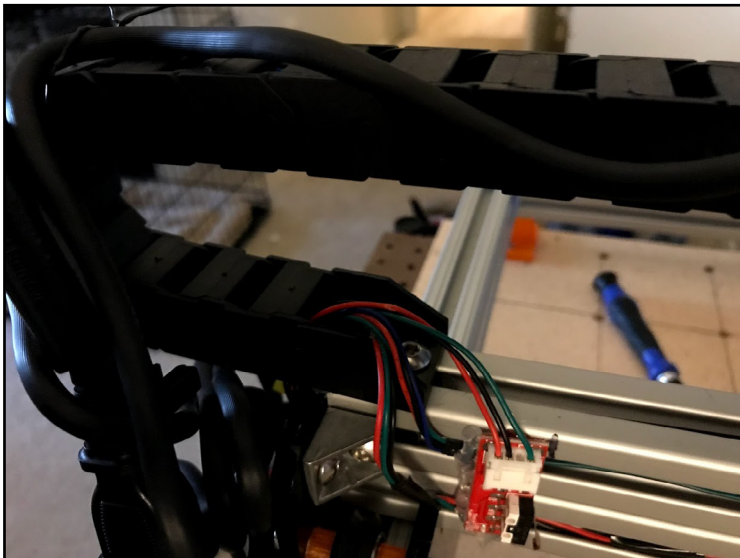

5.2b Follow Step 5.2a to 5.4a above for limit switch placement and the power supply connections.
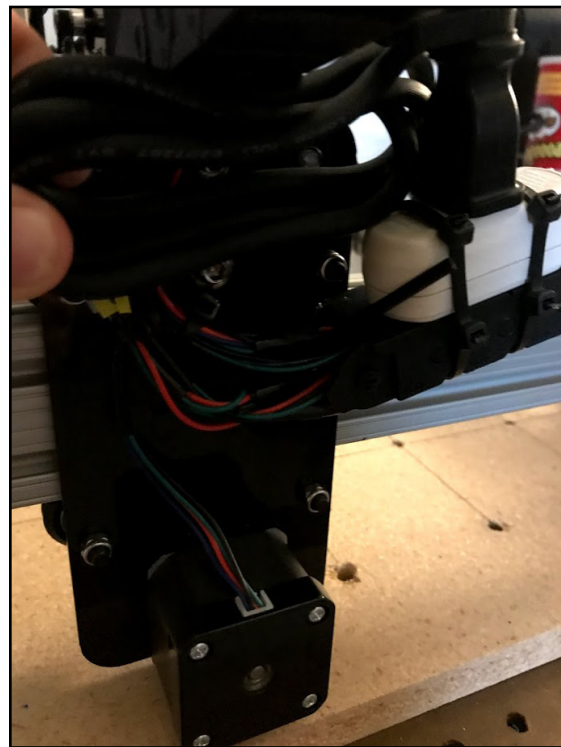
5.3b Attach one end of the X Axis Drag Chain using (1) Cut T-Slot Nut and (1) 0.25" Cap Screw in the 1010 x 6" Extrusion. Attach the other end of the drag chain using the 0.25" Cap Screw holding the belt in place.
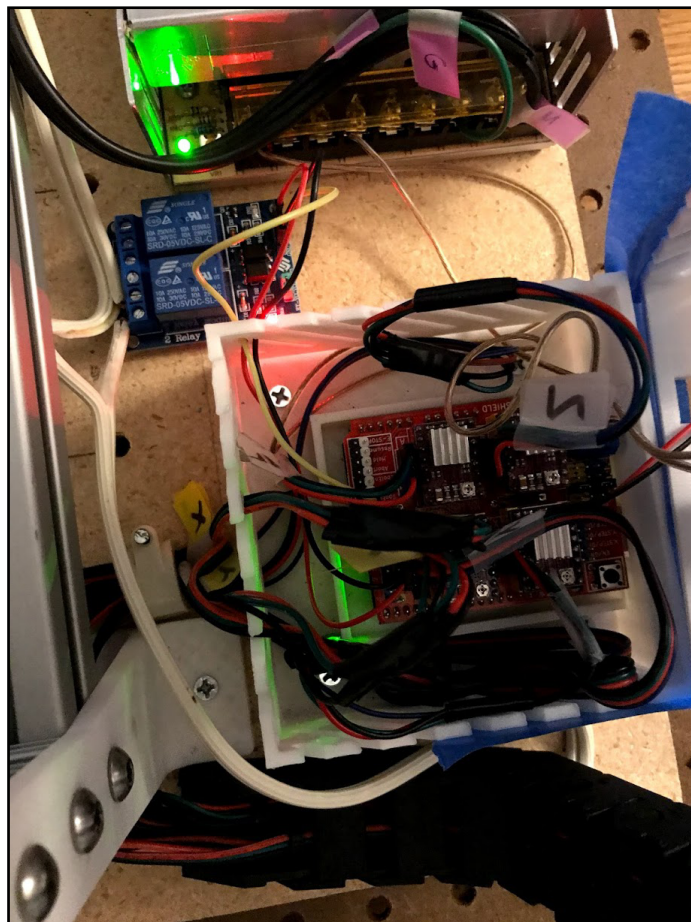
5.4b Attach one end of the Y Axis Drag Chain using (1) #6 x 1/2" Screw attached to Y Plate Outer. Attach the other end of the drag chain using (1) #6 x 1/2" Screw attached to the wasteboard.
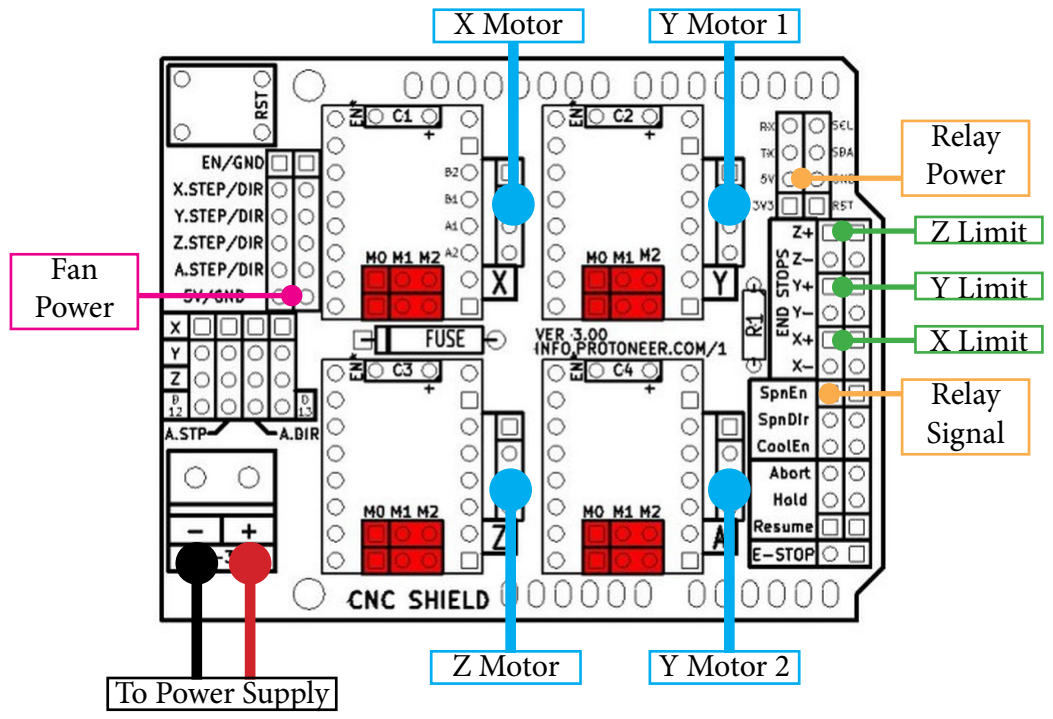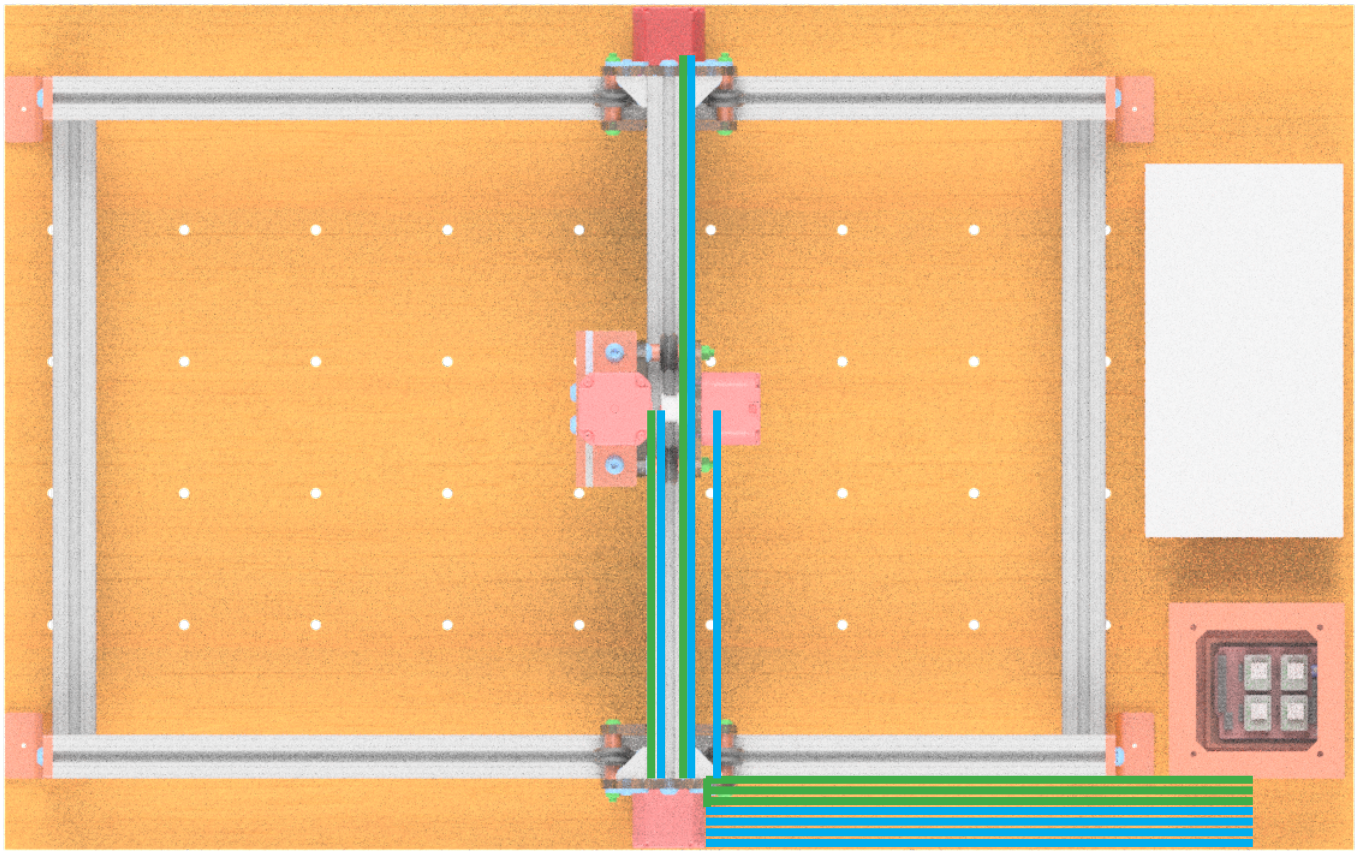
5.5b Use (4) #6 x 1/2" Screws to attach the Arduino Enclosure to the wasteboard.

5.6b Route the cables for the limit switches and motors through the drag chains. Use the extrusion slots for routing the far y-axis motor and limit switch.

X Motor

Y Motor 1

Relay Power

Z Limit

Y Limit

X Limit

Relay Signal

Fan Power

Z Motor

Y Motor 2

To Power Supply

5.7b Follow Step 5.7a and 5.8a for optional Relay and Fan information. Note that the fan can just attach to the top of the <u>Arduino Enclosure</u>.