LEGOLAS
Wiring
Guide

Items Needed

- *(2x)* BuildHAT chargers
- *(1x)* LEGO Inventor Motor Extension Cable
- *(1x)* BNC connector cable (comes with Arduino pH sensor)
- *(3x)* 2-3” Jumper Wires (*Arduino Breadboard Compatible*)
    - Preferably a Red, Black, and Blue Wire
- *(1x)* USB 2.0 Printer Cable - A-Male to B-Male Cord (Will need > 18” cord length)
- *(1x)* Laboratory Retort Support Stand with Rings (*Chemistry Ring Stand*)
    - Need >18” height, at least one ring attachment, and a clamp attachment (*see step 1*)
    - (*optional)* An adjustable wrench for tightly securing the retort stand nut (*see step 1*)

1. Build the Ring Stand

The Laboratory Retort stand w/ a ring is used for managing the *Arduino* → *R-Pi* wired connection, as well as the *pH sensor* → *Arduino* connection

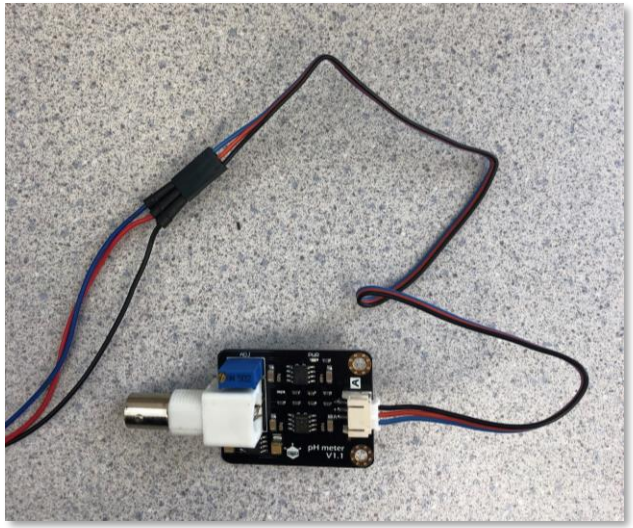
Gather Pieces

Attach post with Nut (*can use adjustable wrench here*)

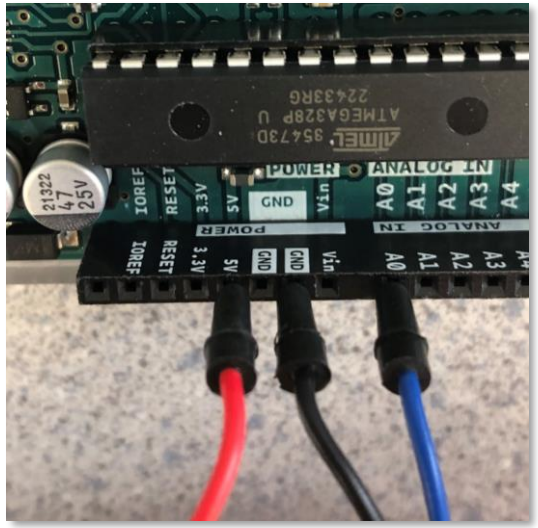
Attach ring at top of post

Attach clamp at bottom of post

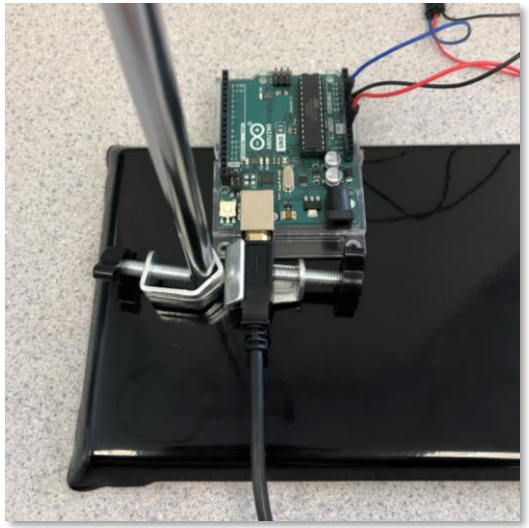
2. Wire Arduino Connections



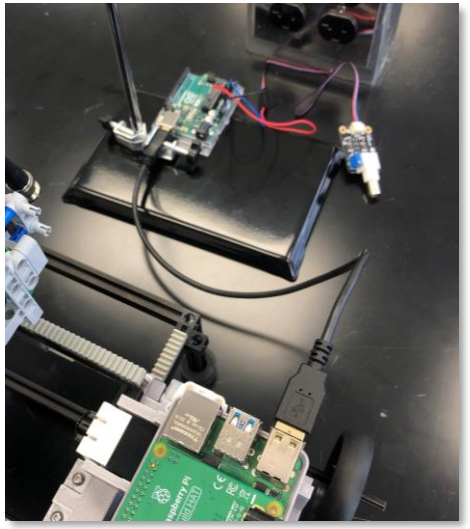
Attach Jumper wires to Arduino pH Sensor's BNC connector piece. Secure with a piece of electrical tape.



Insert other end of the Jumper Wires into the above ports on the Arduino.
Red = 5V
Black = GND
Blue = A0 (*analog port*)

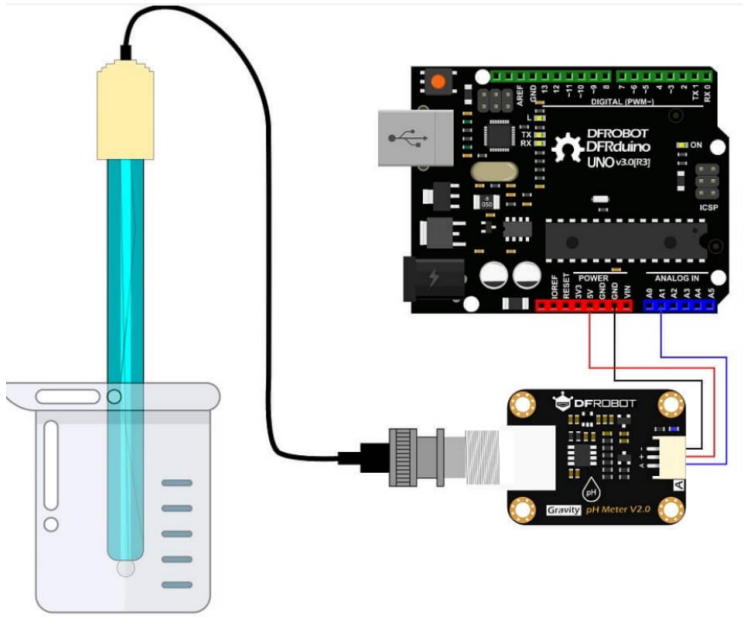


Insert the USB-type B end into the Arduino's port and use the knob on the clamp attachment to fasten the neck of this wire to the stand base. The Arduino should now be attached to the retort stand.

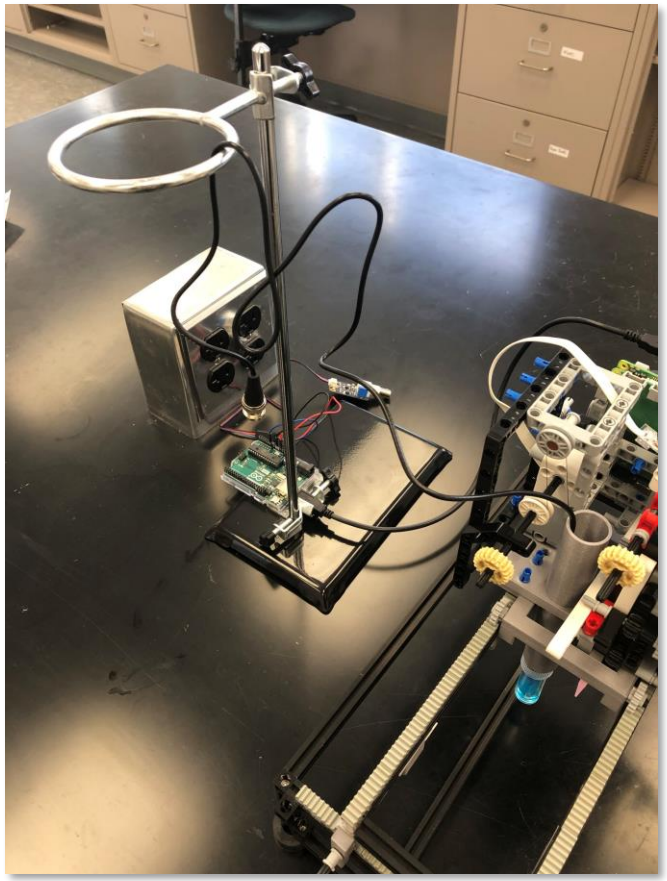


Insert the USB-type A end into the USB receptacle shown above.

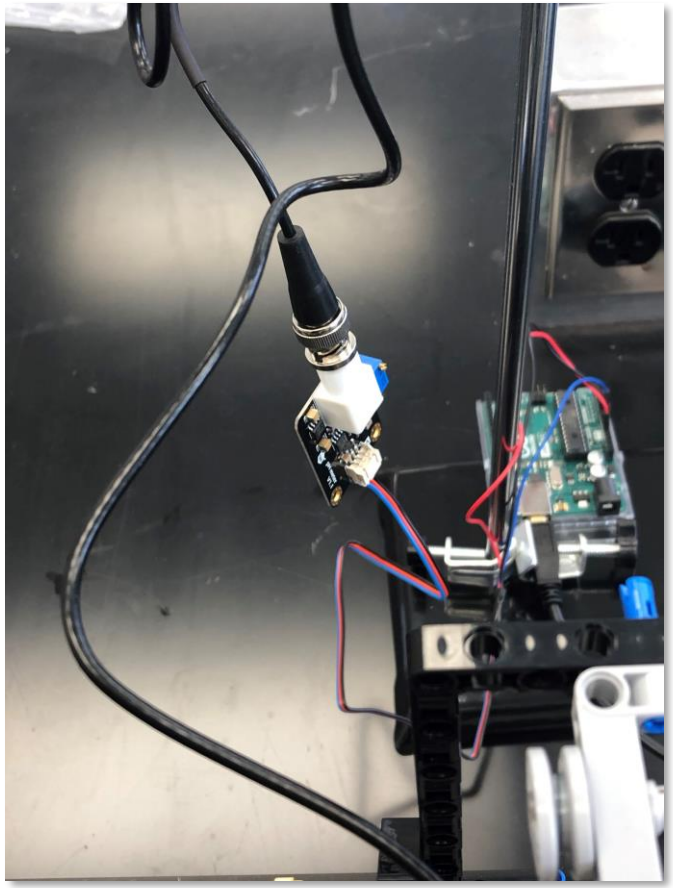
3. Connect pH Sensor



The pH sensor should connect to the BNC piece as shown in the diagram above.

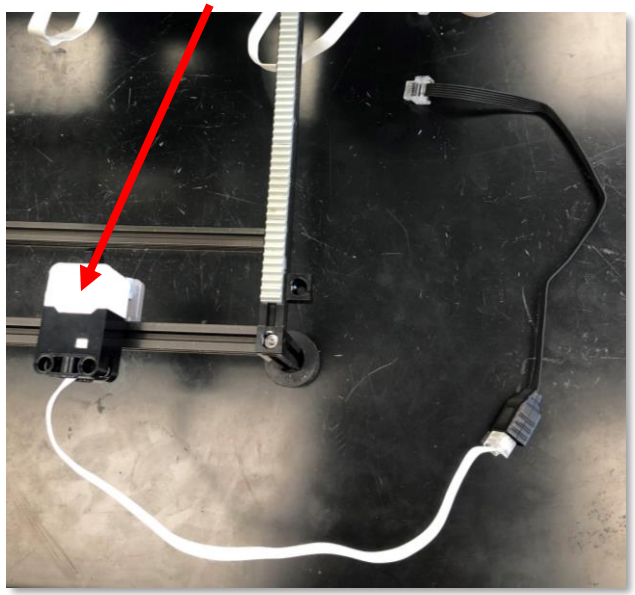


Take the BNC wire from the trolley assembly, and drape it over the top of the ring attachment on the retort stand so that there is some slack (this will be important later for proper functioning of the pH lowering mechanism

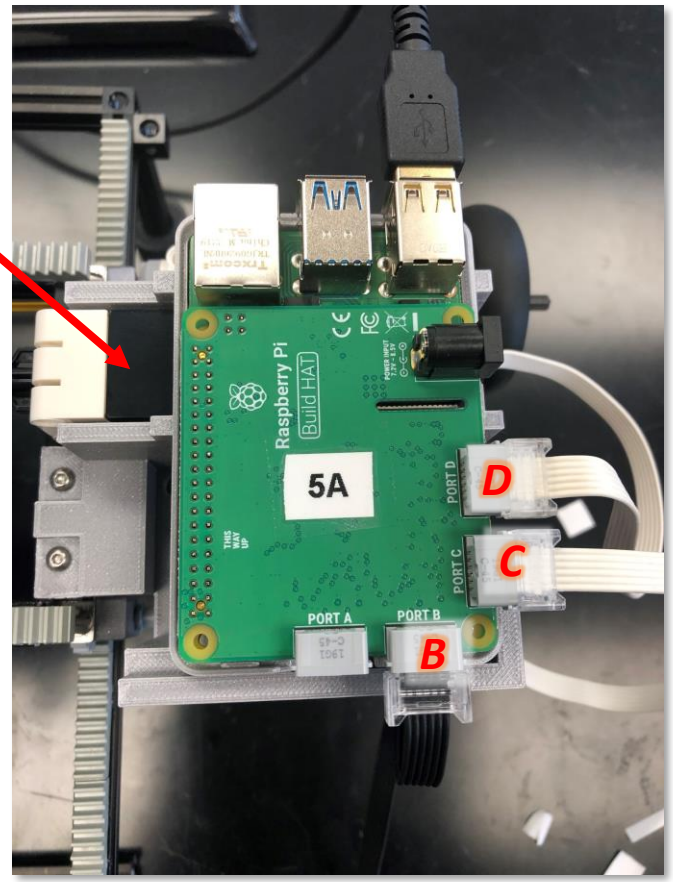


Attach the BNC connector to the BNC wire. It should rest easily with slack on both sides of the ring attachment

4. Wire the Side Assembly R-Pi + BH Stack (*#A*)



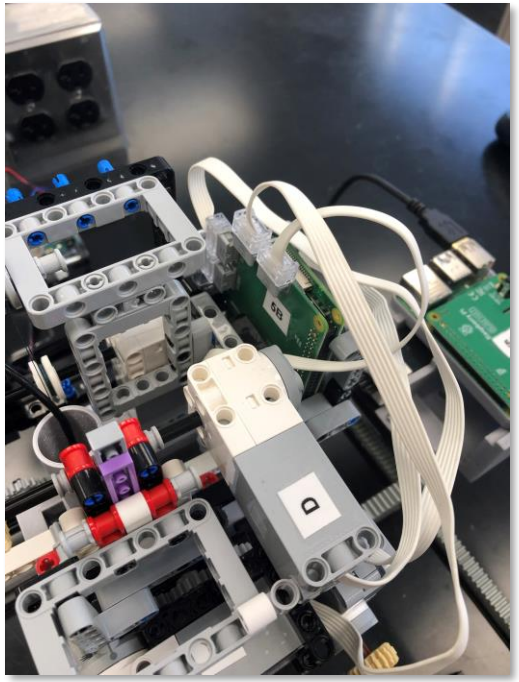
First, attach the LEGO Inventor Extension cable to the Y-axis force sensor



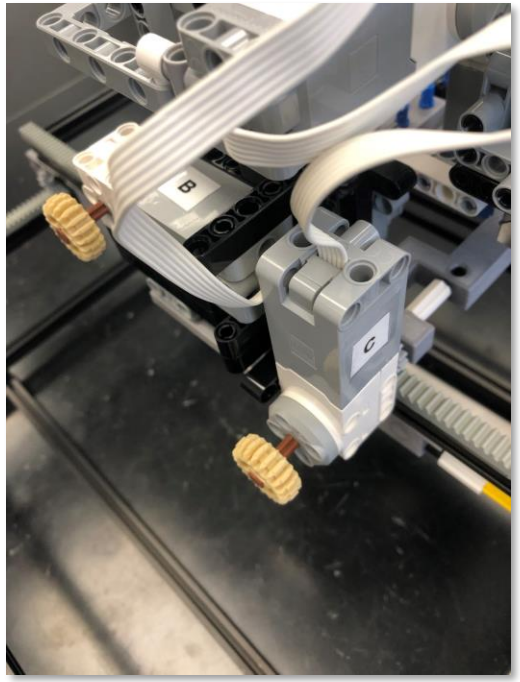
Attach the associated devices using the image above and the table.
(*Y-axis Motor is located beneath the Side Assembly*)

Device	Port
Y-axis Force Sensor	B
Y-axis Motor	C
X-axis Force Sensor	D

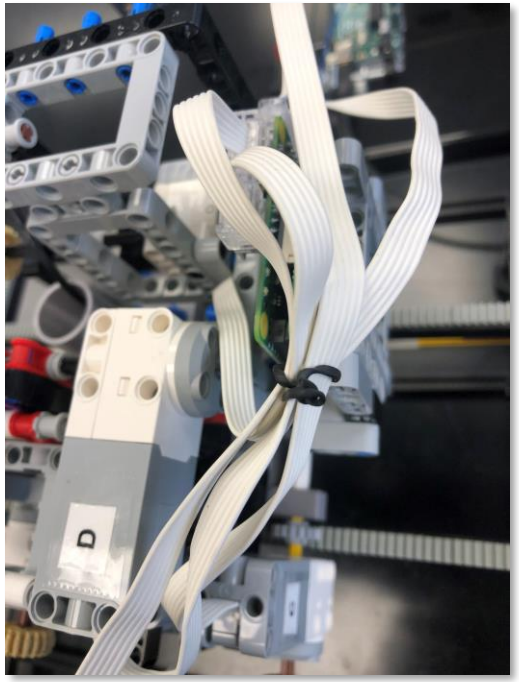
5. Wire the Trolley R-Pi + BH Stack (*#B*)



Attach the devices again, this time for the trolley motors and R-Pi + BH



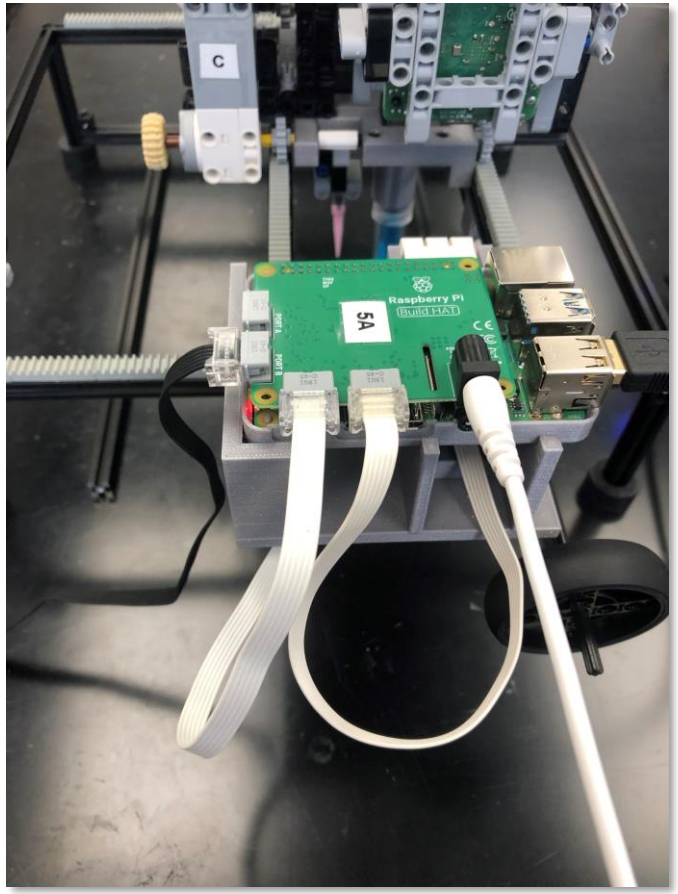
It may be a good idea to label the motors with their port if you need to unplug them later.



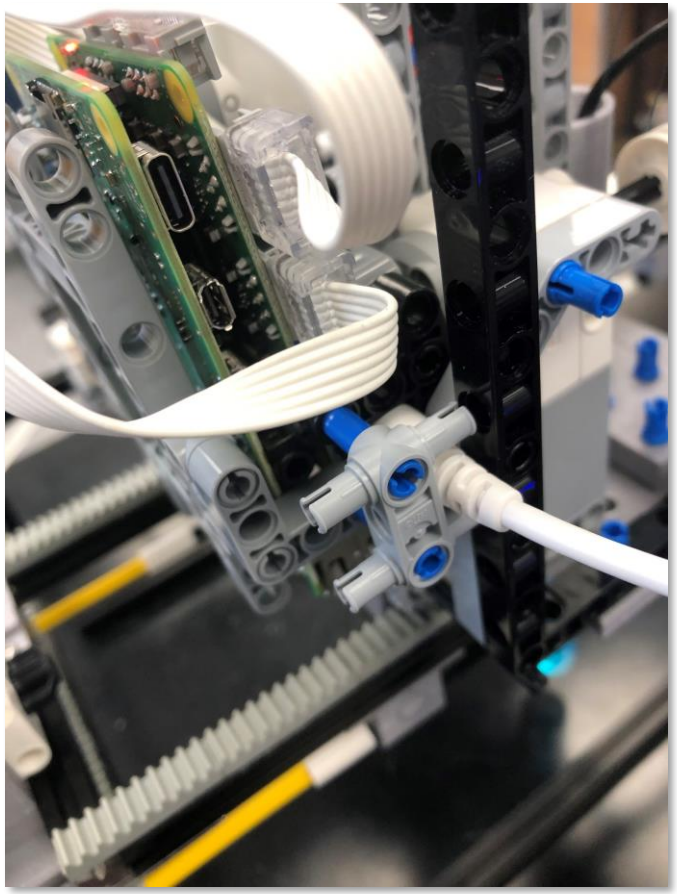
It is also recommended to use a wire tie to keep the group of wires together in a more organized manner.

Device	Port
Syringe Z-Motor	B
Syringe Plunger Motor	D
pH Sensor Z-Motor	A
X-axis Motor	C

7. Connecting Power



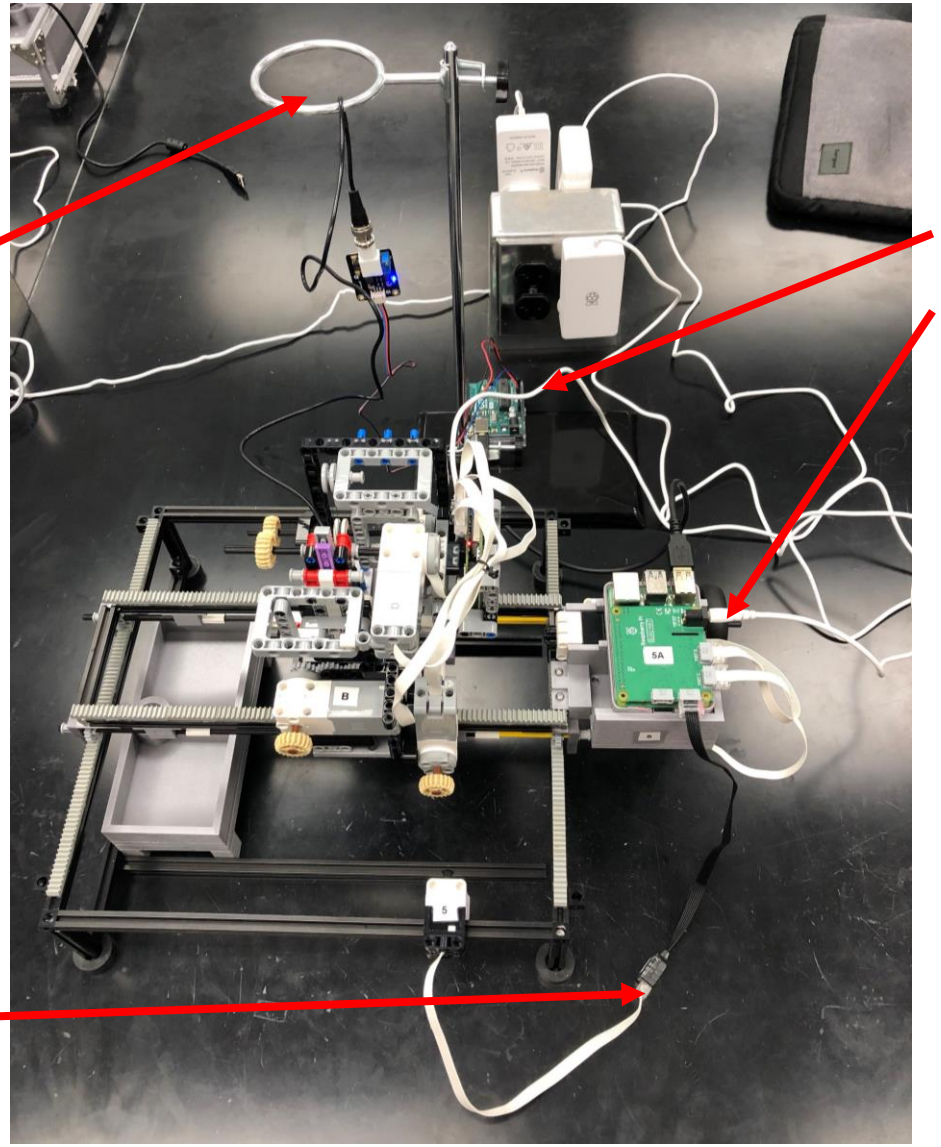
Plug in the BH charger into a wall outlet, then place the other end as shown here. This will power both the R-Pi and the BH



For the other charger, attach it to the trolley through the hole shown here in the LEGO frame.

7. Wire Management Tips and Checks

Keep the retort stand around 3-6” behind the stand frame.



Keep BH charger cords outside the sample space, with some slack

Keep Y-axis force sensor cord outside the frame space

Once the wires are arranged, ensure you have enough slack in the BNC cord to allow the range of motion shown in this video. Repeat this process at all 4 corners of the cartesian space