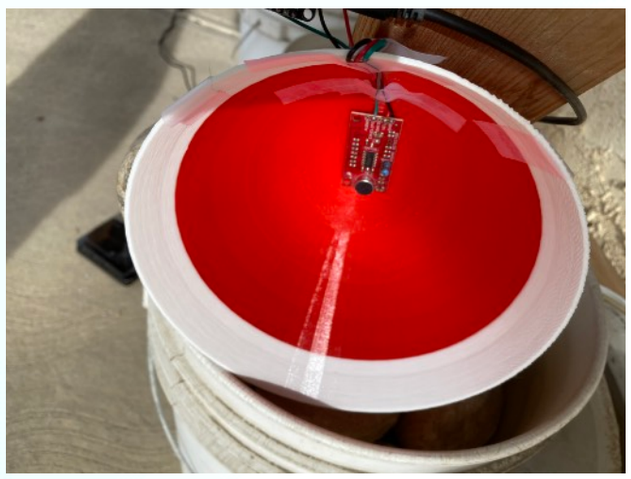
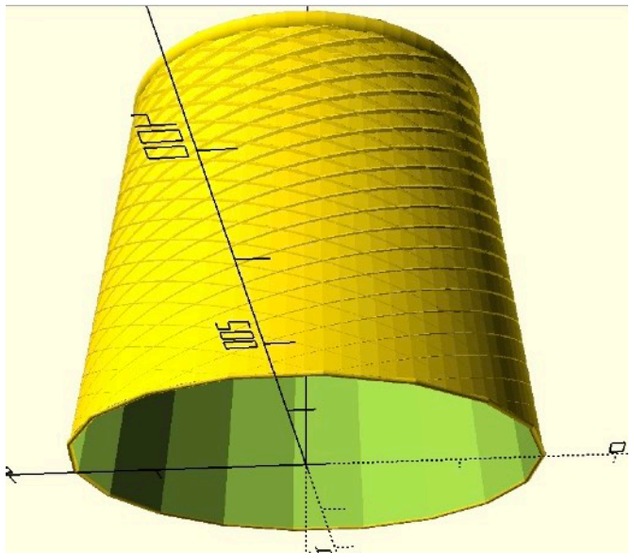
Experiences with 3D Printing and Practical Applications





Christian Falkenberg-Andersen B.Sc,BSc, MSc, MD. CUUG NOV 26, 2024

Outline:

*Get demo printing

*My introduction to 3D printing.

- cuug connection

*My printers:

Prusa I3 MK3 purchased july 2018

Prusa XL. Purchased September 2023

(After waiting for it for 2 years.)

*Versatility of what you can make with 3D printer

lots of examples

OpenSCAD- the cad software I prefer to use for my designs

* finish with demo if printing was successful

My introduction to 3D printing.

- cuug connection

  Watch out who you sit next to

Prusa I3 MR3 (since 2018)

-company has been around for a while.

-a lot of the parts are 3D printed.

- reasonable size 20x20x25cm prints

-Came disassembled (good thing)

-0.4mm nozzle.

- mishaps - fan skirt,wire harness screw

Original Prusa i3 MK3

Prusa XL September 2023

-wanted to print bigger things. 36x36x36 cm

-I stuck with Prusa because I had been happy with 1st printer

Core xy printer compared to a “bed slinger” printer.

-0.6mm nozzle prints faster.

- multihead capability (I don’t have that.

Mishap: print nozzle came apart

3D printing

So what can you make with a 3D printer

So what can you make with a 3D printer

-really anything you can think of. With some limitation

- cannot print in mid air (>25 mm)

- overhang - gets rough for angles less than 45 degrees

- some types of filament gets soft at low temperatures

PLA 60*C

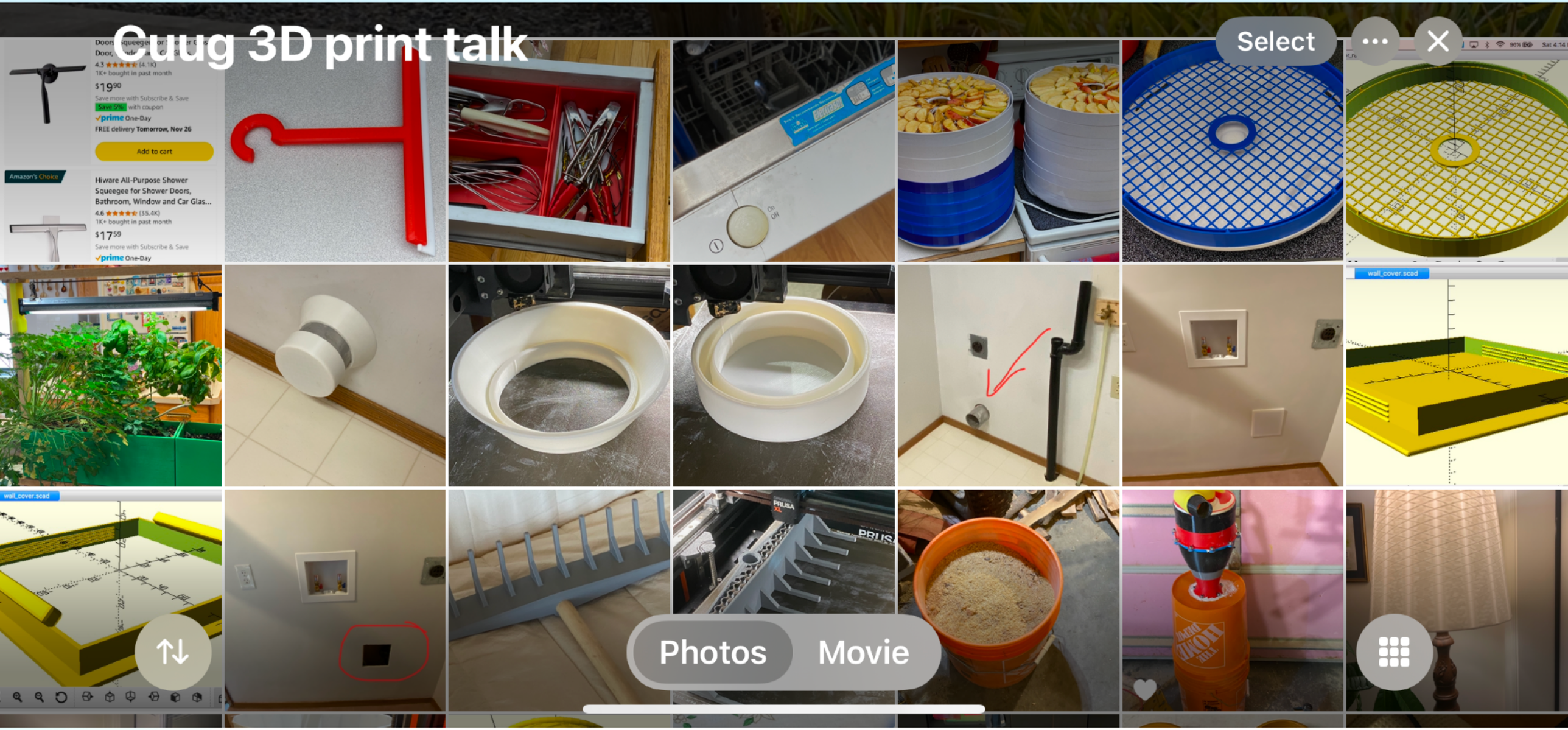
PET-G. 85 *C

ABS 105 *C

TPU. Flexible filament, very strong , prints slow

Lots of diverse printed examples

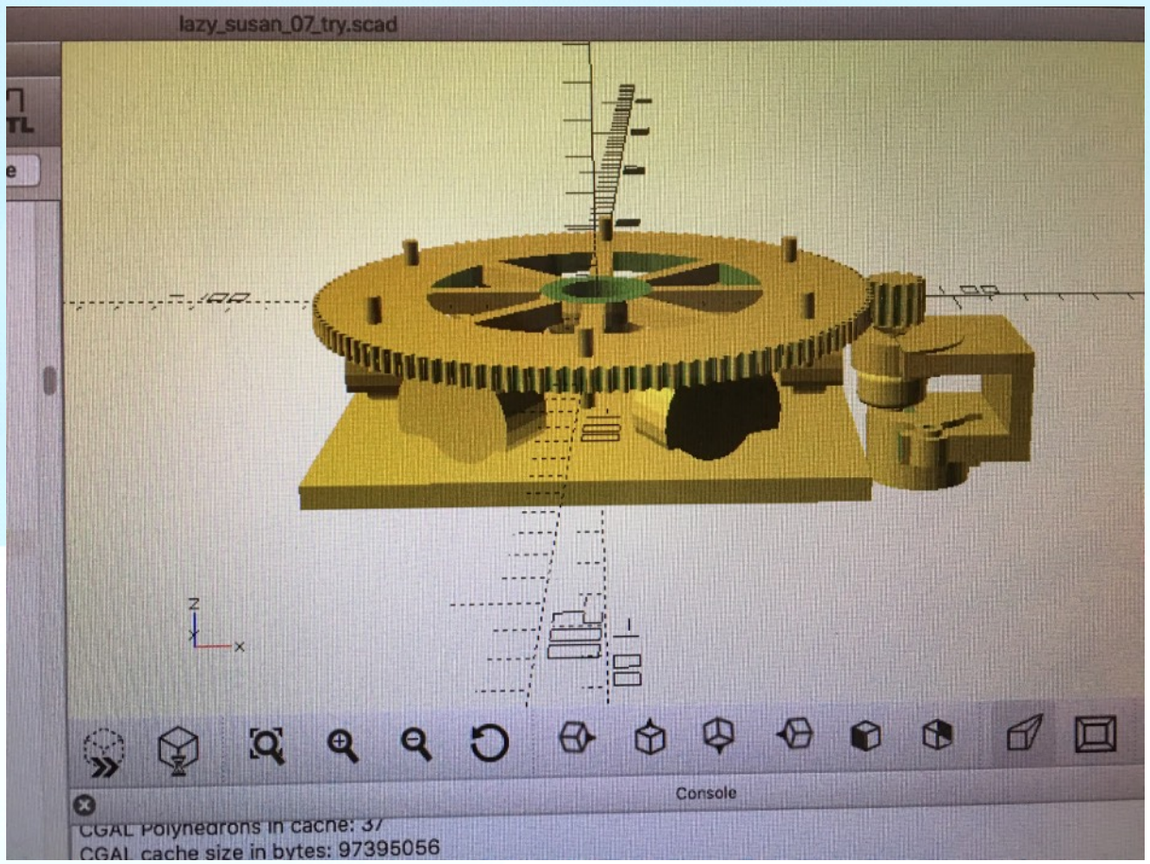
(Pictures and videos from phone folder)

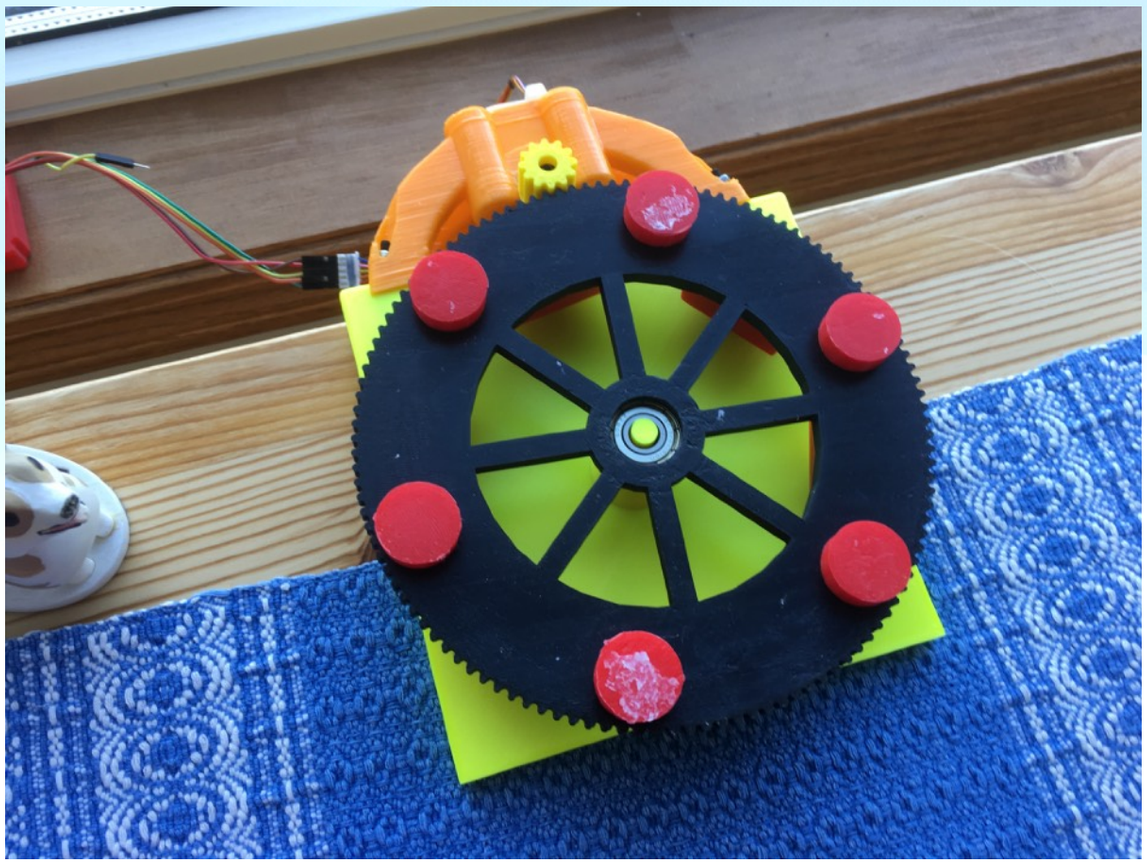


3D printing

Lots of diverse printed examples

Rotating platform for plants ("π" turns per day)





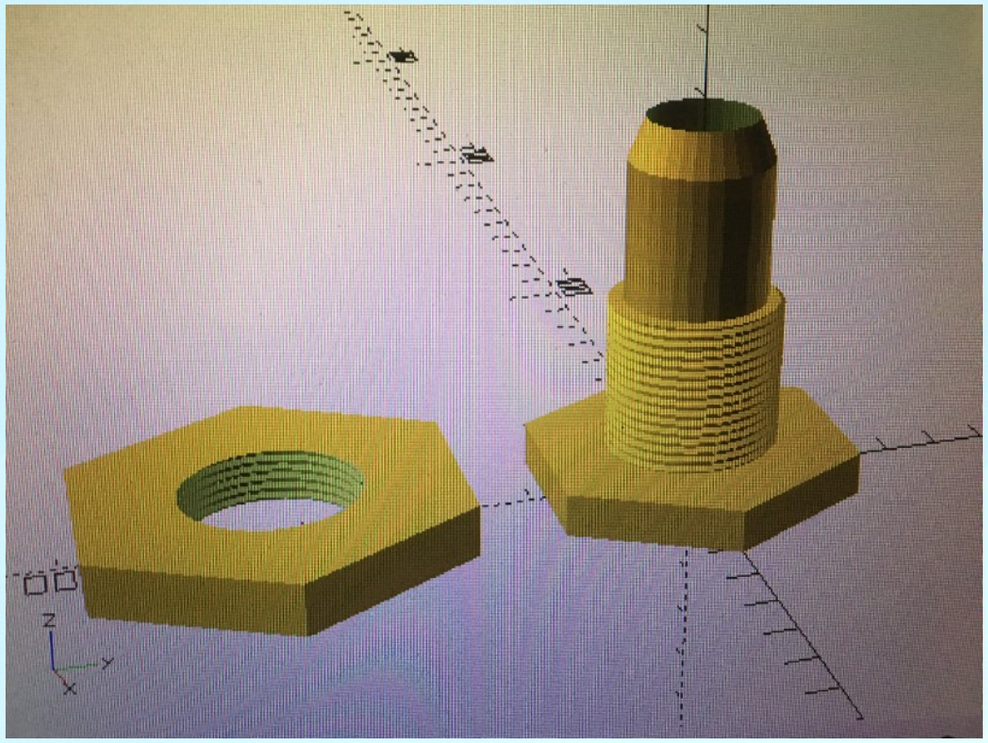
3D printing

Lots of diverse printed examples

Rain water diverter (PLA but with paint it has lasted 5 years.

3D printing

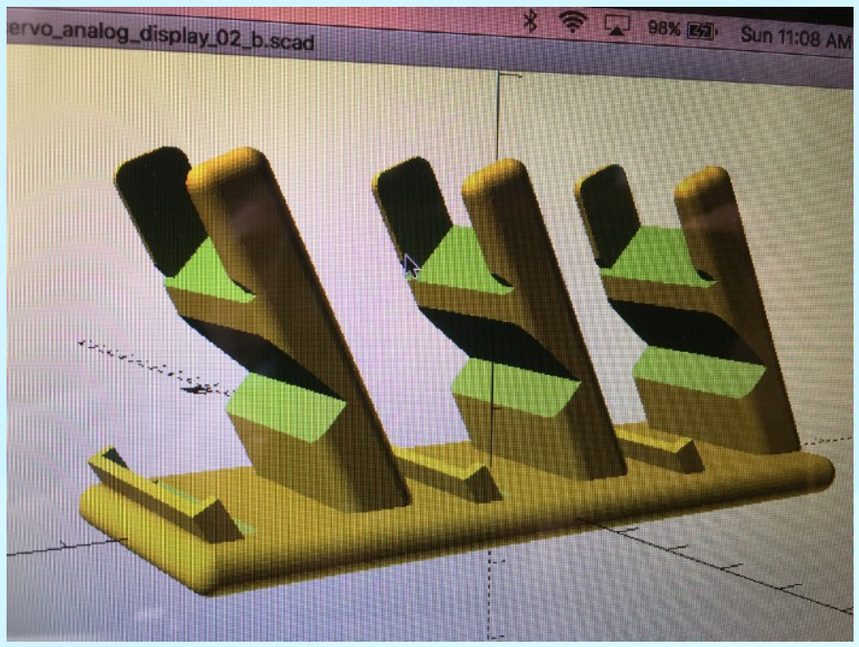
Lots of diverse printed examples

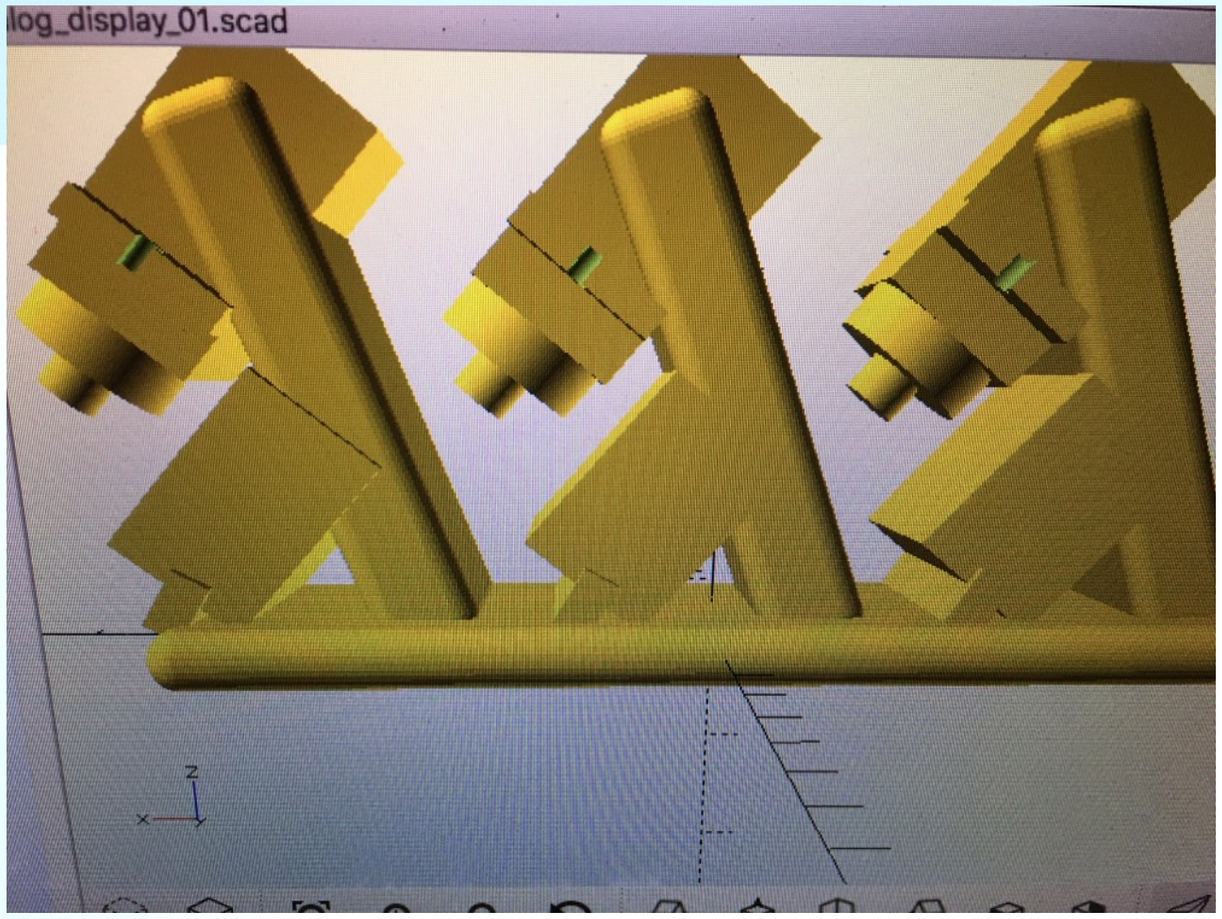


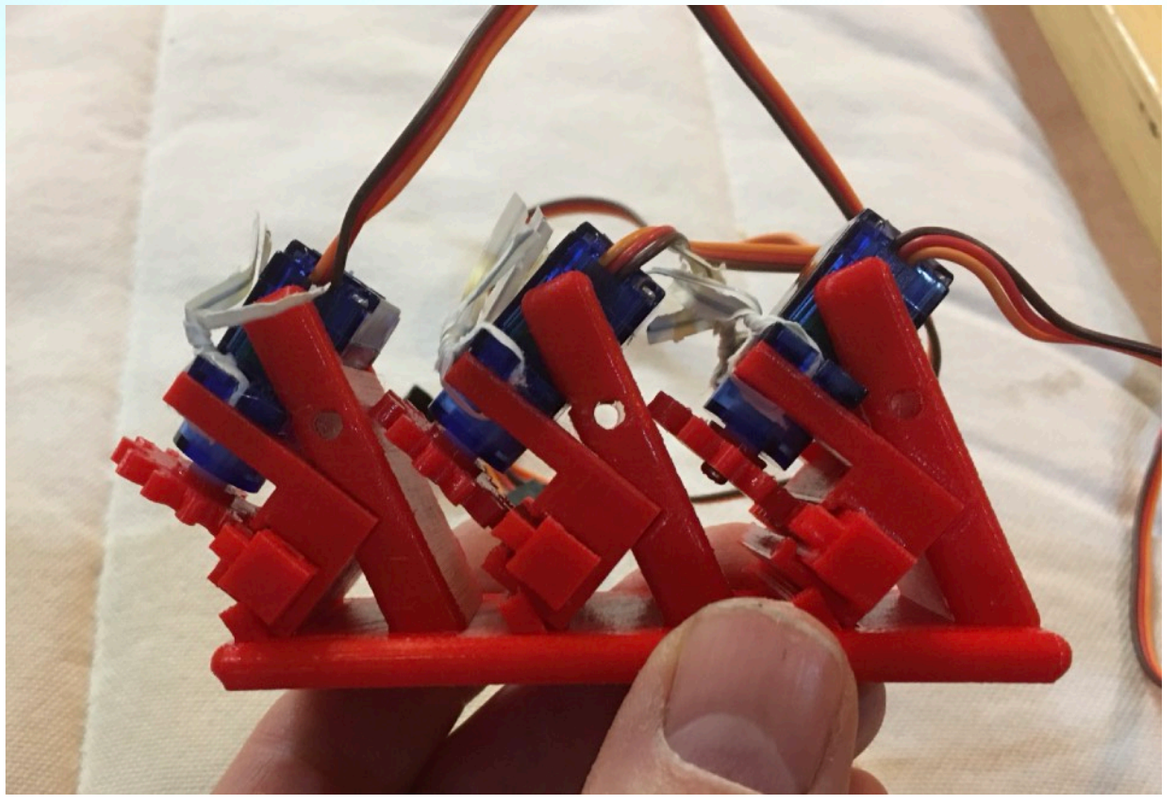
3D printing

Lots of diverse printed examples

Lots of diverse printed examples (triple actuator)

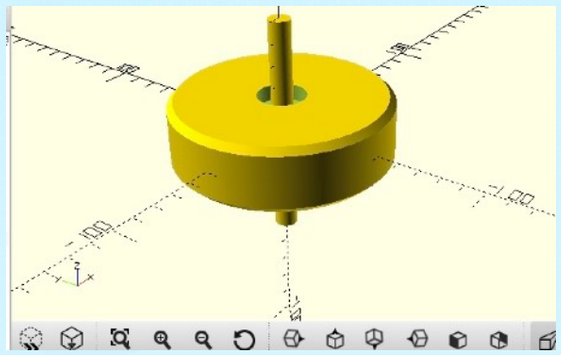


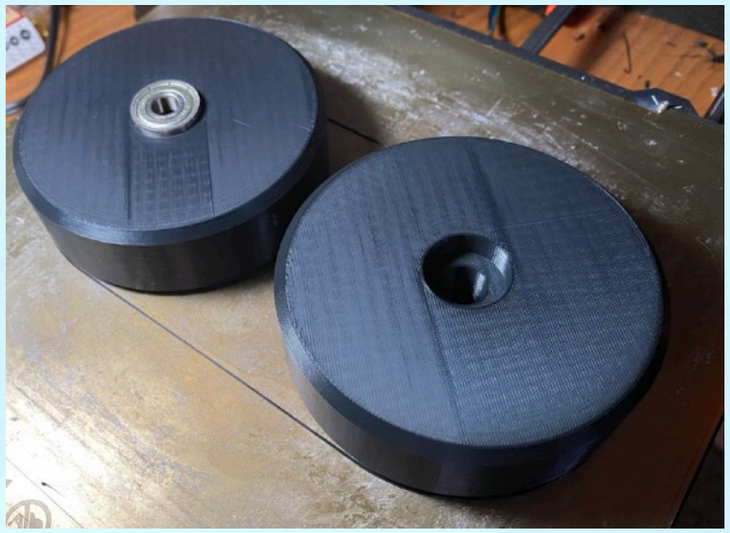




3D printing

Lots of diverse printed examples

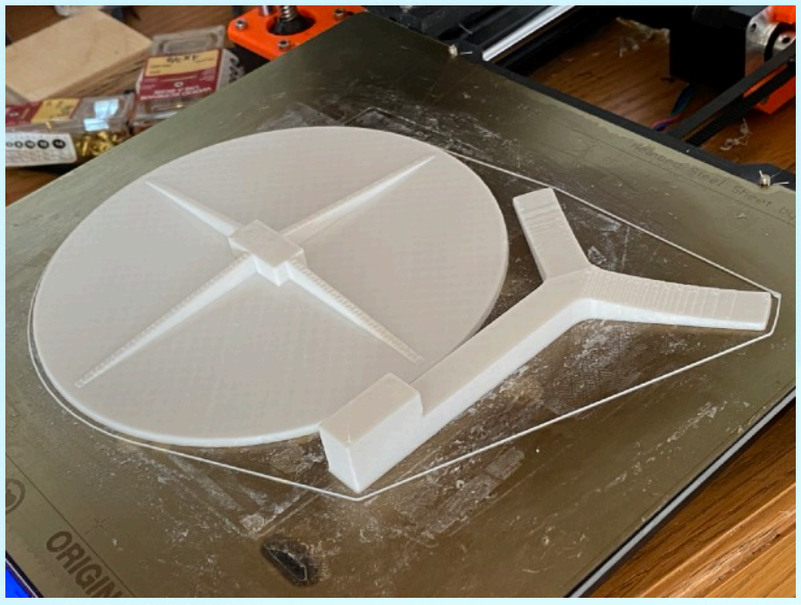


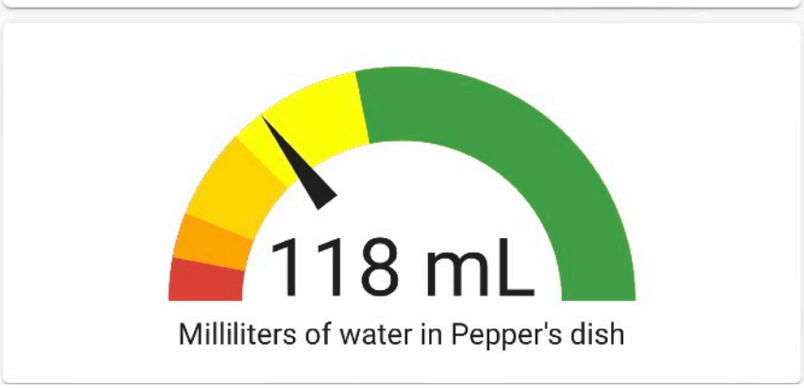


3D printing

Lots of diverse printed examples

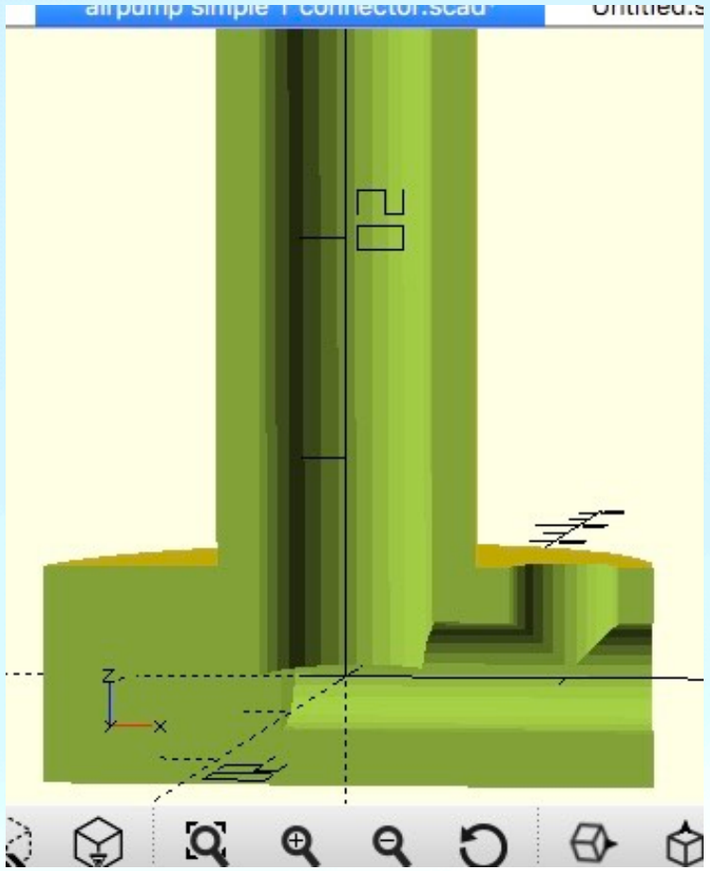
Dog water dish monitor

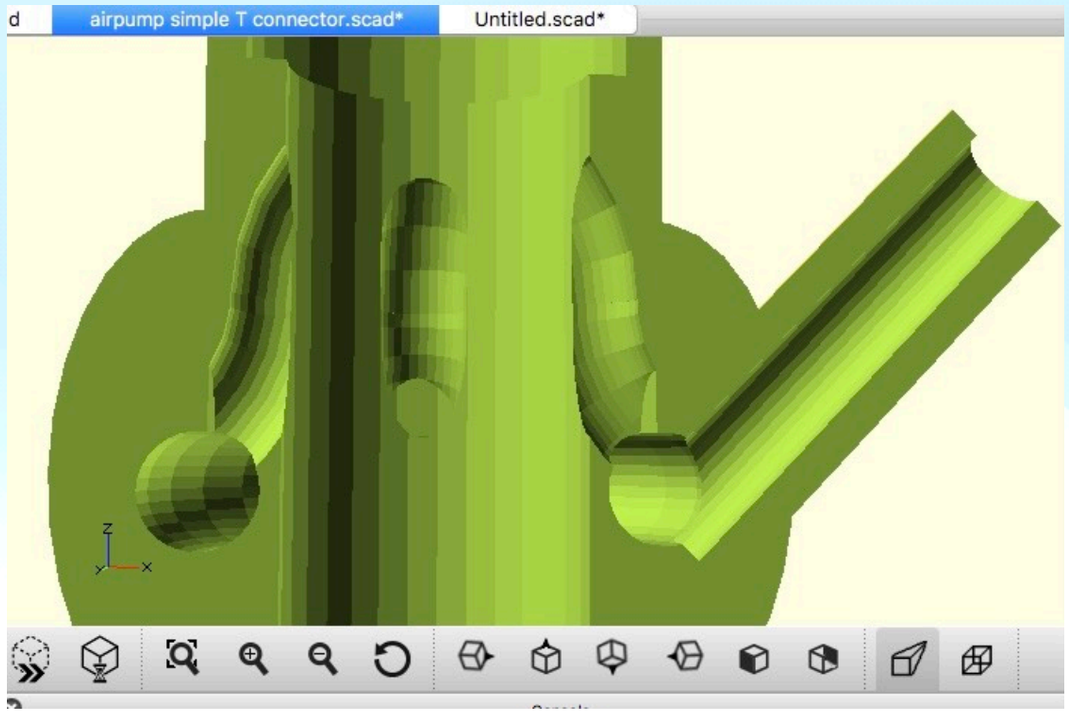


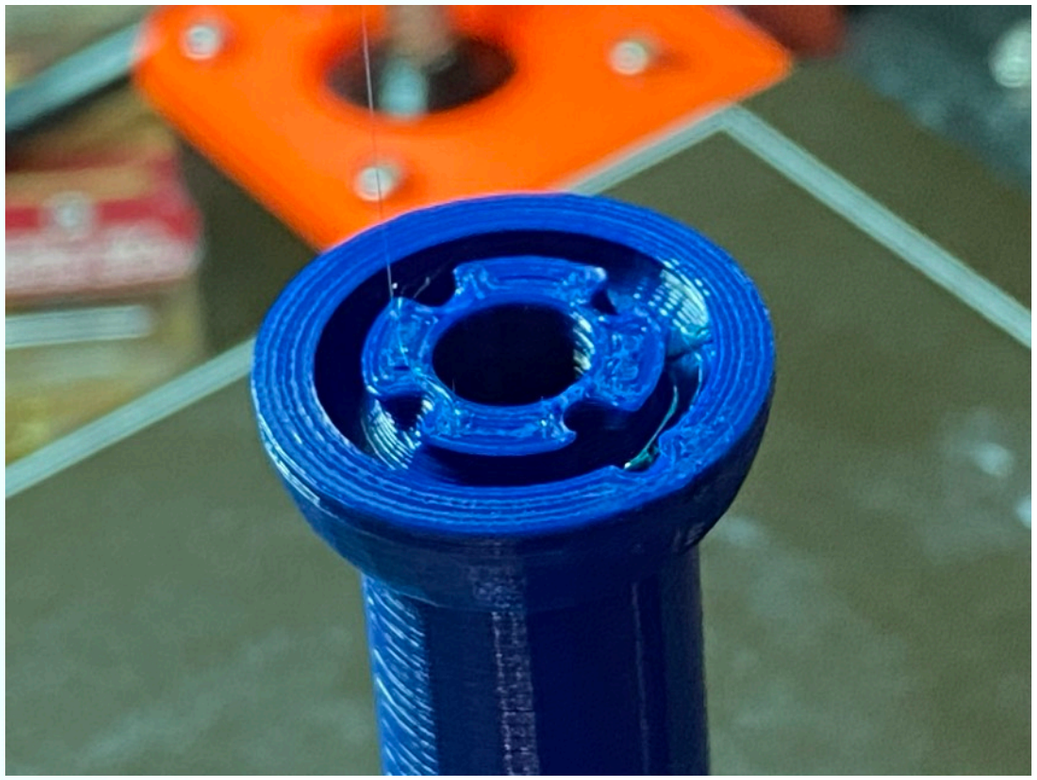


3D printing

Lots of diverse printed examples (water pump)



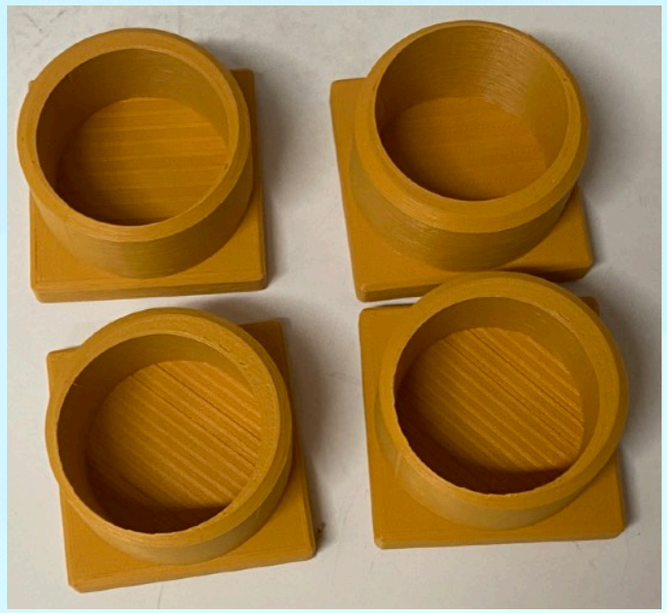




3D printing

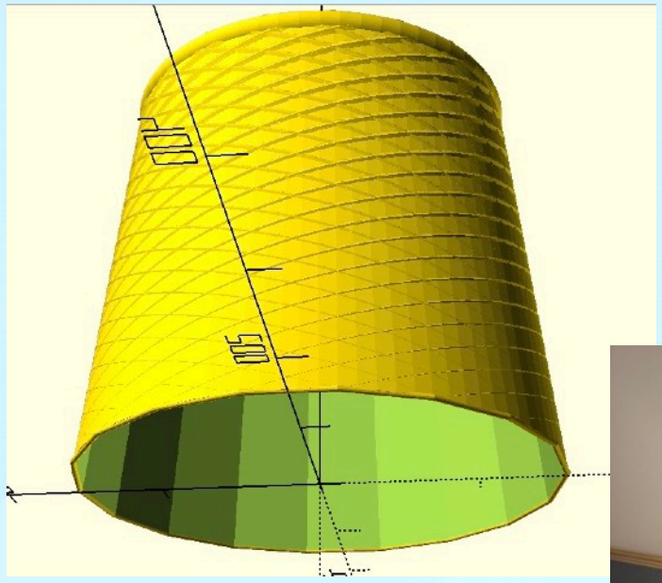
Lots of diverse printed examples

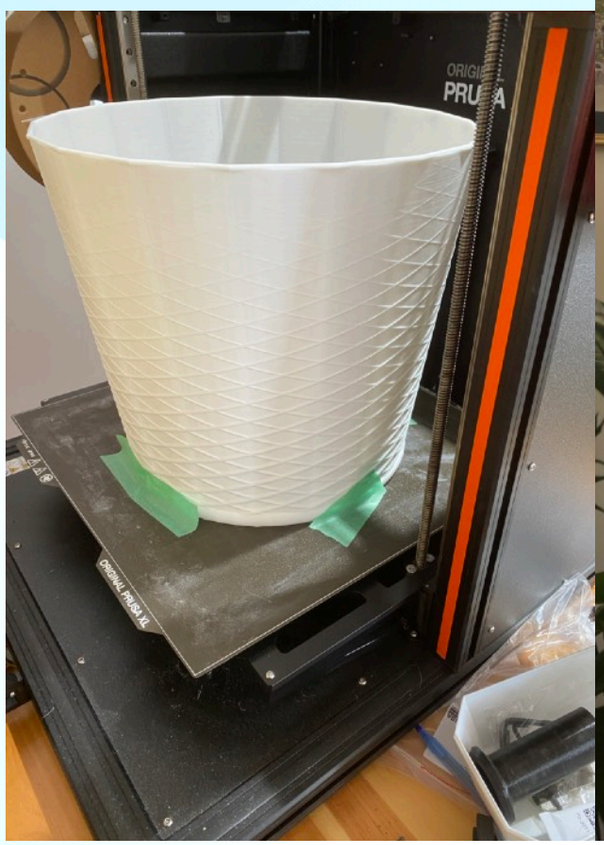
(hardwood floor protection)



3D printing

Lots of diverse printed examples (lampshade)





Lots of diverse printed examples (cyclone dust extraction for woodworking)

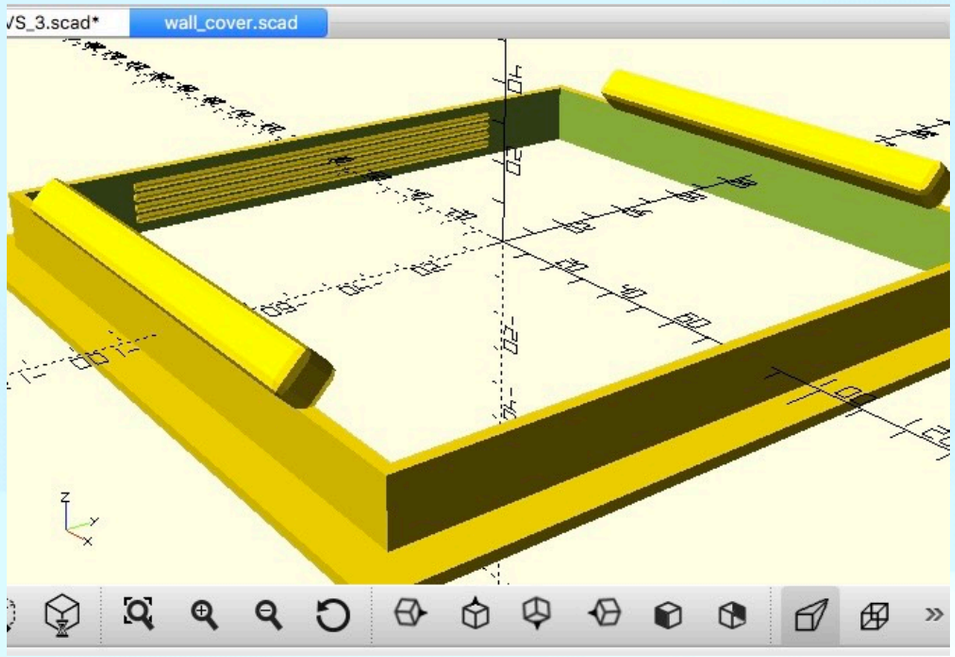
3D printing

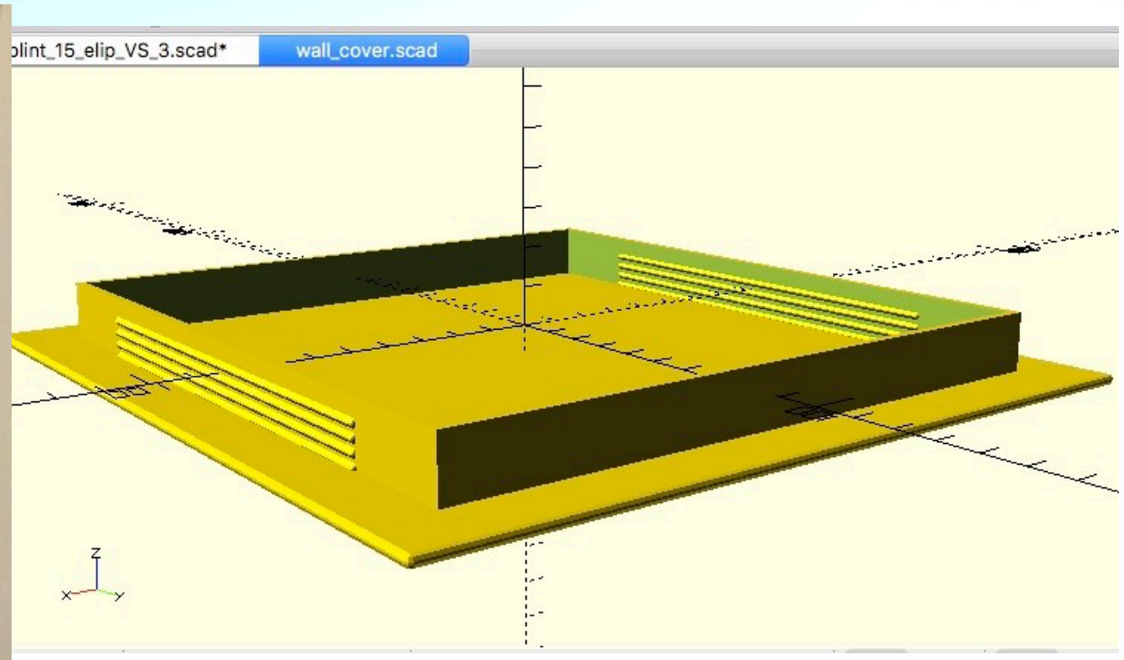
Lots of diverse printed examples

-Japanese garden gravel pattern tool

3D printing

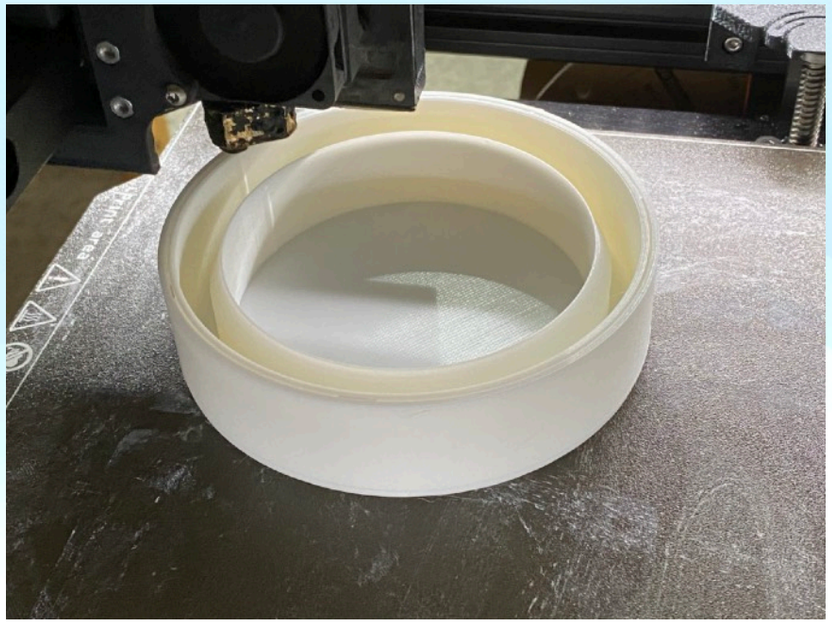
Lots of diverse printed examples (cleanout cover)

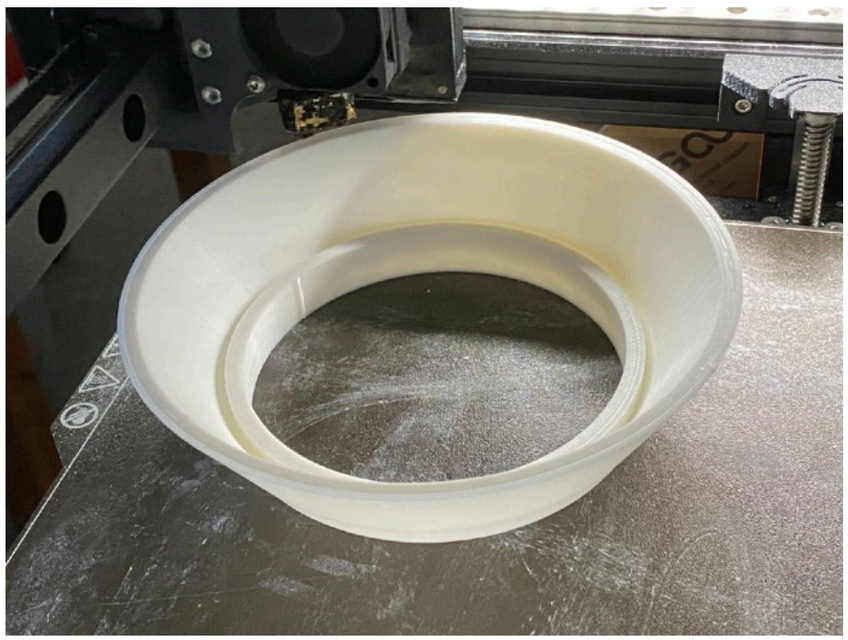




3D printing

Lots of diverse printed examples (dryer duct cover)





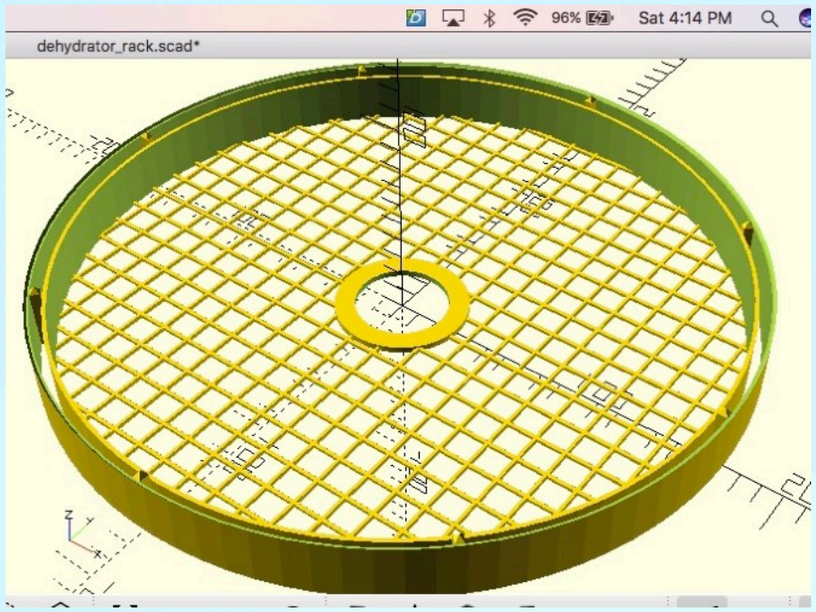
3D printing

Lots of diverse printed examples

- herb flower pot made from abs filament

3D printing

Lots of diverse printed examples -drying tray



Lots of diverse printed examples

-Dishwasher on/off button

3D printing

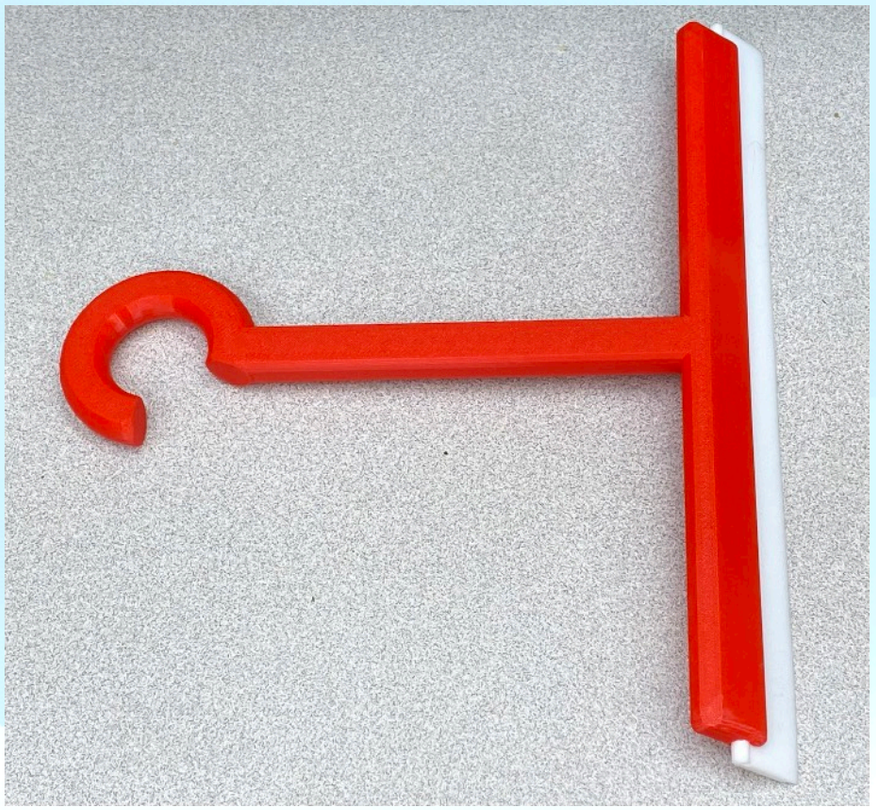
Lots of diverse printed examples

- drawer cutlery trays- made to fit the drawer

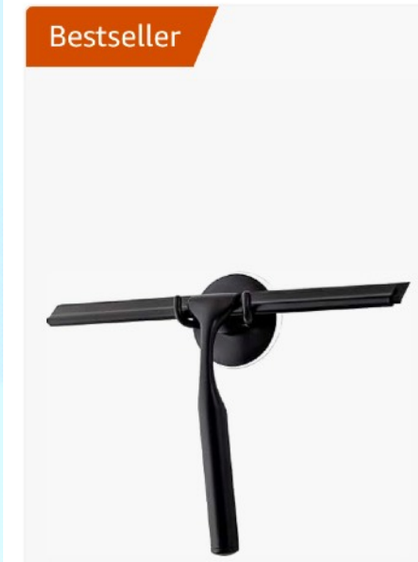
printing

Lots of diverse printed examples

Squeegee cost $2.00.



Amazon cost ($17-$19)



Bestseller

Sponsored

Ettori Shower Squeegee for Glass Doors, Squeegee for Shower Glass Door, Window and Car Glass,...

4.3 ★★★★½ (4.1K)

1K+ bought in past month

$19.90

Save more with Subscribe & Save

Save 5% with coupon

prime One-Day

FREE delivery **Tomorrow, Nov 26**

Add to cart

Amazon's Choice

Hiware All-Purpose Shower Squeegee for Shower Doors, Bathroom, Window and Car Glas...

4.6 ★★★★½ (35.4K)

1K+ bought in past month

$17.59

Save more with Subscribe & Save

prime One-Day

FREE delivery **Tomorrow, Nov 26**

Add to cart

3D printing

How to generate a 3dimensional model for printing

-Fusion 360 - can get hobby license but have to pay if revenue >$1000USD/year

-Blender free program.

-Freecad - free

-OpenSCAD- free. My preferred program.

-And others.

3D printing

OpenSCAD. https://openscad.org/

Construct final shape by adding or subtracting

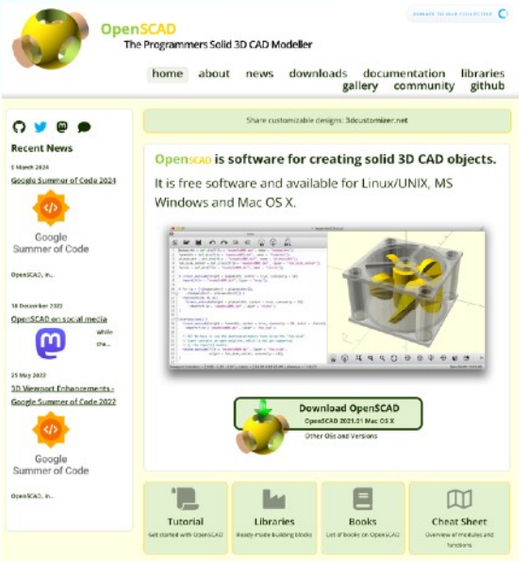
Geometric objects.

Has useful libraries

https://openscad.org/libraries.html

https://github.com/revarbat/BOSL/wiki/shapes.scad

(LIB needs to be in the right location)



Useful cheat sheet

https://openscad.org/cheatsheet/index.html

Can set up a customizer

Process: CAD->STL file-> slicer program -> Print

Some simple OpenSCAD examples: switch to Mac

3D printing

OpenSCAD. https://openscad.org/

Screen shots in case links did not work

2D

```
circle(radius | d=diameter)
square(size,center)
square([width,height],center)
polygon([points])
polygon([points],[paths])
text(t, size, font,
     halign, valign, spacing,
     direction, language, script)
import("….ext", convexity)
projection(cut)
```

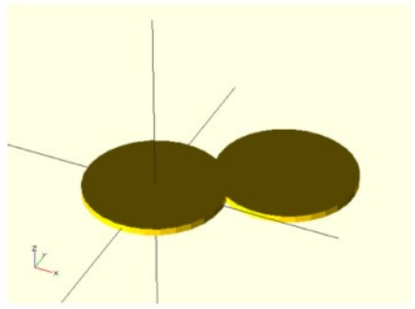
3D

```
sphere(radius | d=diameter)
cube(size, center)
cube([width,depth,height], center)
cylinder(h,r|d,center)
cylinder(h,r1|d1,r2|d2,center)
polyhedron(points, faces, convexity)
import("….ext", convexity)
linear_extrude(height,center,convexity,twist,slic
rotate_extrude(angle,convexity)
surface(file = "….ext",center,convexity)
```

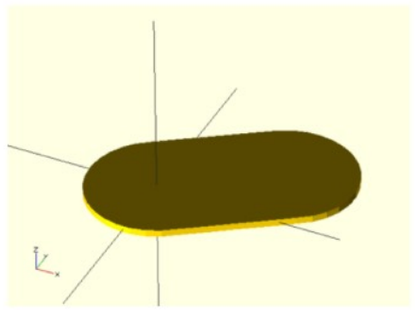
Transformations

```
translate([x,y,z])
rotate([x,y,z])
```

hull



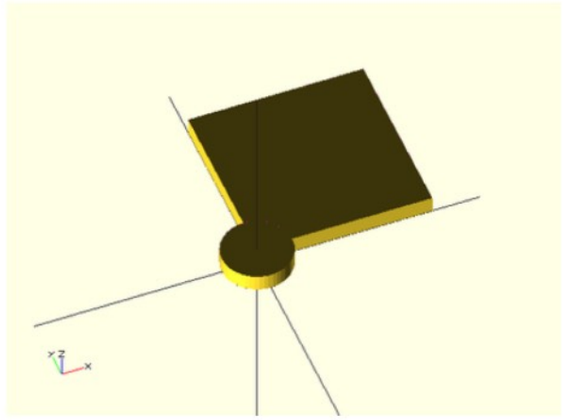
Two cylinders



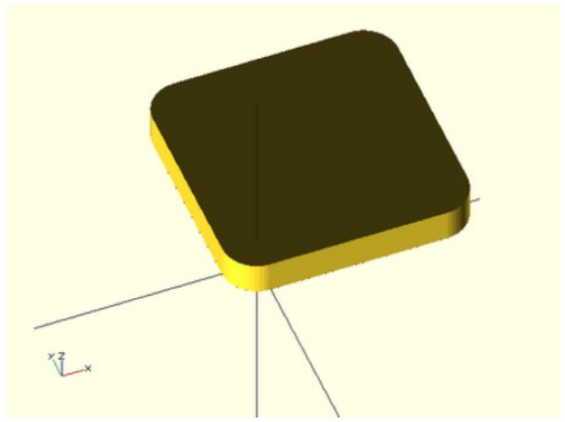
Convex hull of two

Flow Control

```
for (i = [start:end]) { … }
for (i = [start:step:end]) { … }
for (i = […,…,…]) { … }
for (i = …, j = …, …) { … }
intersection_for(i = [start:end]) { … }
intersection_for(i = [start:step:end]) { … }
intersection_for(i = […,…,…]) { … }
if (…) { … }
let (…) { … }
```



A box and a cylinder



Minkowski sum of the box and cylinder

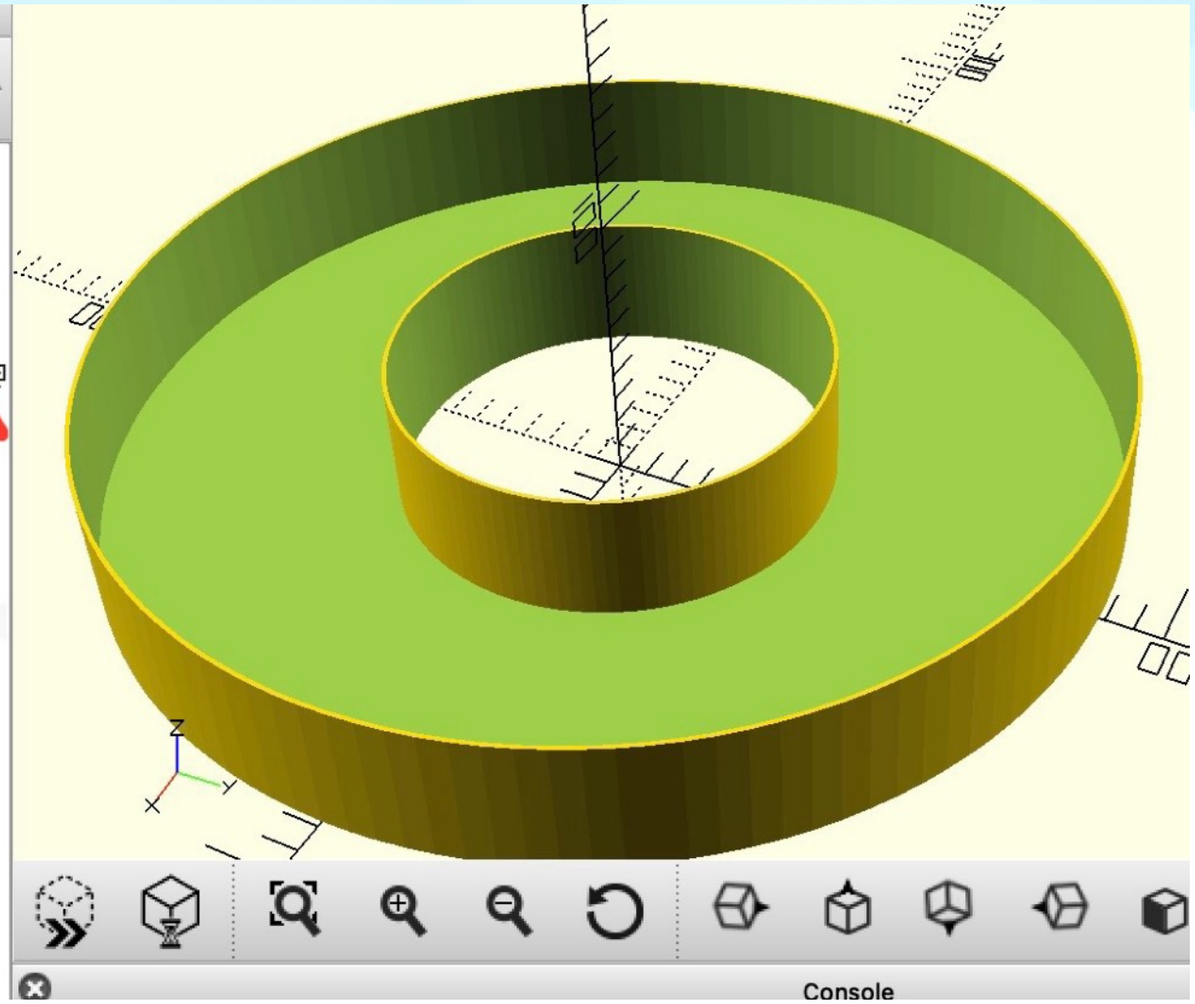
3D printing

Screen shots so things can be shown in zoom:

- this is used to keep wreath shaped flowers and branches moist this xmas

Editor

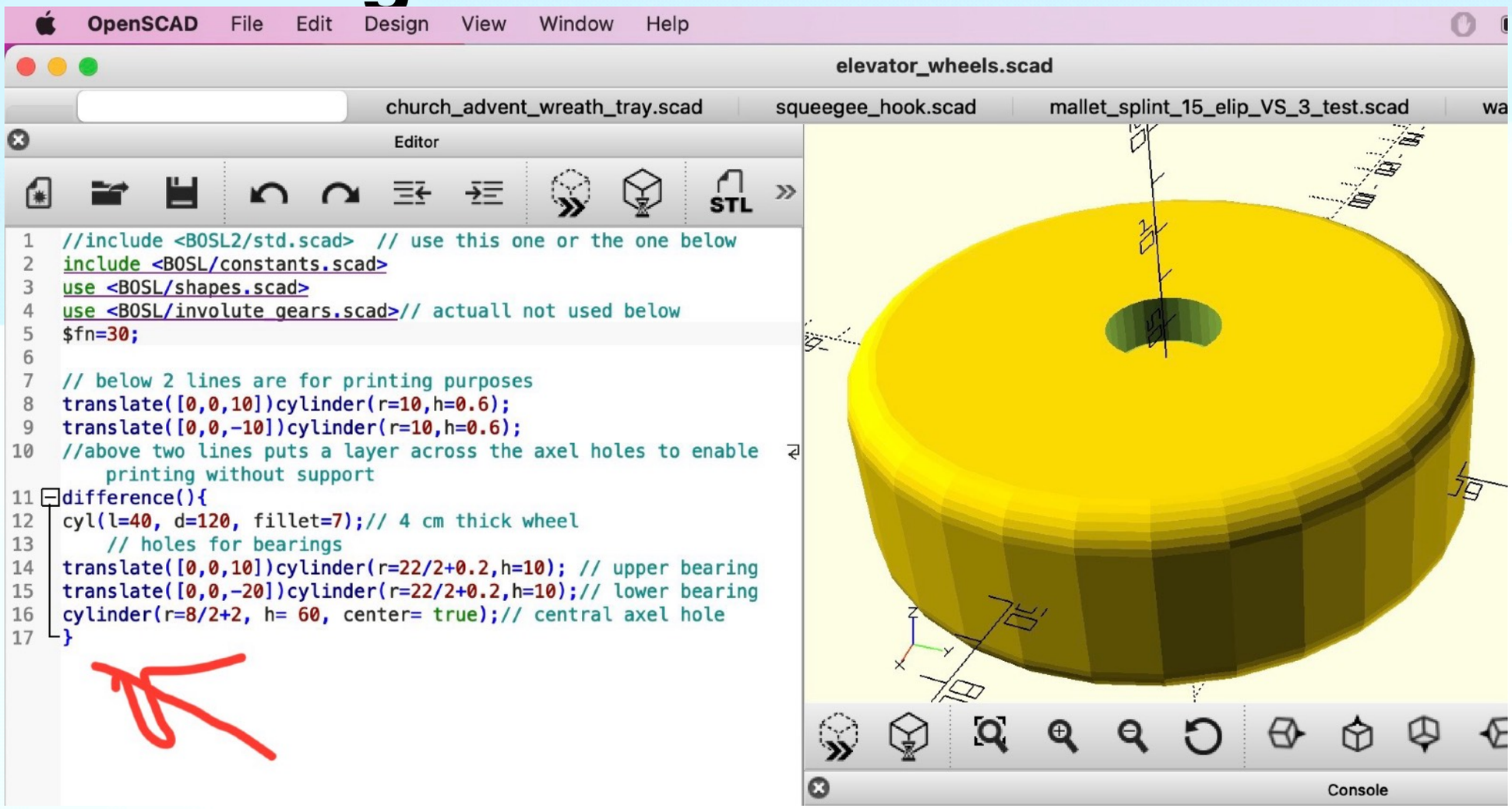
```
include <BOSL/constants.scad>
use <BOSL/shapes.scad>

use <BOSL/transforms.scad>
// documentation https://github.com/revarbat/BOSL/wiki

//rounded_prismoid(size1=[100,200], size2=[80,180], h=50,
    r1=5, r2=5, $fn=24);
$fn=120;



difference(){
tube(h=50, od=356, id=150);
translate([0,0,3])tube(h=50, od=356-3, id=150+3);
}
```



3D printing

Screen shots so things can be shown in zoom

-17 lines makes a wheel with holes for bearings.



3D printing

OpenSCAD. https://openscad.org/

Screen shots so things can be shown in zoom

- 40 lines makes a nice squeegee

Editor

```
10  blade_thick=2.6+fudge;
11  blade_l=250;
12  blade_w=22.3+fudge;
13  cube_size=50;
14
15  difference(){// make flat surface for printing
16      union(){
17      translate([0,-150-26,-11.88])torus(r=22.5, r2=7.5,$fn=30);
18      translate([0,-150/2-9.5,-11.88])cuboid([15,150,15],
        fillet=5);
19      rotate([45,0,0]){
20
21          difference(){
22          translate([0,-blade_w*0.6,0])cuboid([blade_l*0.95,
        blade_w-0.5,rubber_edge_dia*2], fillet=3);
23          blade();
24          }
25      }
26      }
27      translate([0,0,-18])downcube([1000,1000,1000]);
28      translate([- cube_size/2-8.5,-154,0])cube([cube_size,
        cube_size,cube_size],center= true);
29
30      translate([- cube_size/2-8.5,-150,0]){
31      rotate([0,0,18])cube([cube_size,cube_size,cube_size],
        center= true);
32  }
33  }
34  module blade(){
35  //blade simulation
36  cube([blade_l,blade_w-0.5,blade_thick],center = true);
37  translate([0,-blade_w/2+rubber_edge_dia/2-0.5,0]){
38  rotate([0,90,0])cylinder(r=rubber_edge_dia/2, h=blade_l,
        center= true, $fn=60);
39  }
40  }
```

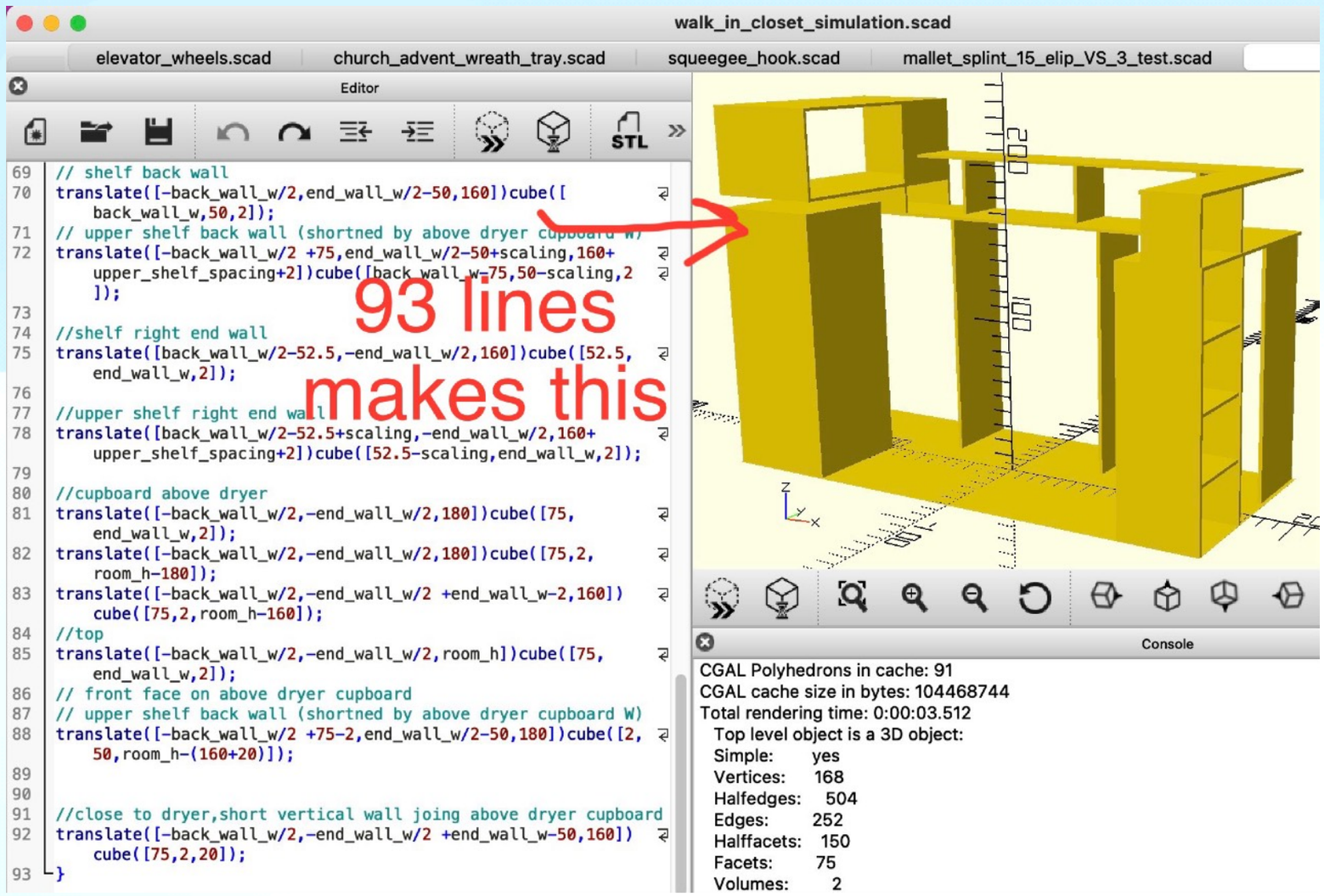
Console

```
CGAL Polyhedrons in cache: 86
CGAL cache size in bytes: 104680136
Total rendering time: 0:00:07.262
  Top level object is a 3D object:
  Simple:       yes
  Vertices:    1130
  Halfedges:   5028
  Edges:       2514
  Halffacets:  2772
  Facets:      1386
  Volumes:        2
```

3D printing

OpenSCAD. https://openscad.org/

Screen shots so things can be shown in zoom



3D printing

Back to finger splint (if printing worked !)

-Mallet finger injury

-common injury to ends of fingers

-Merc manual link :

https://www.merckmanuals.com/professional/injuries-poisoning/sprains-and-other-soft-tissue-injuries/mallet-finger

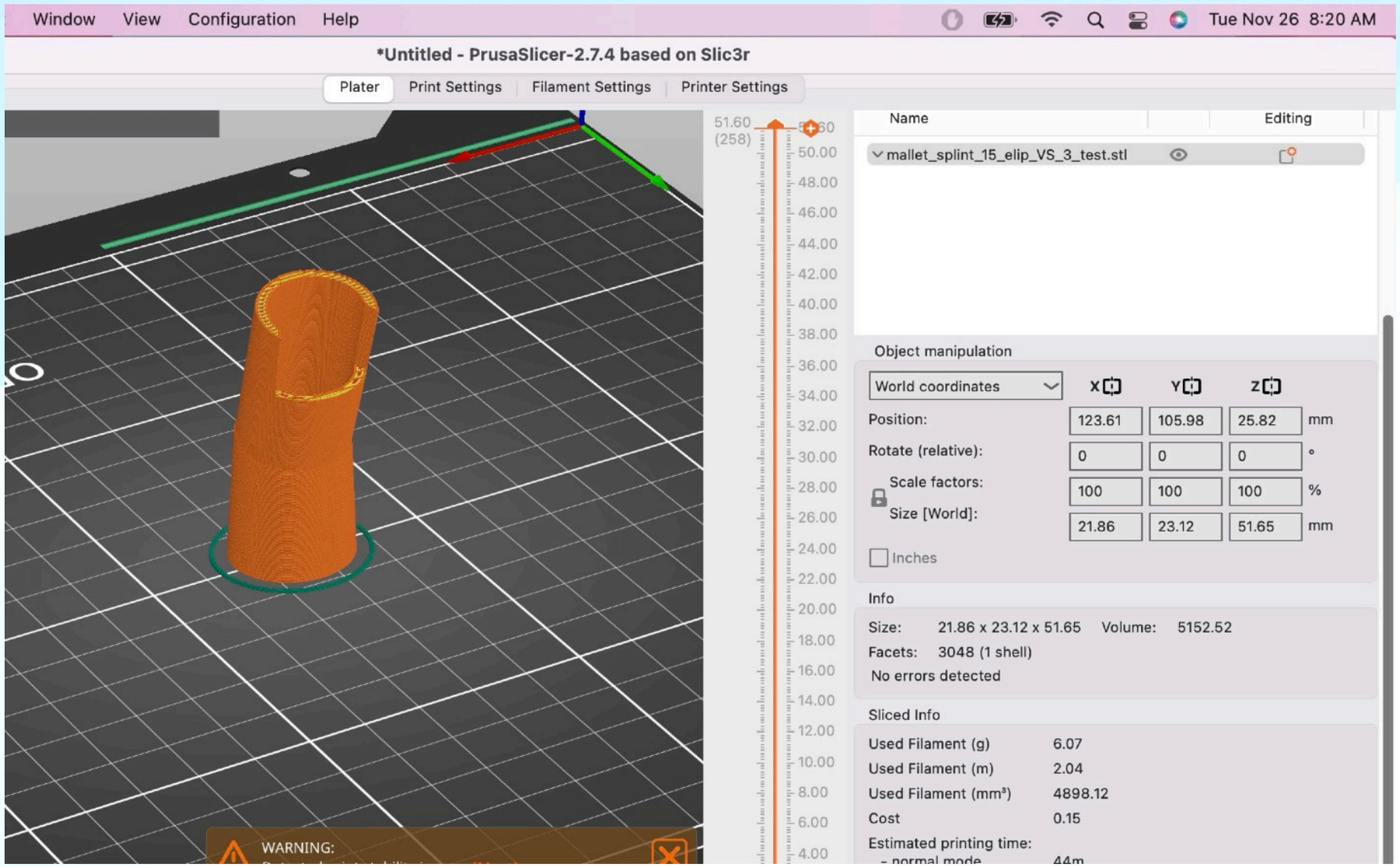
-Benefits of using 3D splint

Can achieve a good fit

3D printing

OpenSCAD. https://openscad.org/

Screen shots so things can be shown in zoom

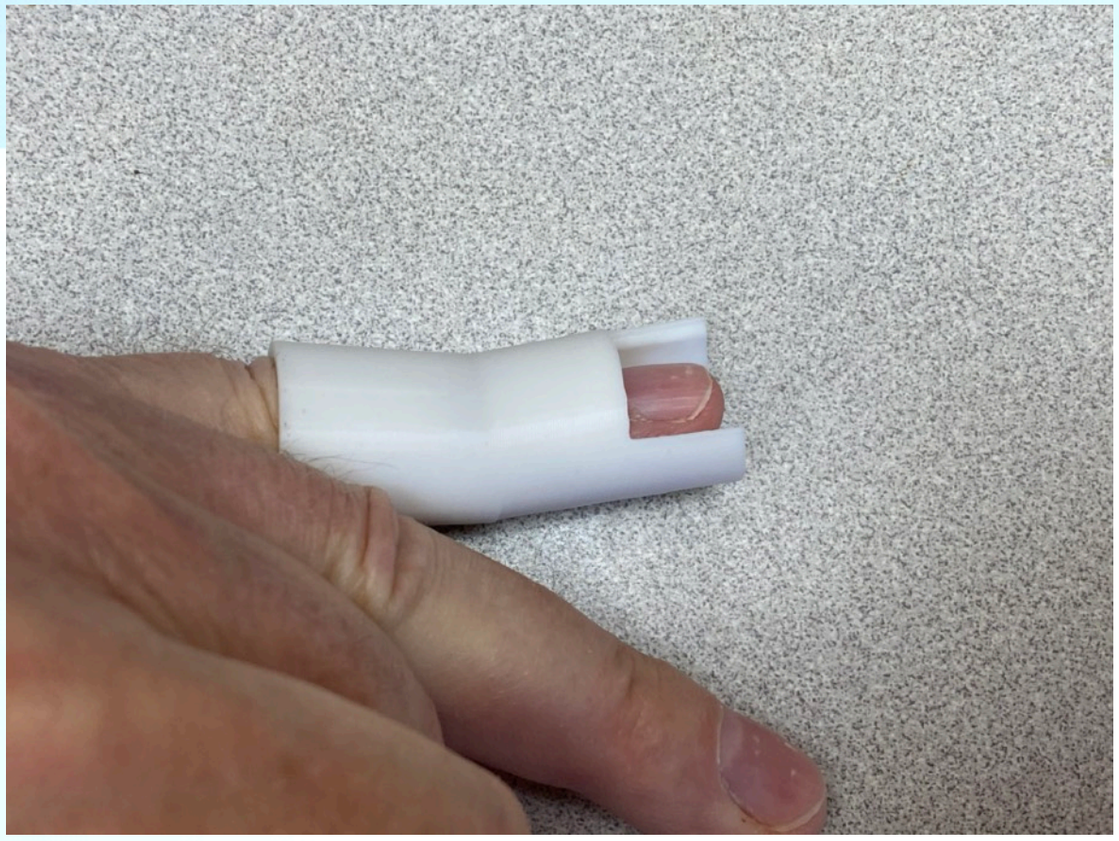


3D printing

Splint illustration (in case demo did not work)

Measurements were done on L hand

Left 5th digit



Right 5th digit

3D printing

Questions:

?????