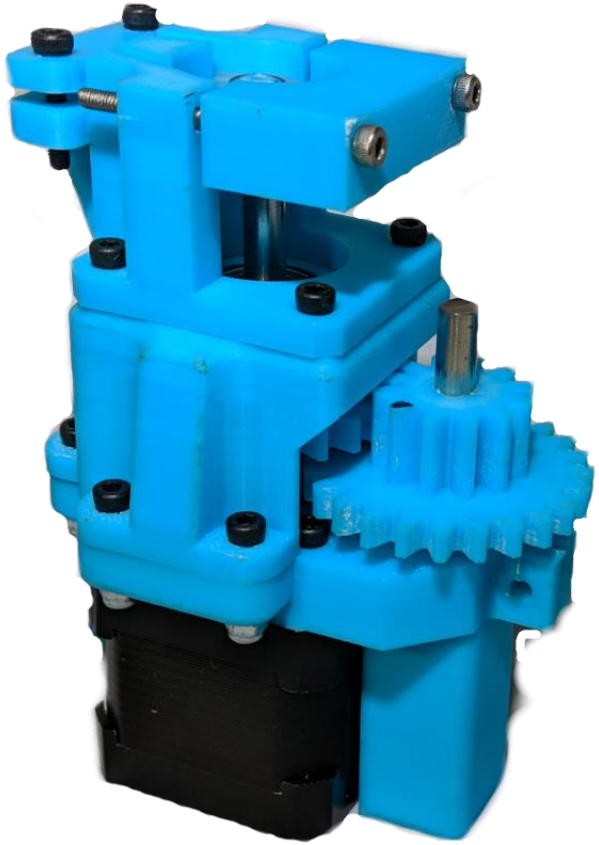
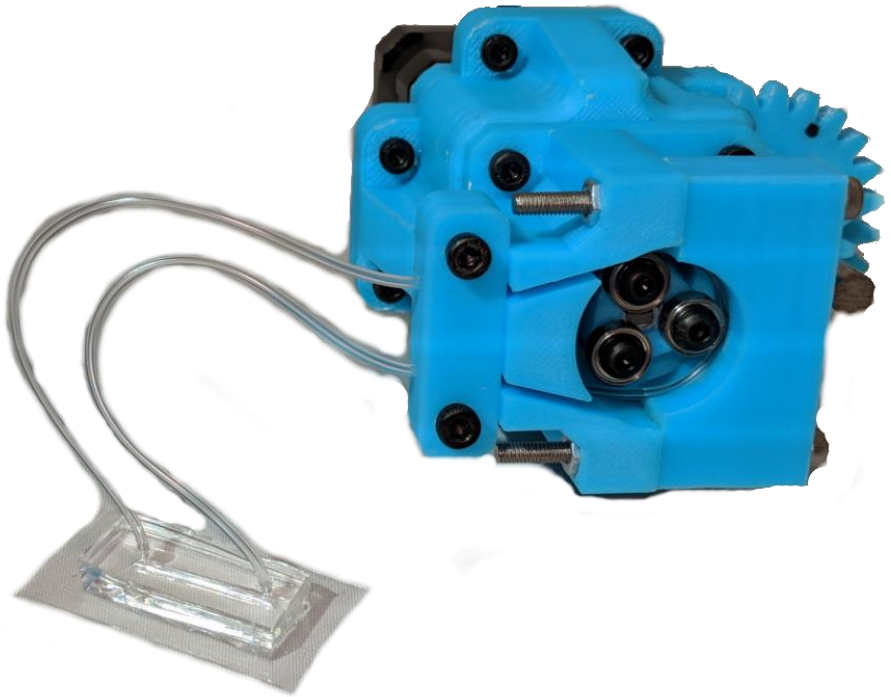
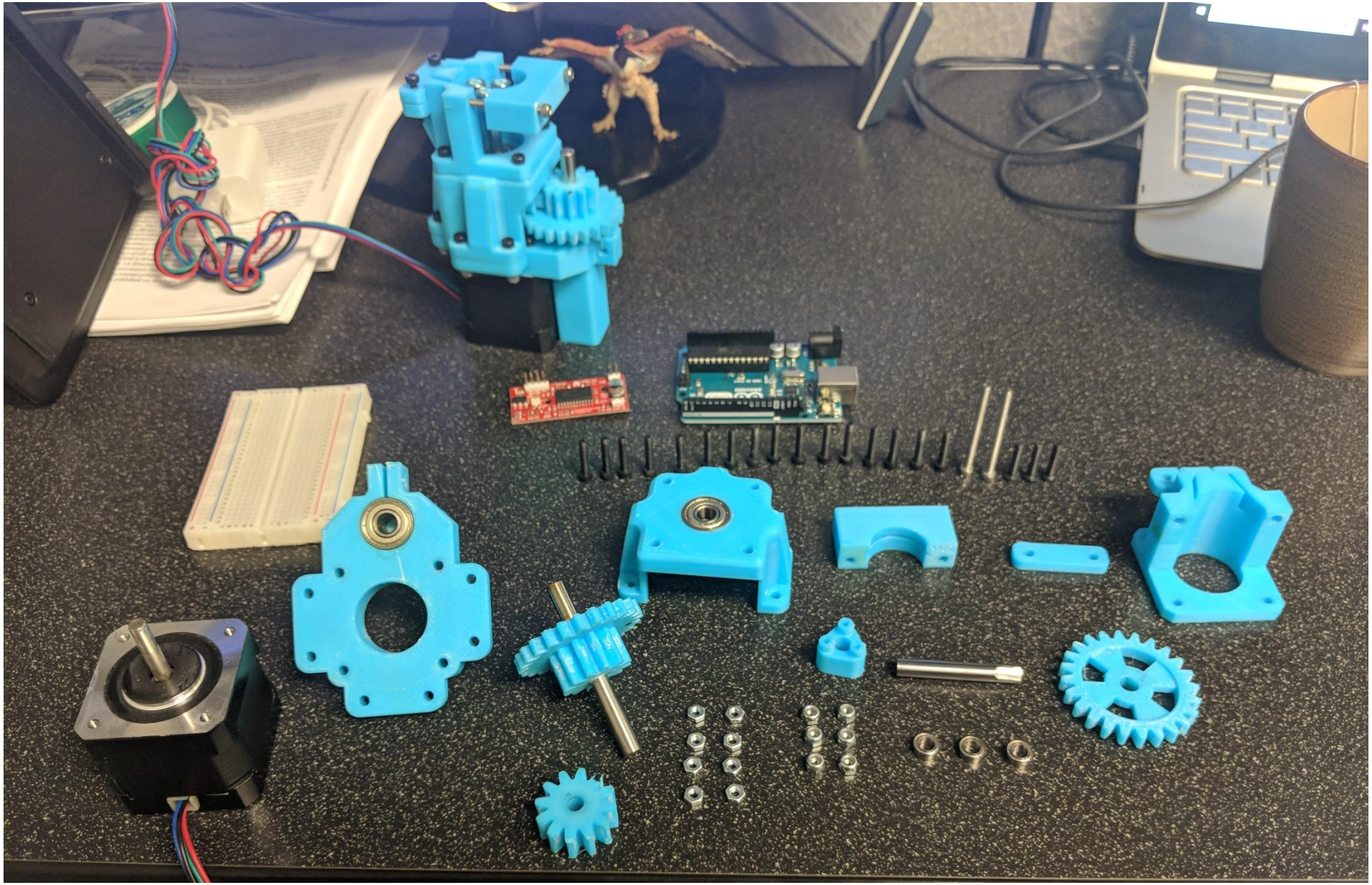
How to assemble and use the 3D-printed peristaltic pump



From Warren Ruder's Lab
Pitt Bioengineering
September 30, 2019



Parts



Parts

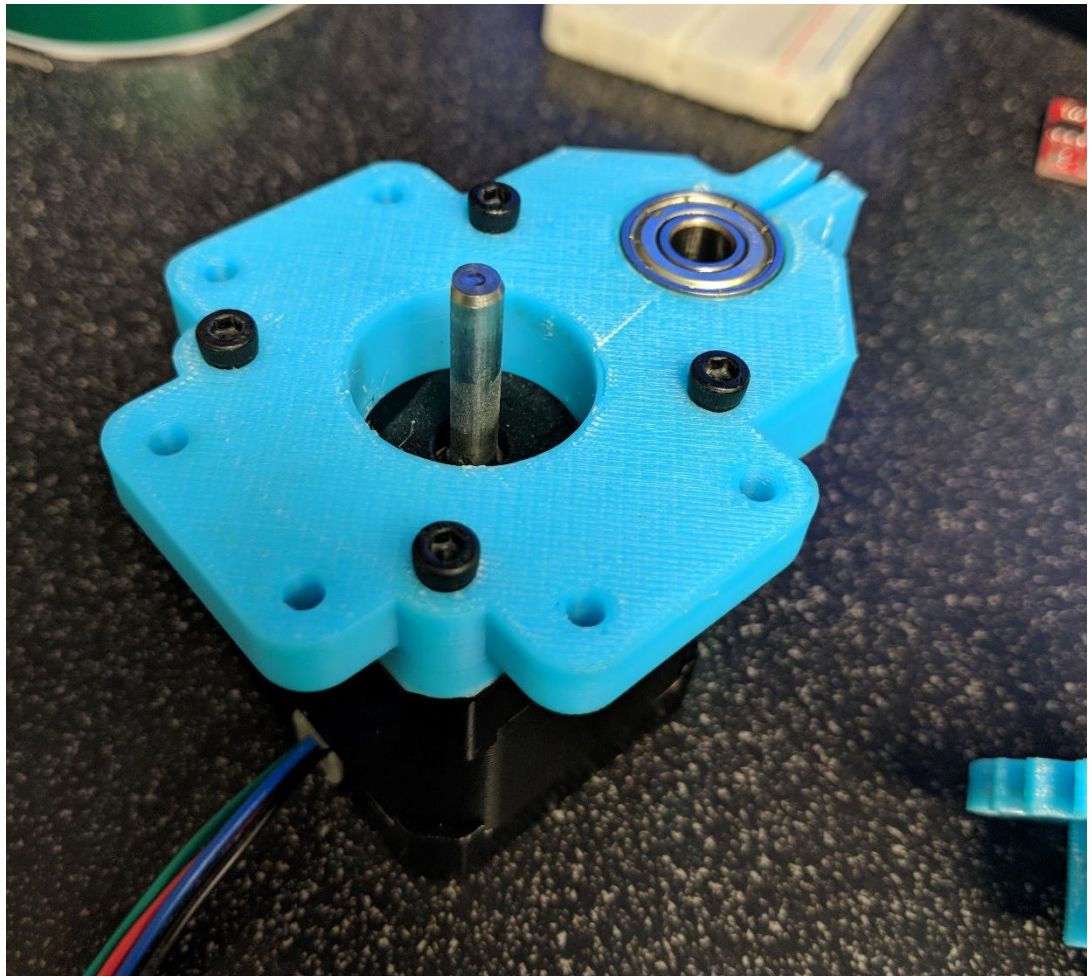
Hex Socket Machine Screws M3-0.5 x 16mm	19
Hex Socket Machine Screws M3-0.5 x 40mm	2
Steel lock nut M3-0.5	6
Zinc M3-0.5 nut	8
Linear Shaft 6x100mm	1
Ball Bearing 17x6x6mm	4
Ball Bearing, I.D. 4.72mm, O.D. 7.9mm, Thickness 3.16 mm	3
NEMA 17 Stepper Motor	1
Sparkfun Easydriver Motor Controller	1
Arduino Uno	1
3D printed Components	9

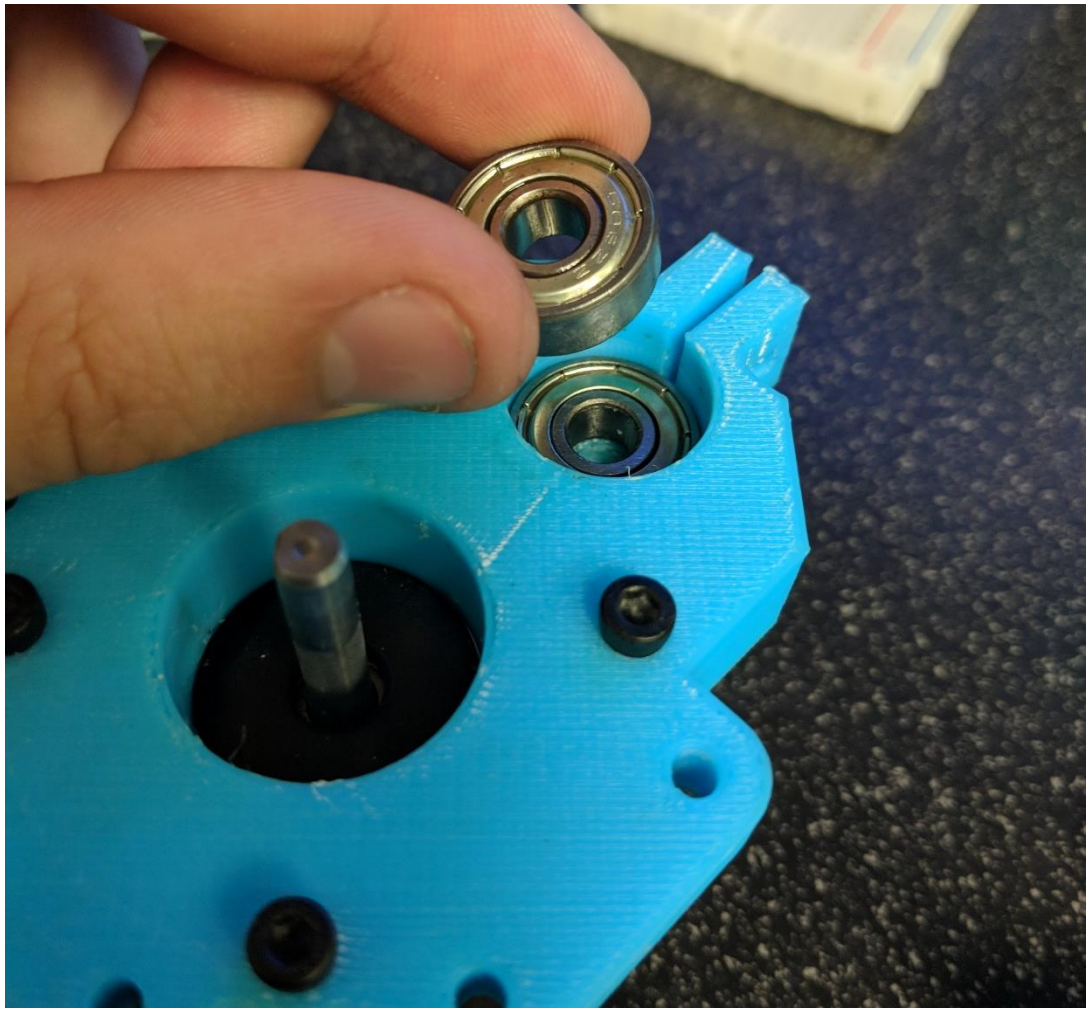
3D printed components

- Gear Box Base
- Small Gear
- Stacked Gear
- Gear box upper case
- Large gear
- Pump stator (comes in 2 flavors, one for 1.47mm tube, one for 3mm tube)
- Pump lid (comes in 2 flavors, one for 1.47mm tube, one for 3mm tube)
- Pump clamp
- Pump rotor

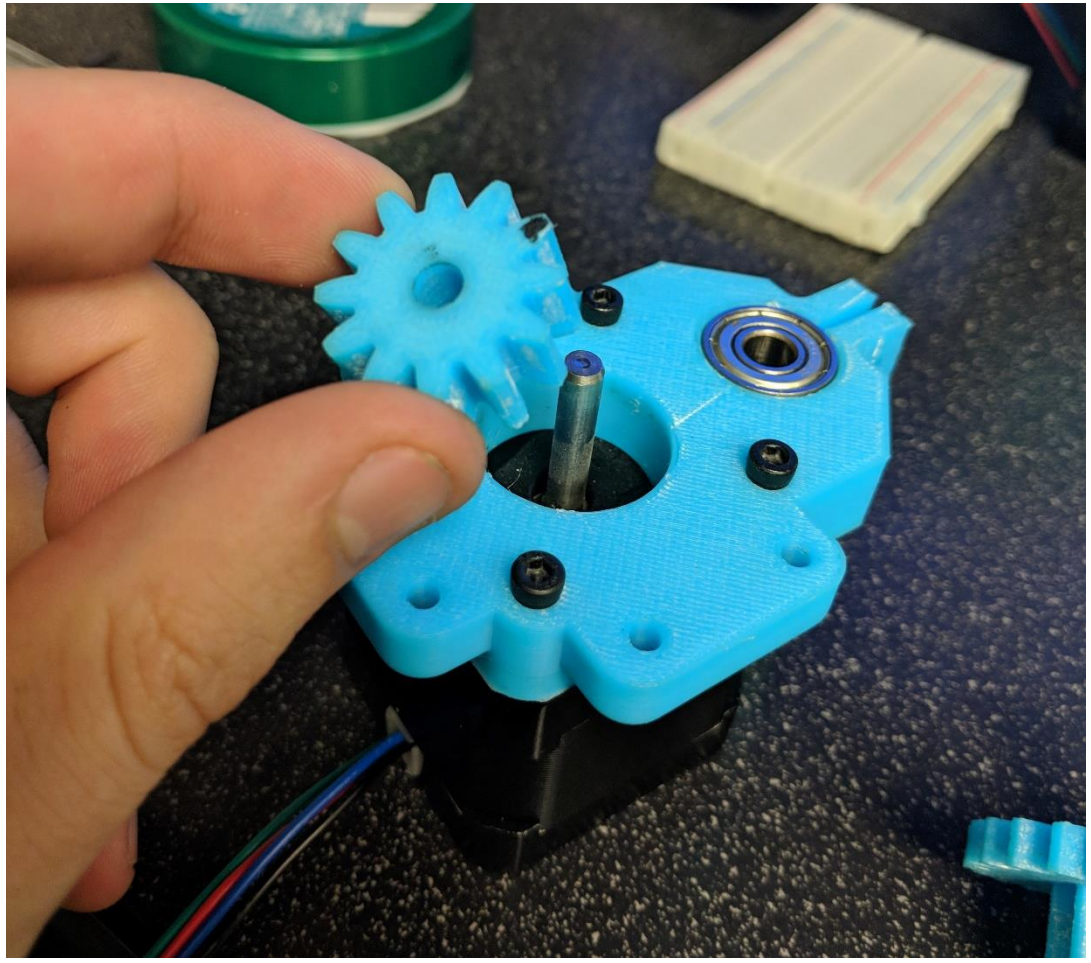
Cut shaft into 2 pieces. One piece should be 40mm, the other doesn’t matter.

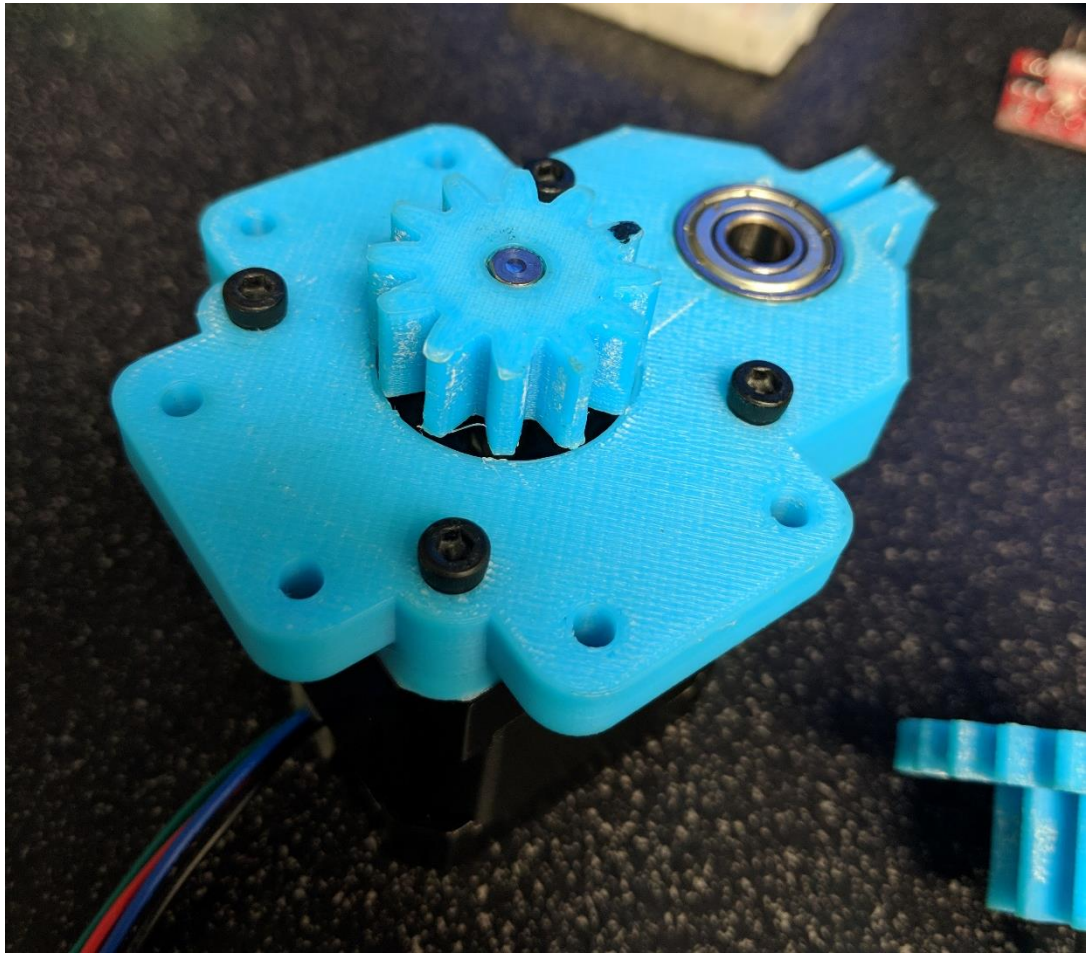
Attack baseplate with hex screws and insert bearings



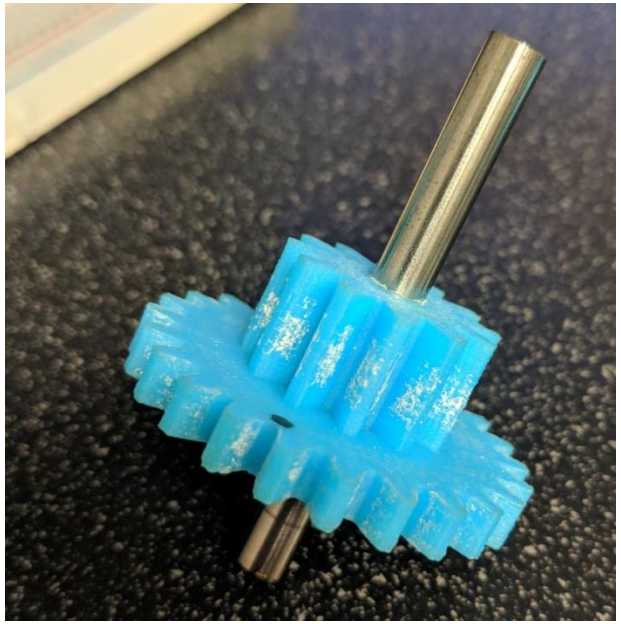


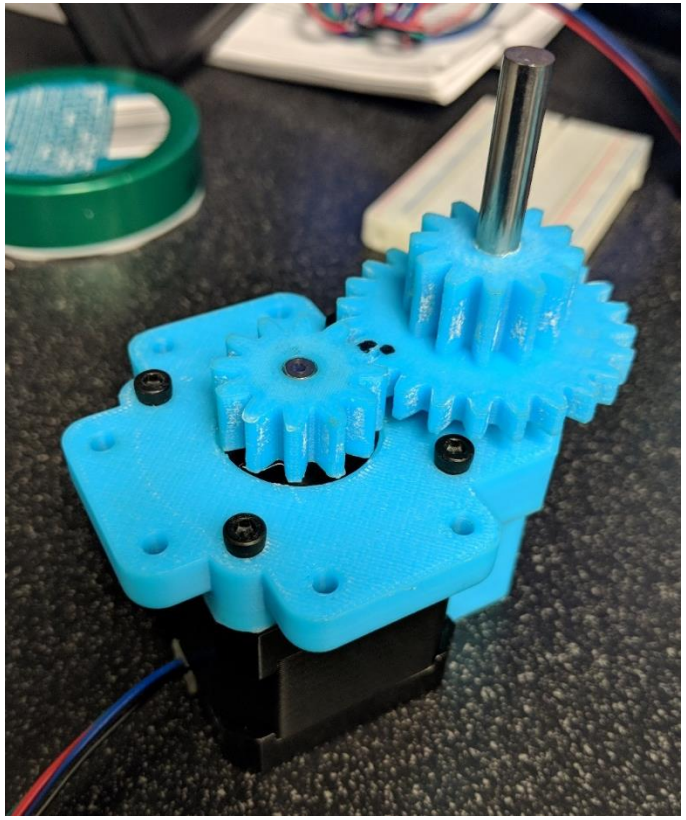
Press fit small gear onto stepper motor shaft

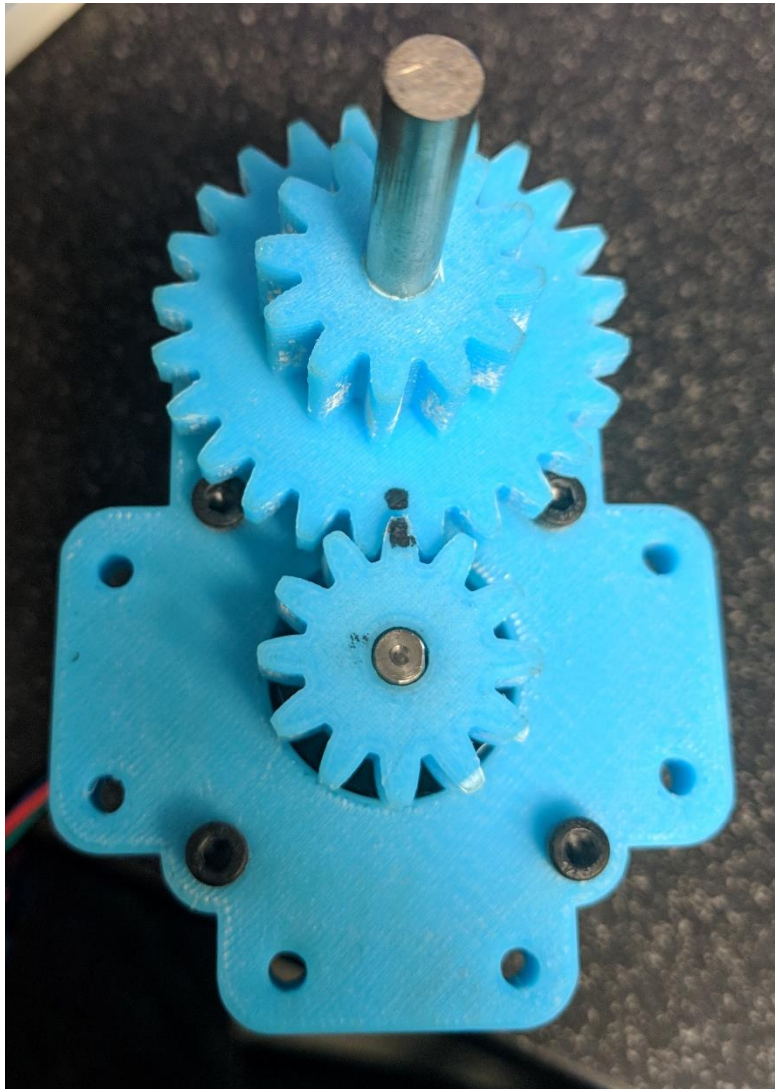




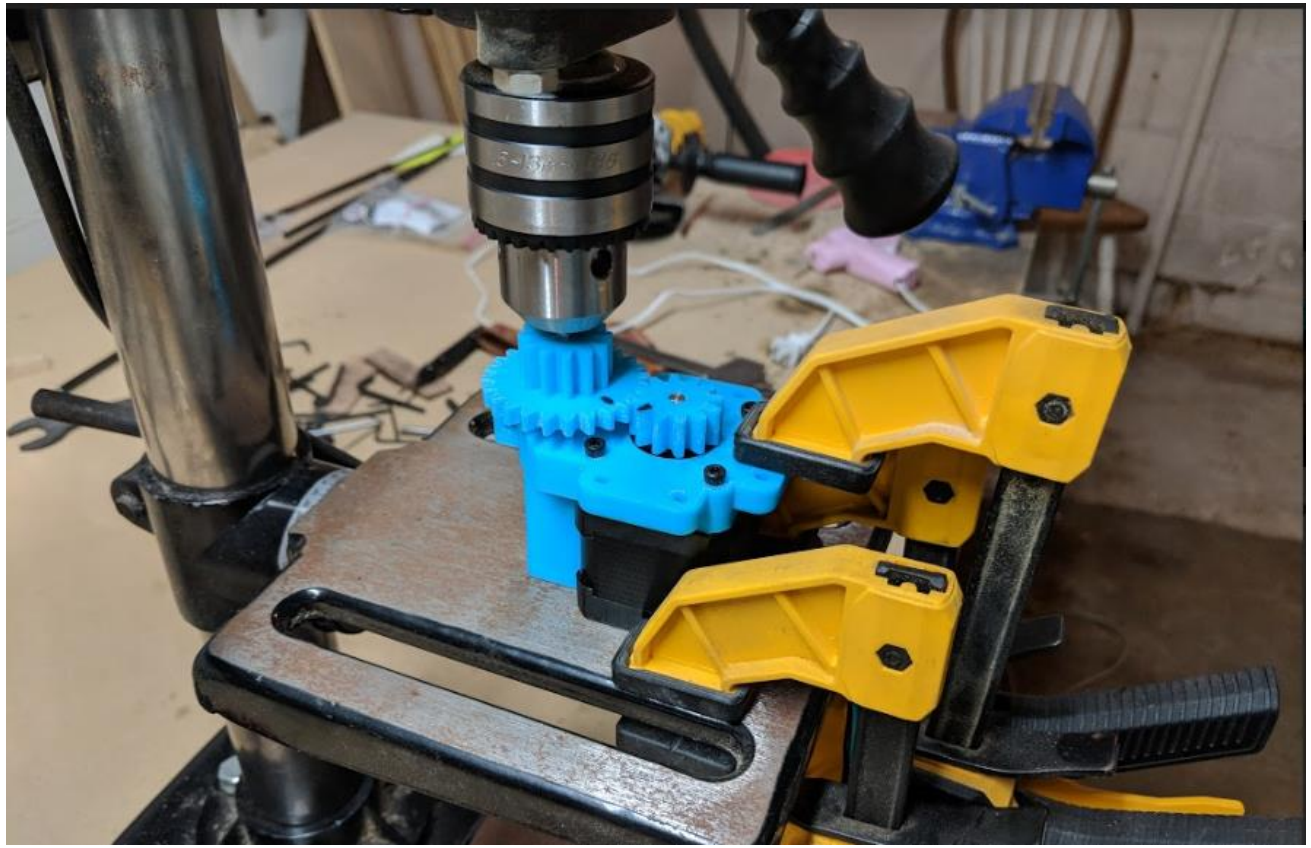
Press stacked gear onto long end of cut shaft, so that it meshes with the gear on the motor



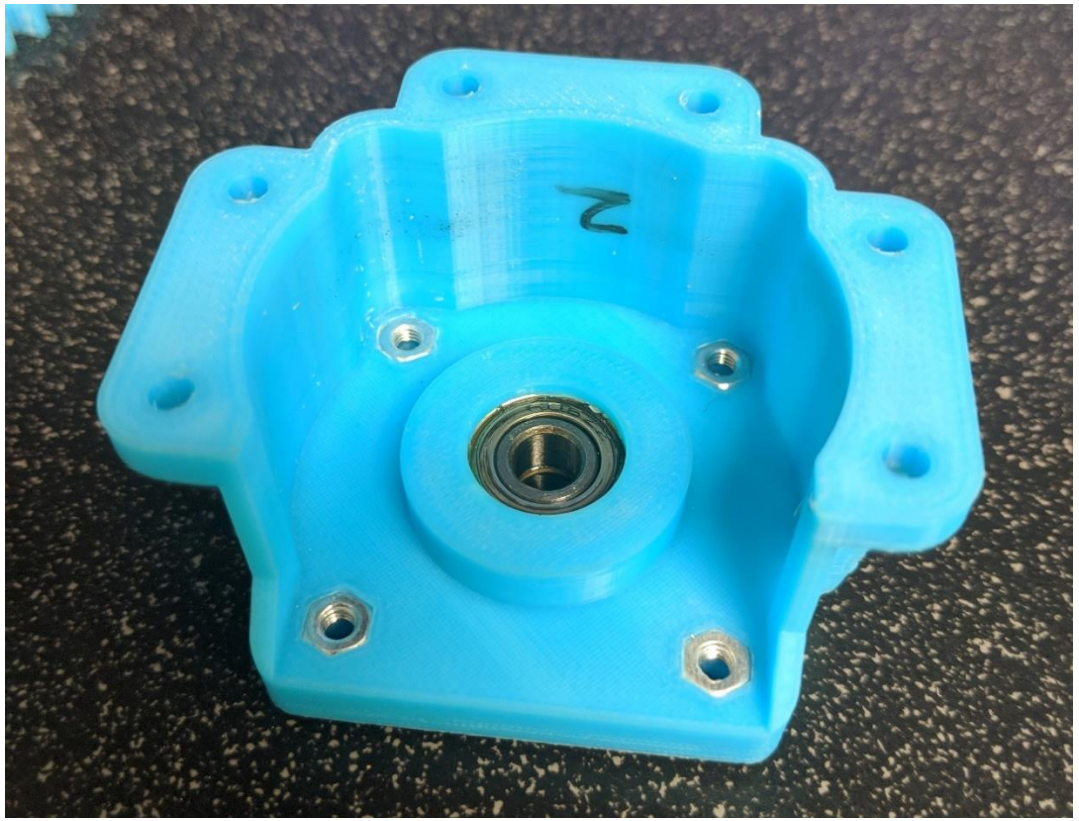




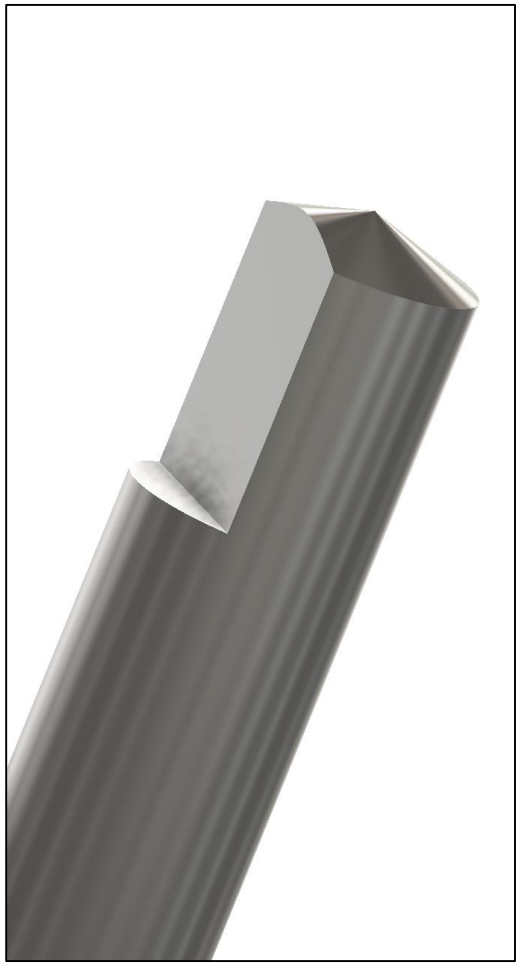
Depending on the accuracy of your 3D printer, the gears may not mesh smoothly at first, causing them to lock up. This can be fixed by driving the shaft with a drill until the small burrs and imperfections have worn away on the gears.



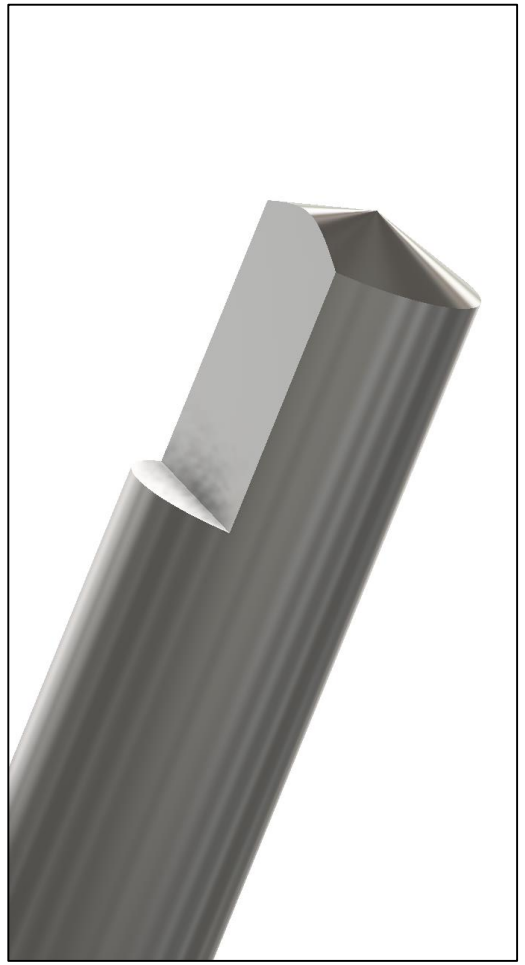
Insert Ball bearings and nuts into top casing



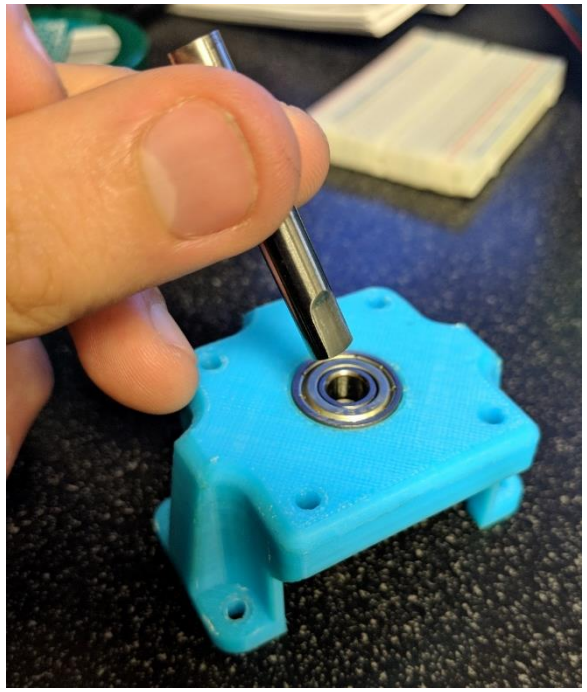
Cut shaft to 40mm, mill side of shaft with dremel tool until it fits it’s gear, and create a very shallow point on end of shaft. This is so that it spins freely on it’s end.

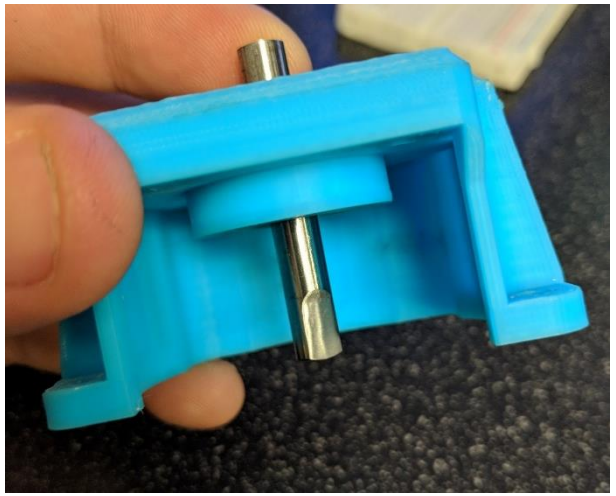


Tip: the best way to make this shallow point is by mounting the shaft in a drill or drill press, and spinning it while grinding with a dermal. Or use a lathe if you have one.

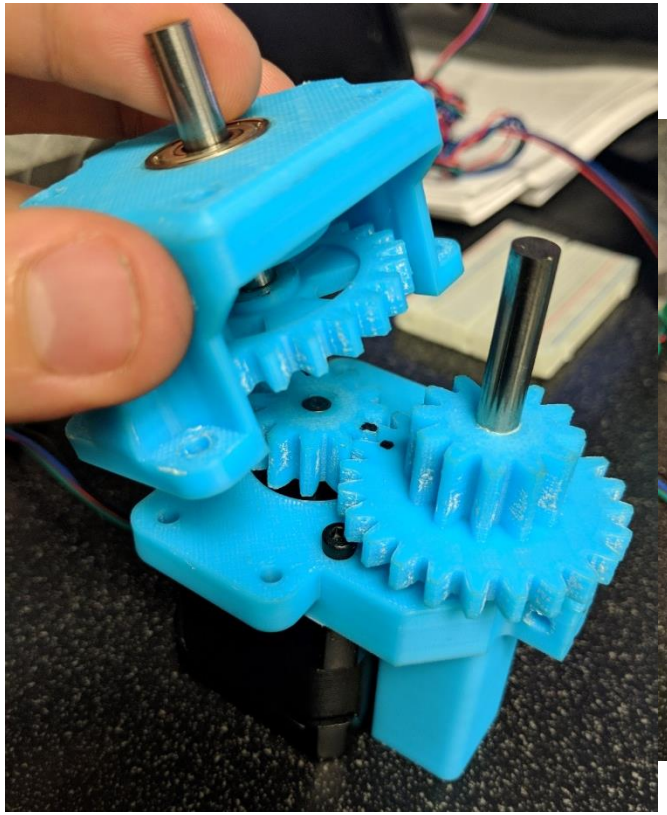
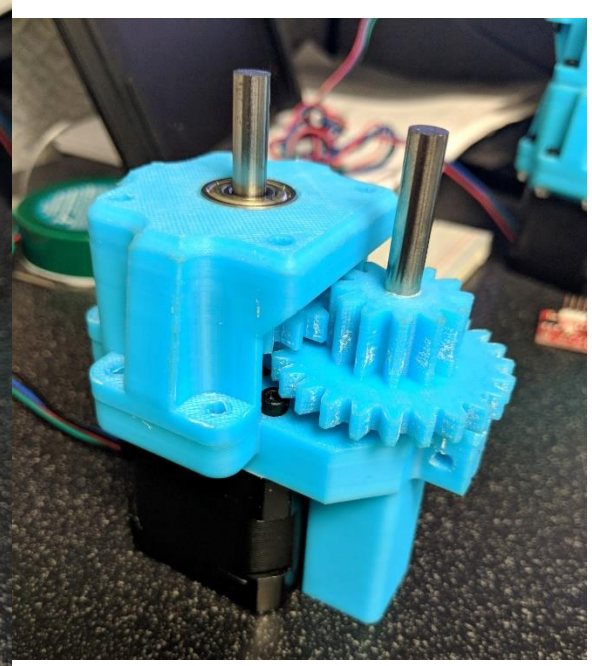
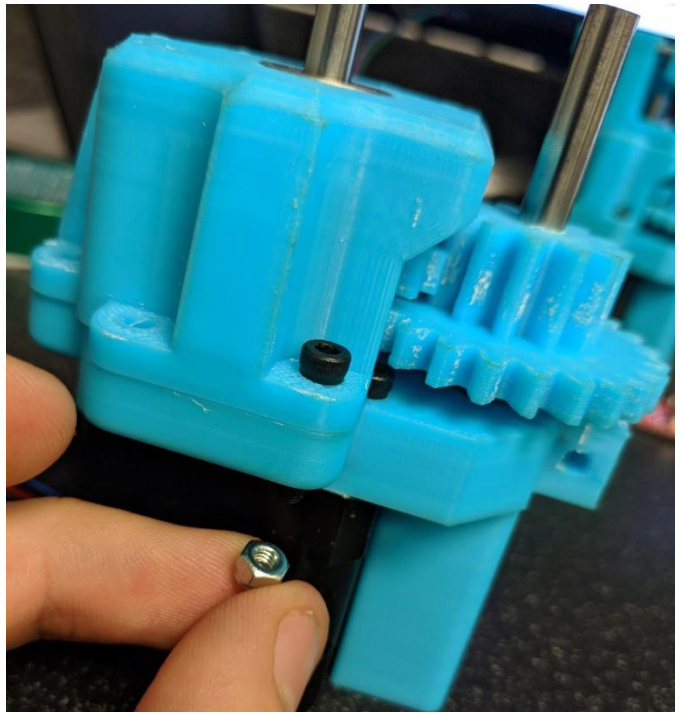
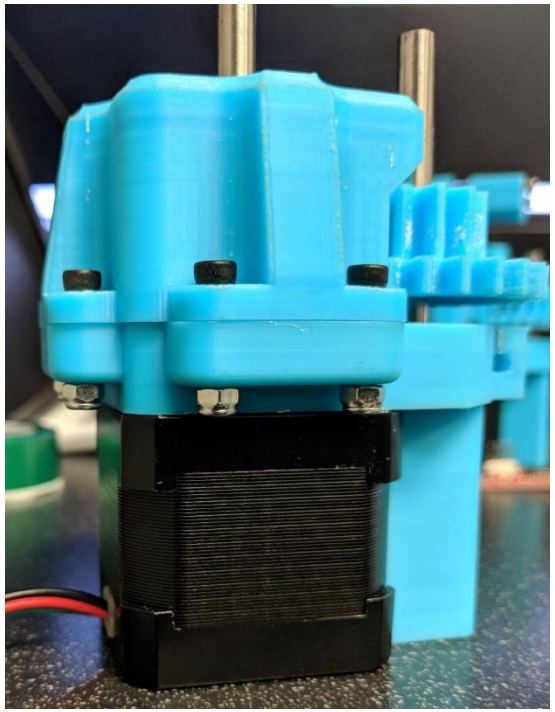


Insert machined shaft into casing, and attach fitted gear

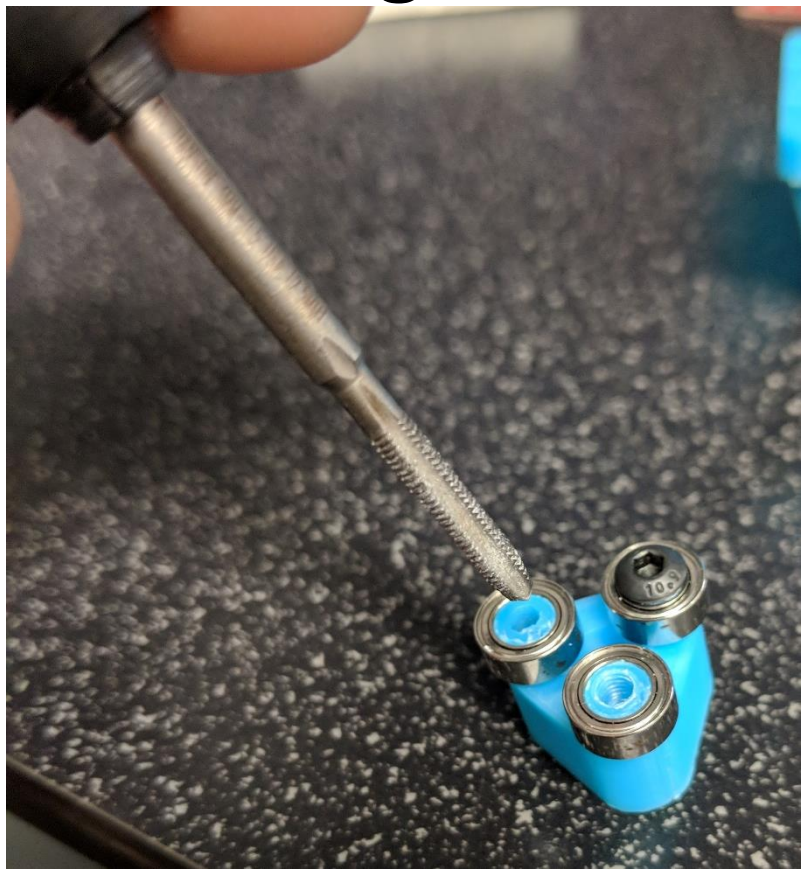




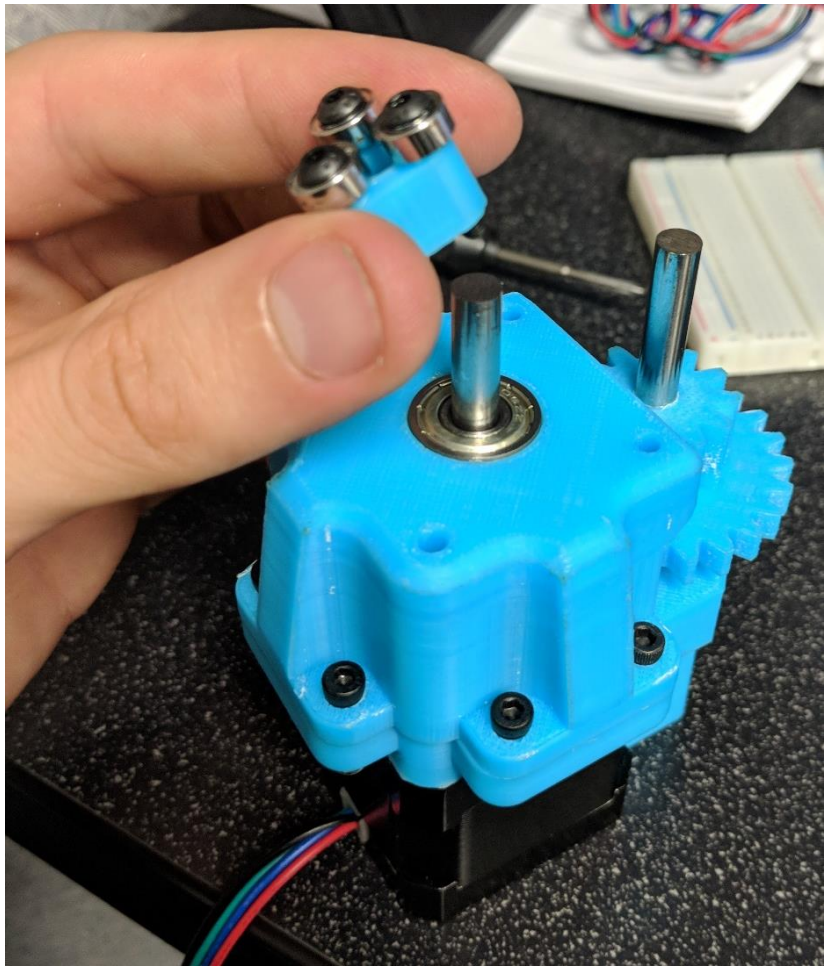
Mount top casing assembly to bottom, screw together

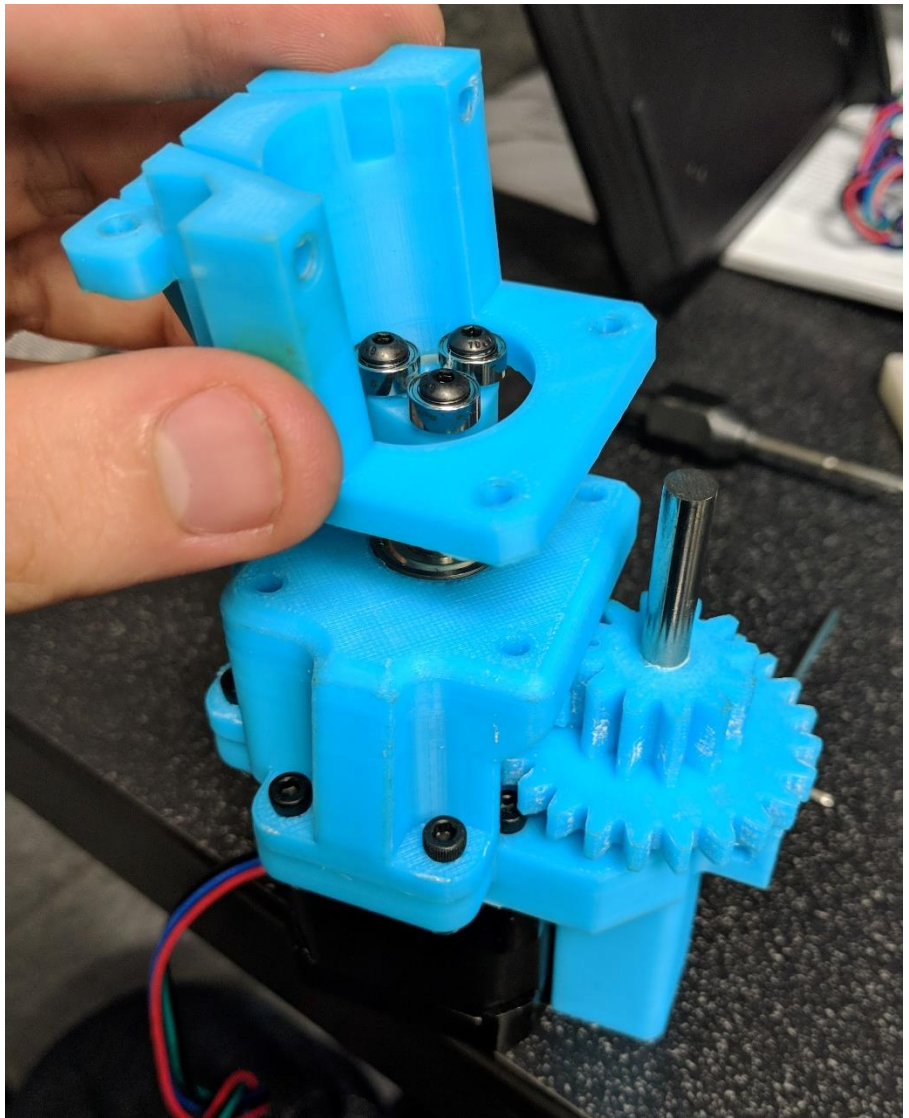
Insert small bearings onto rotor. This is best done by placing the bearings on the table, placing the rotor on top of them, and then giving a few light hits with a hammer. Then tap the holes for the screws using an M3-0.5 tap, and screw together.

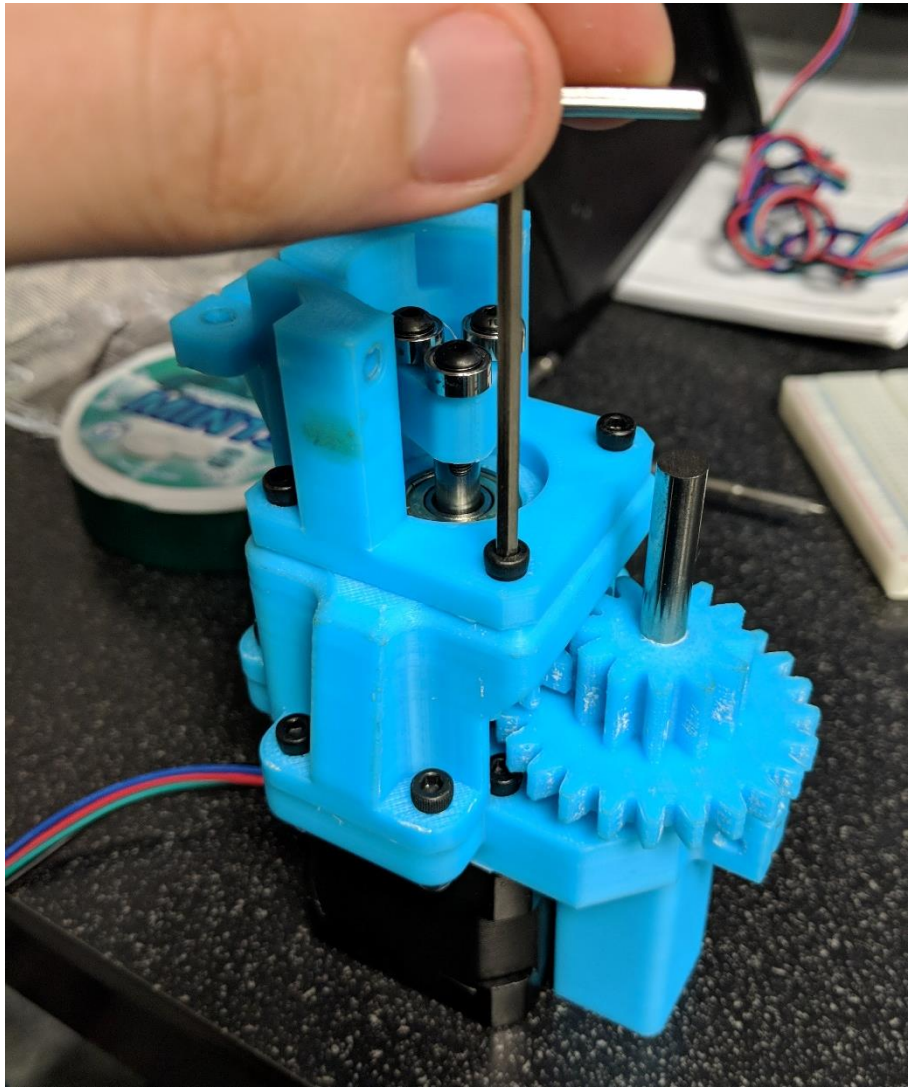


Press rotor onto shaft

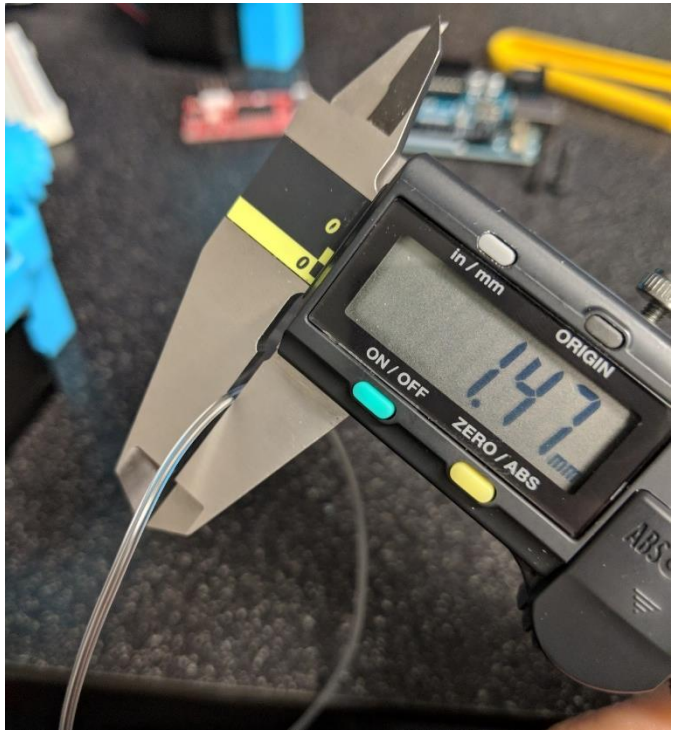


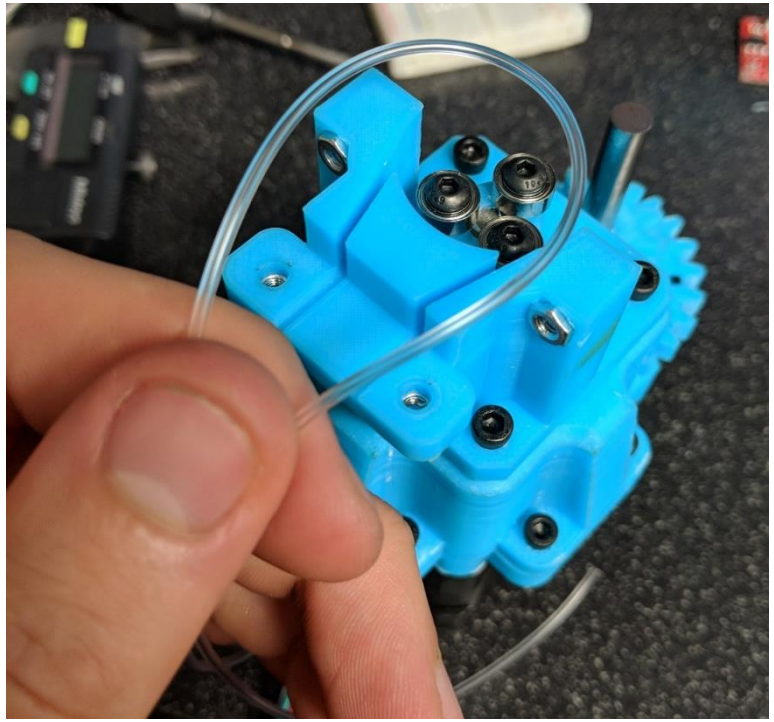
Mount Peristaltic Pump Stator

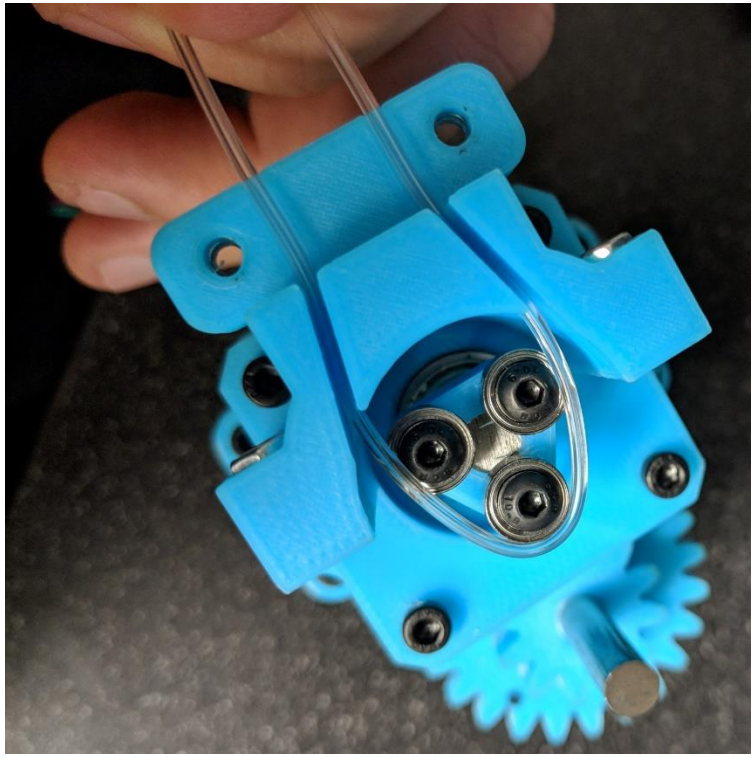




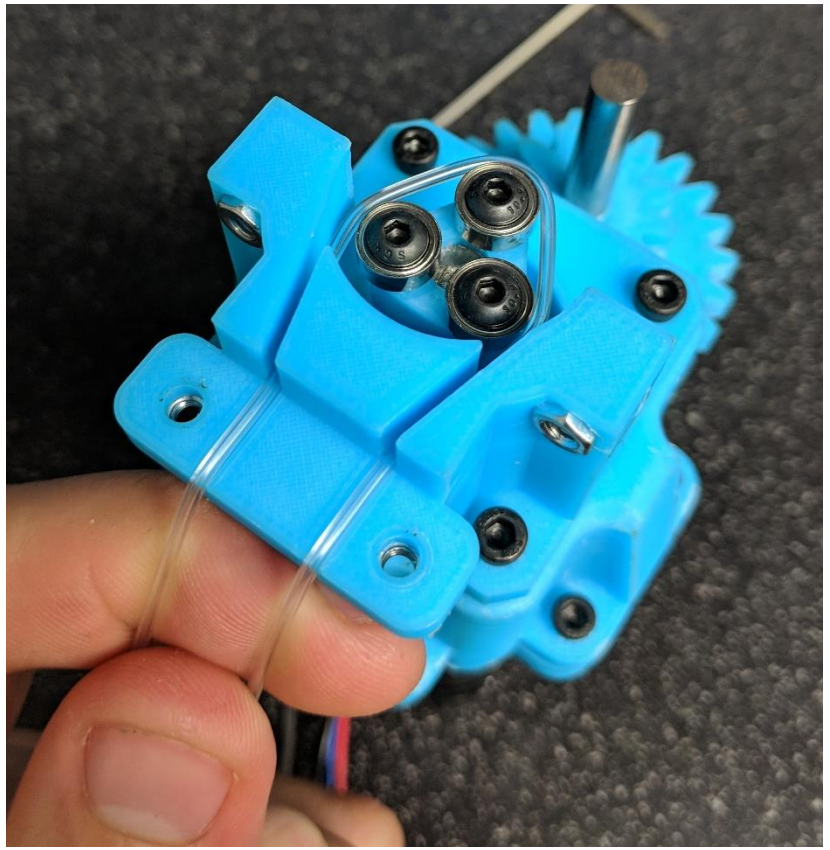
Form loop in tygon tubing and insert into slots, and press against rotor

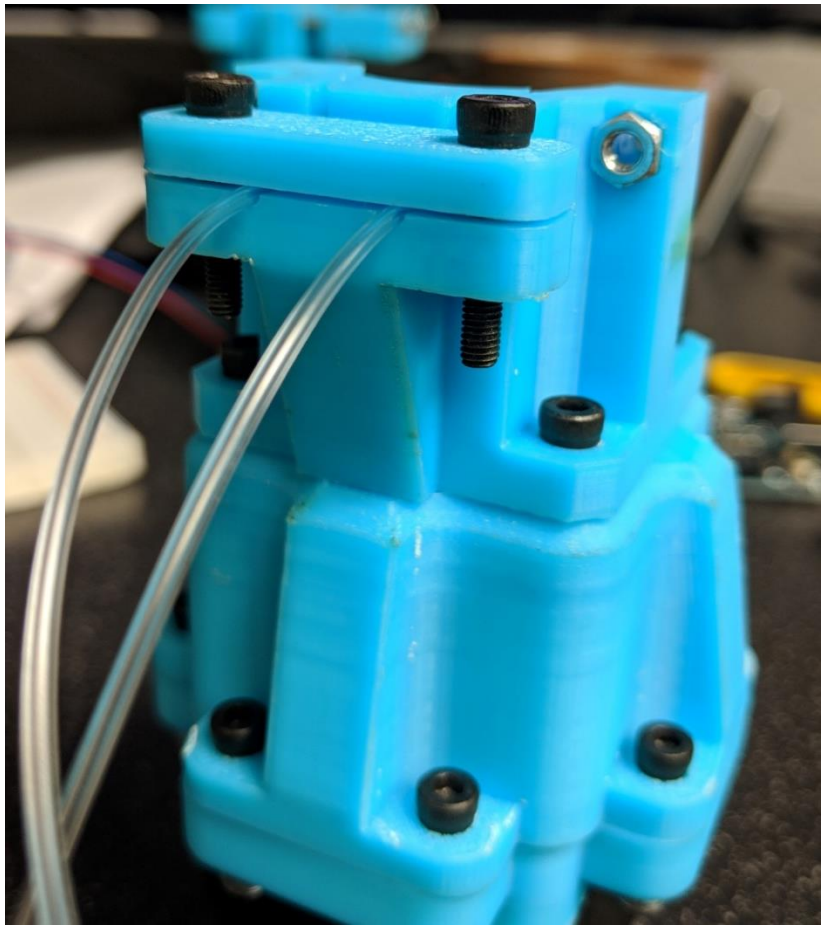




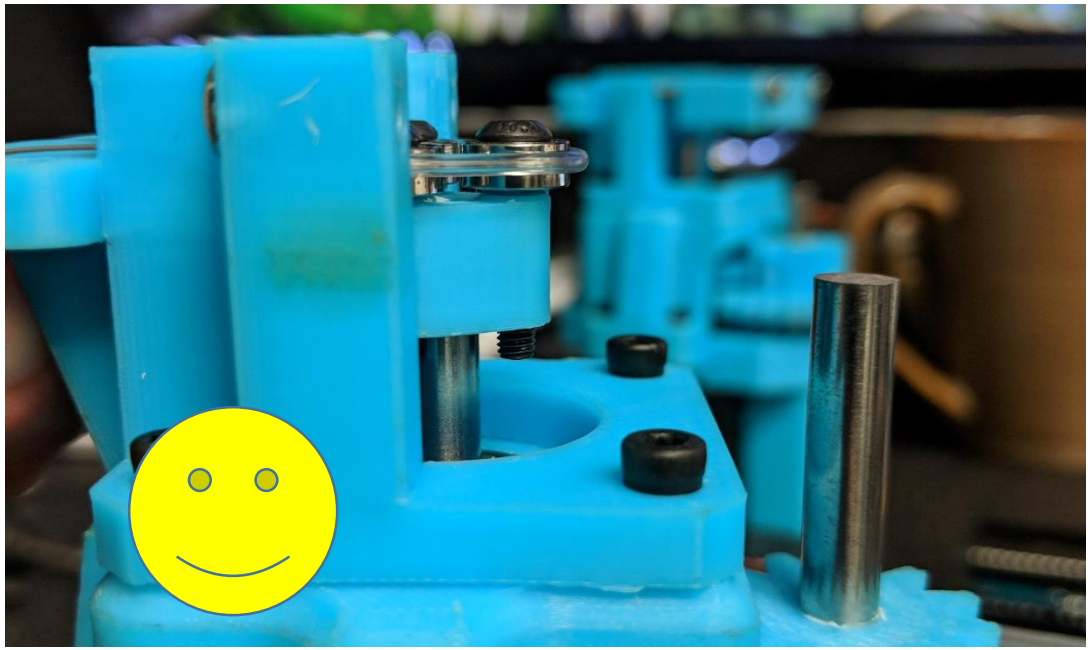


Apply tension to the tubing, and clamp in place. Do not over tighten the clamp, it should just be enough to hold the tubing without squeezing it shut.

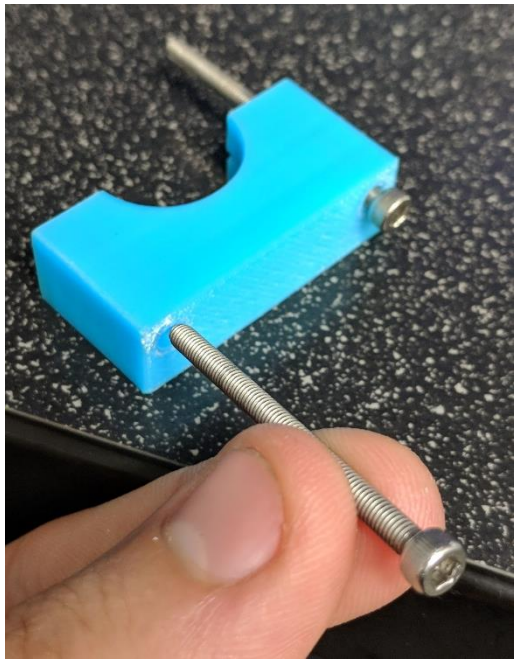


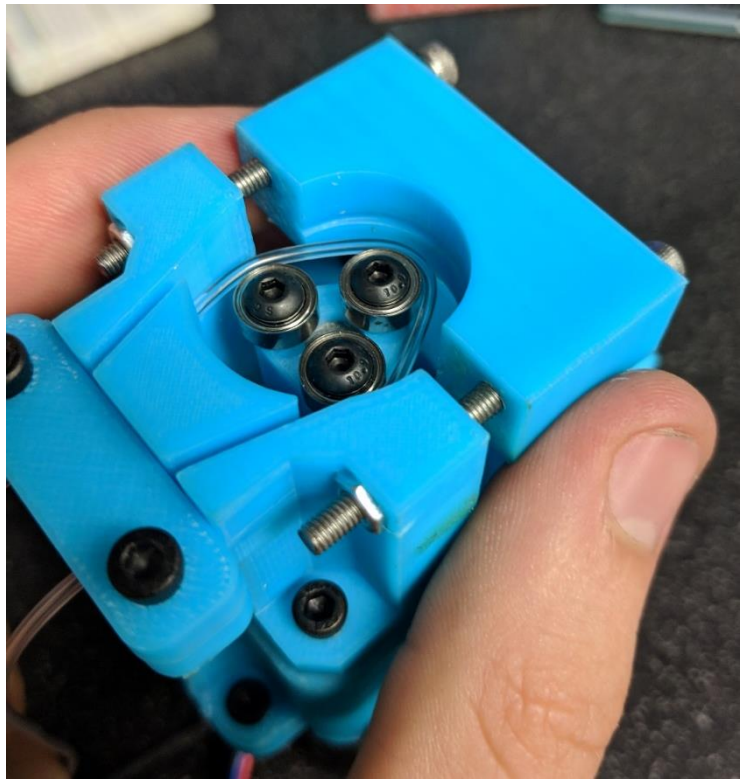


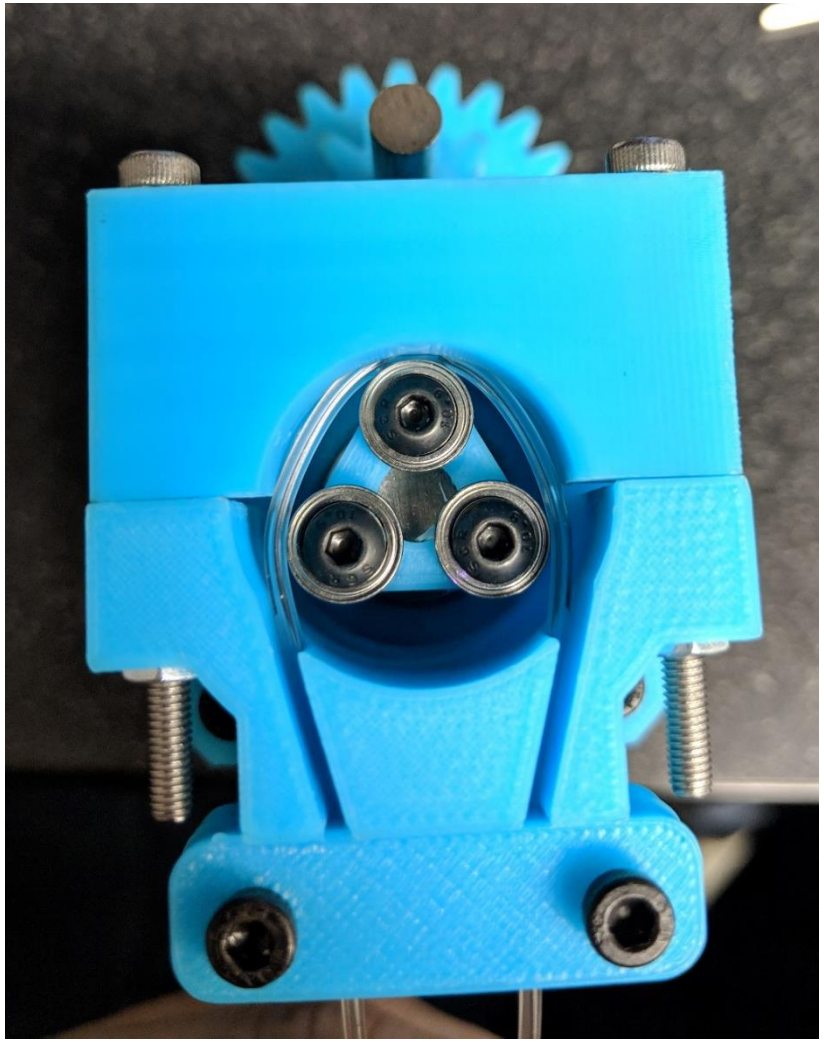
Adjust the height of the rotor so that the tubing is straight, and sits squarely on the bearings.



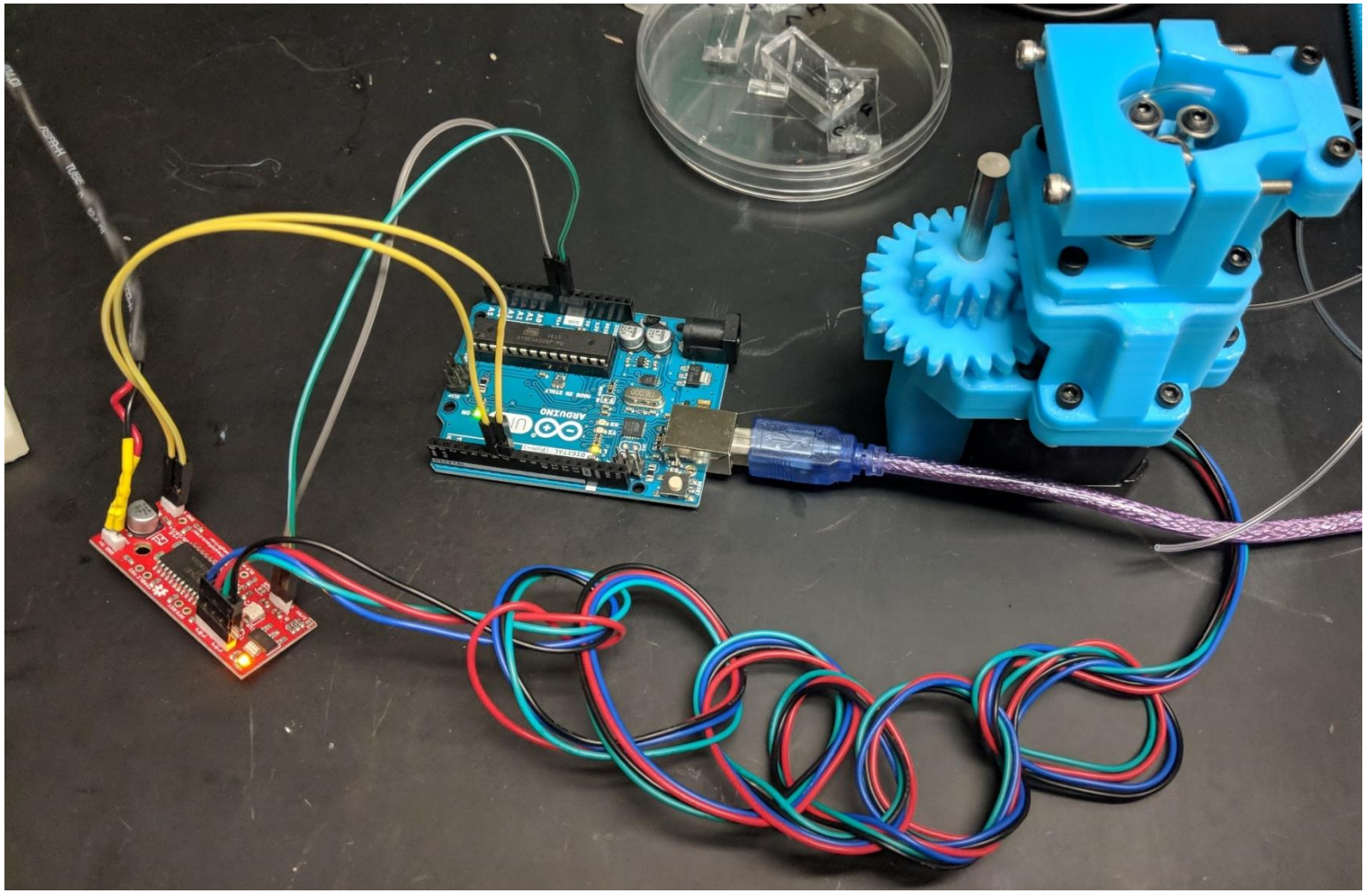
Add second clamp. This should be fully tightened for use, and loosened when the pump is not running, to prevent damage to the tubing.







Hook up the electronics.



Stp goes to digital pin 6 and dir goes to digital pin 7. 10V power should be connected to M+ on the motor driver. Ground should be connected to Gnd on both boards. +5V from the motor driver goes to Vin on the Arduino. The leads from the stepper motor should be attached to the A and B pins on the motor driver.

Program the Arduino

This is the simplest program to control the pump. It just spins the rotor in a single direction at a set speed. The speed is controlled by altering the length of the delays in the main loop.

```
1     #define stp 6
2     #define dir 7

3     void setup() {
4       pinMode(stp, OUTPUT);
5       pinMode(dir, OUTPUT);
6     }
7
8     //Main loop
9     void loop() {
10
11        digitalWrite(stp,HIGH); //Trigger one step forward
12        delay(.1);
13        digitalWrite(stp,LOW); //Pull step pin low so it can be triggered again
14        delay(1);
15    }
```