

15-294 Rapid Prototyping Technologies: Molecule Exercise and 3D Printer Intro

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3D Printing vs. Laser Cutter

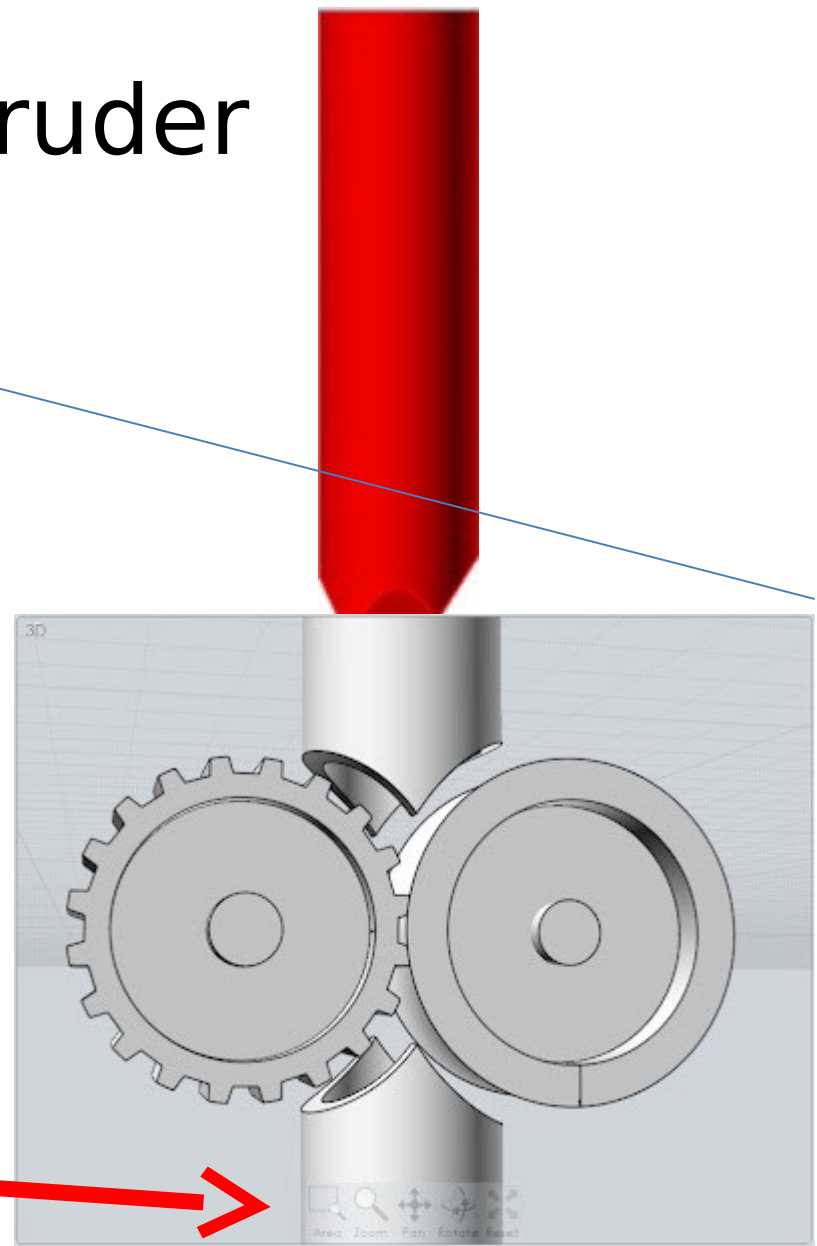
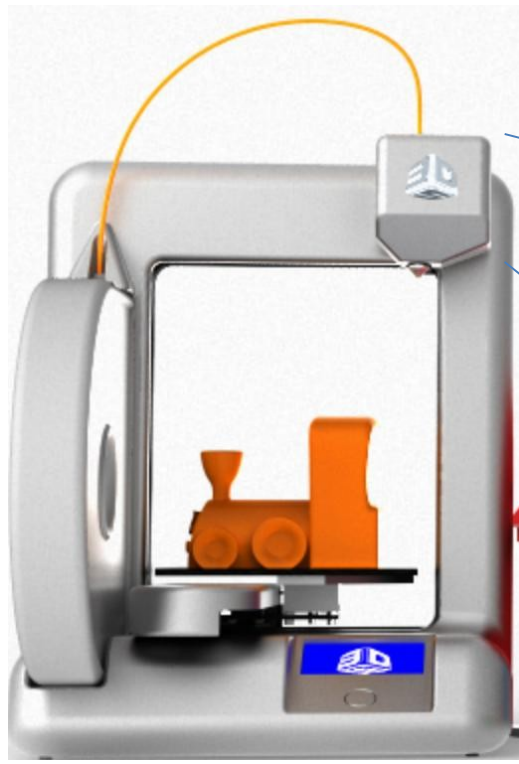
- ✗ Slower
- ✗ Less precise
- ✗ More expensive
- ✗ Limited materials
- ✗ Support material may be required
- ✓ Complex 3D structures!



Low Cost 3D Printers

- RepRap: 2005 onward
 - Adrian Bowyer, University of Bath (UK)
 - Goal: open source 3D printer that can replicate itself
 - 4 generations: Darwin, Mendel, Prusa Mendel, Huxley
 - Spawned many start-ups
- Makerbot
 - Evolved from RepRap; initially was open source
 - Cupcake, Thing-o-Matic, Makerbot2, Replicator
- Solidoodle (\$500)
- Zortrax M-200
- Many, many more...

The Cube 2 Extruder



Heated section



Image from cubifyfans.blogspot.com

The NvPro



H01020 | NVBOTS 01 - CMU

PRINTING



Stop

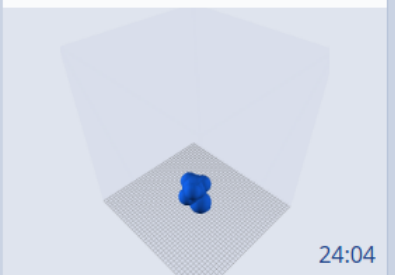


Skip

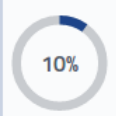


Maintenance

CURRENT PRINT JOB

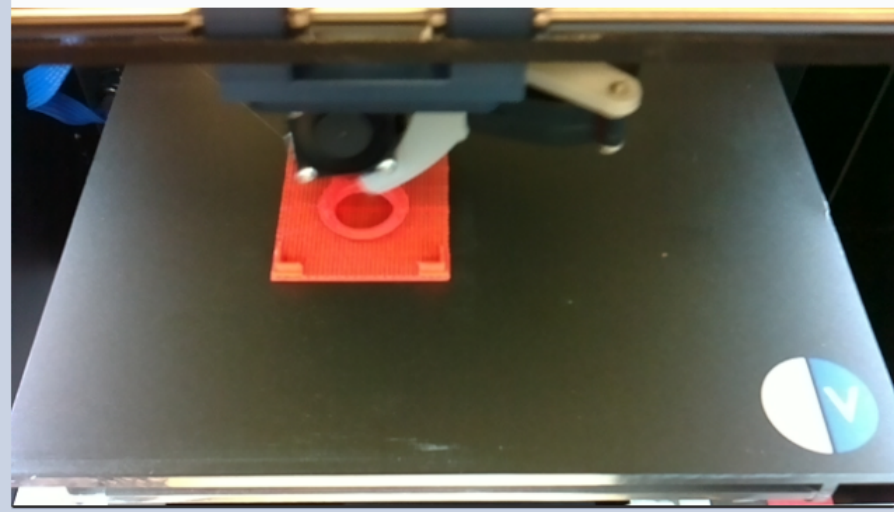


24:04

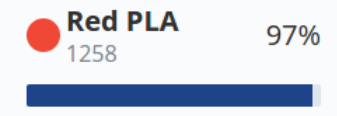


Ethanol-2016.STL
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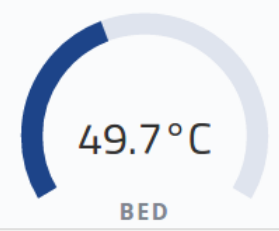
LIVE FEED



FILAMENT



TEMPERATURE



QUEUE PREVIEW

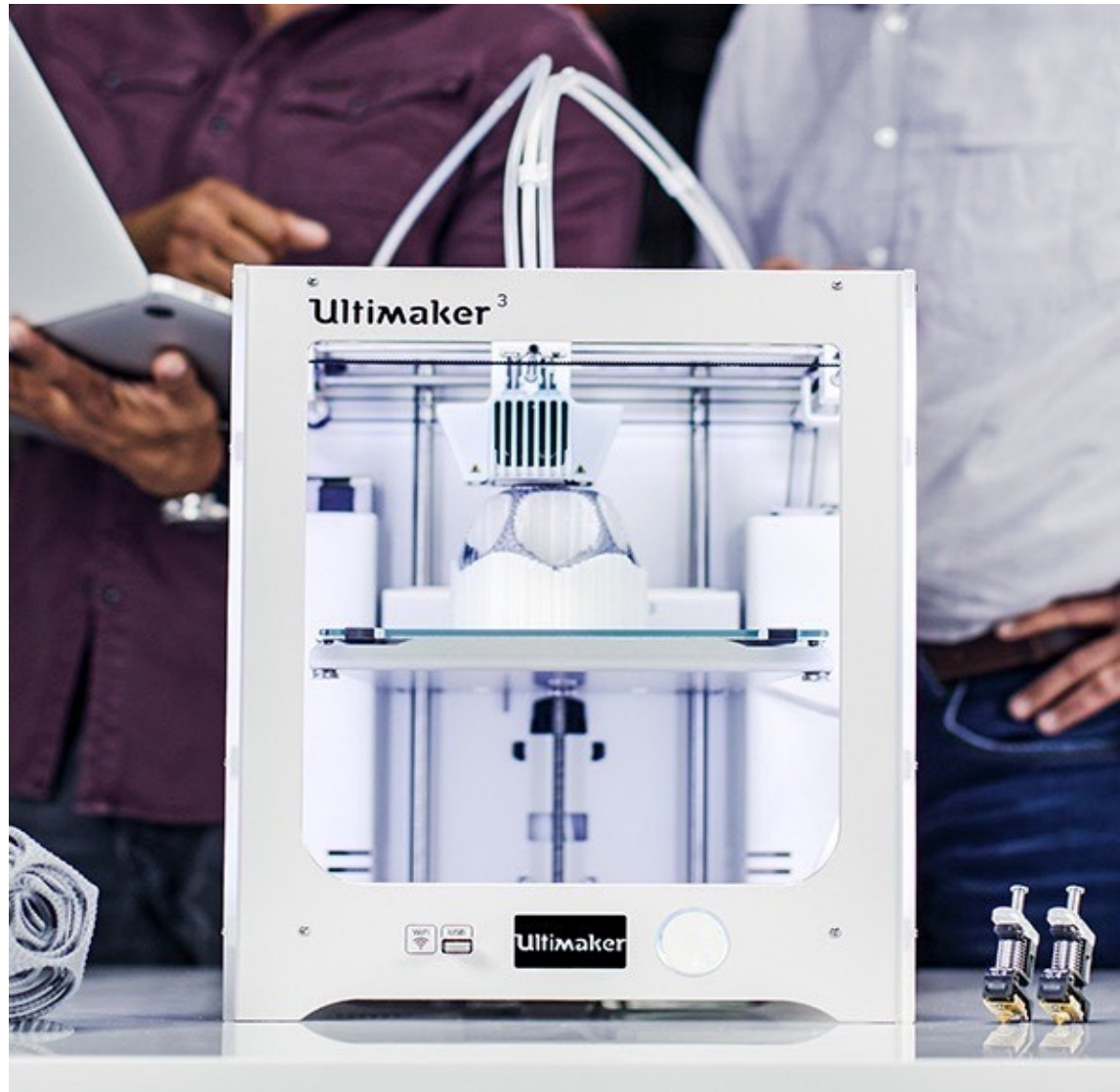
There are no jobs waiting to print.

See All

Zortrax M200

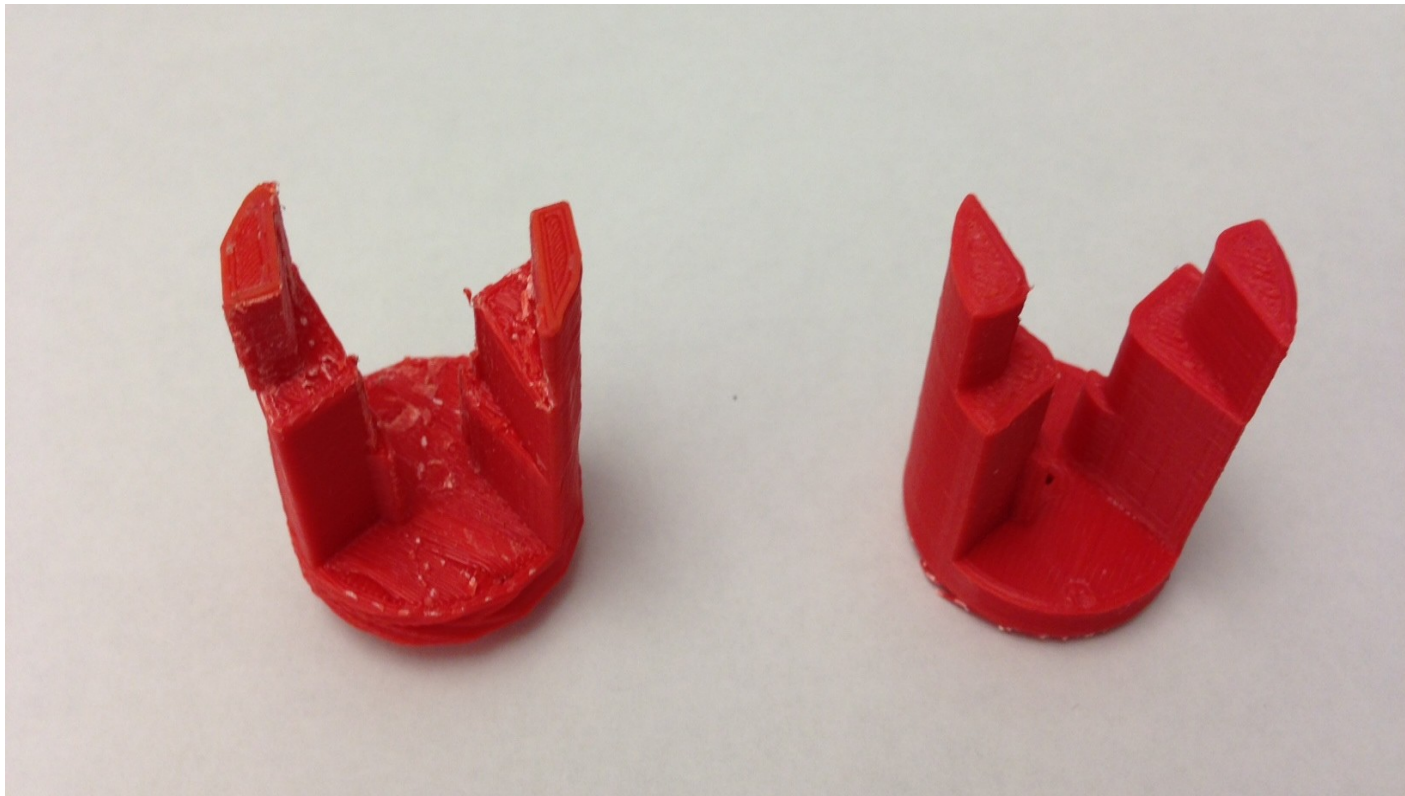


Ultimaker 3



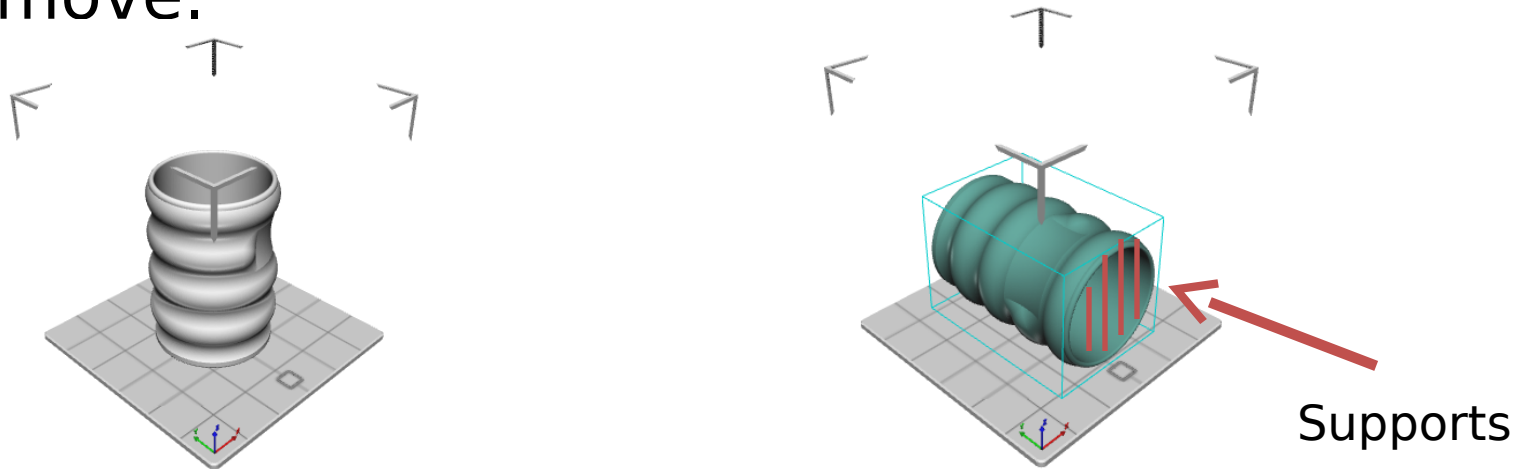
Coarse vs. Fine STL Triangulation

- Too coarse can lose detail, but too fine can also cause features to be lost.
 - SolidWorks “fine” (under “Options” when you save an STL file) seems to be okay, but don’t go to “custom” and crank up resolution to the max.



Part Orientation

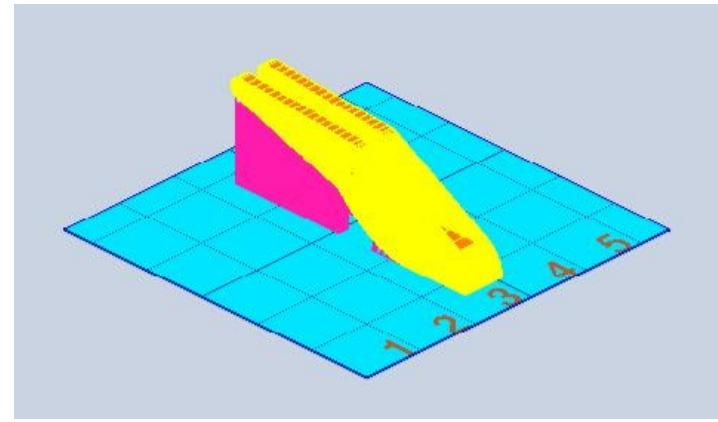
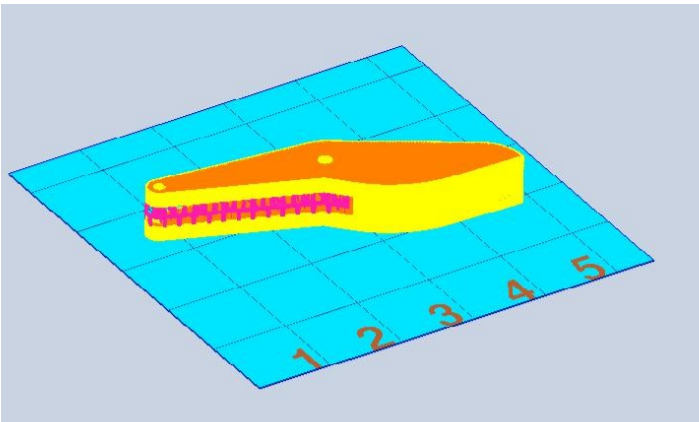
- Choose your part orientation to avoid the need for supports if possible.
- Don't put supports where they will be difficult to remove.



- Remember: supports leave a rough surface.

Part Orientation

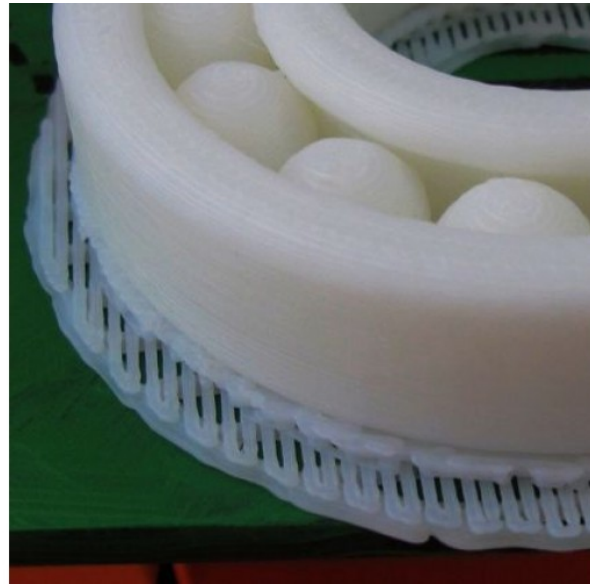
- Sometimes the use of support material is unavoidable.
- Don't put supports where they will be difficult to remove.



- Remember: supports leave a rough surface.

Use of a Raft

- Why use a raft?
 - Stable base of support for tall, skinny parts.
 - Prevents warping of big smooth parts (like cases) by reducing surface contact with heated bed (1st gen. Cubes only).
- Why avoid a raft?
 - Ruins the part finish (get out your sandpaper).
 - Takes more time and more plastic to print.



Changing the Amount of Infill

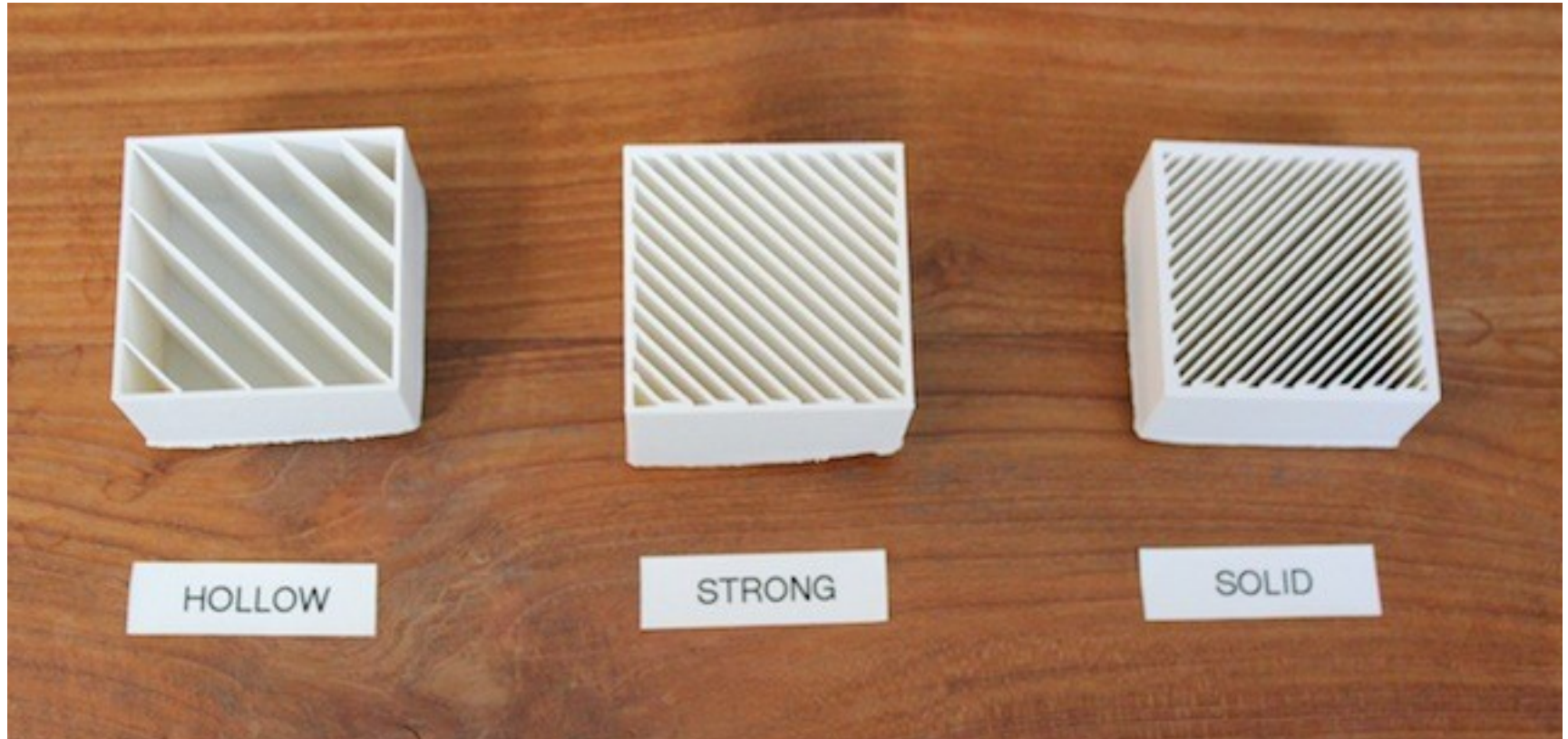


Image from cubify.com



Dashboard



Upload

Approve

Queue

Library

Support

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Ethanol-2016.STL

GENERAL

TRANSFORMS

ADVANCED

Quality

Fast

Standard

Strength

Infill: 5%

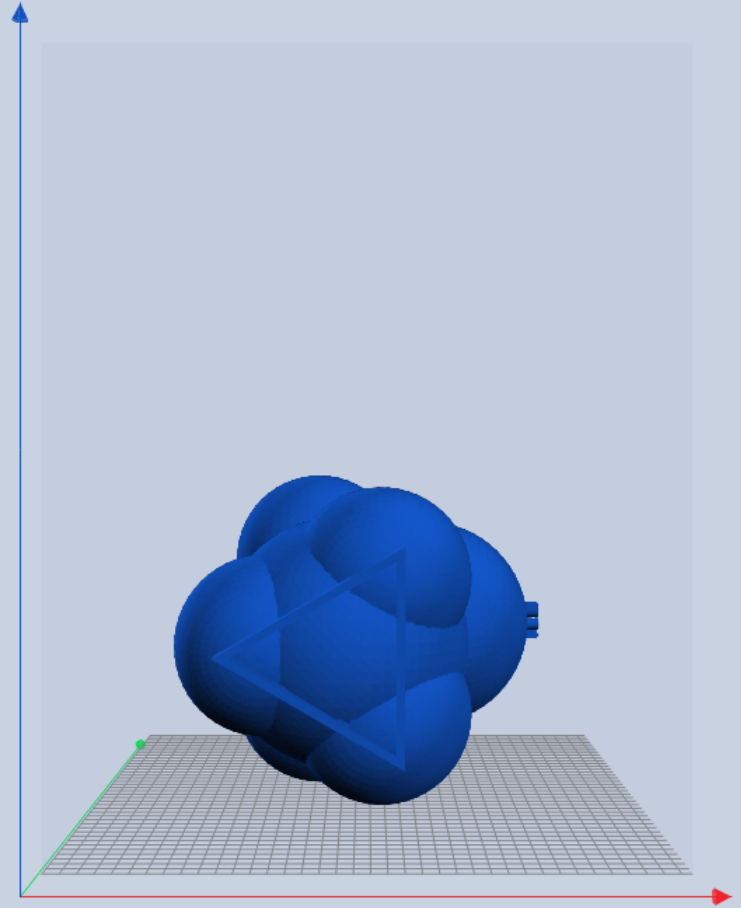
Copies



1



x: 131mm y: 127mm z: 113mm mm in



Ethanol-2016.STL

GENERAL TRANSFORMS ADVANCED

Units i

mm in

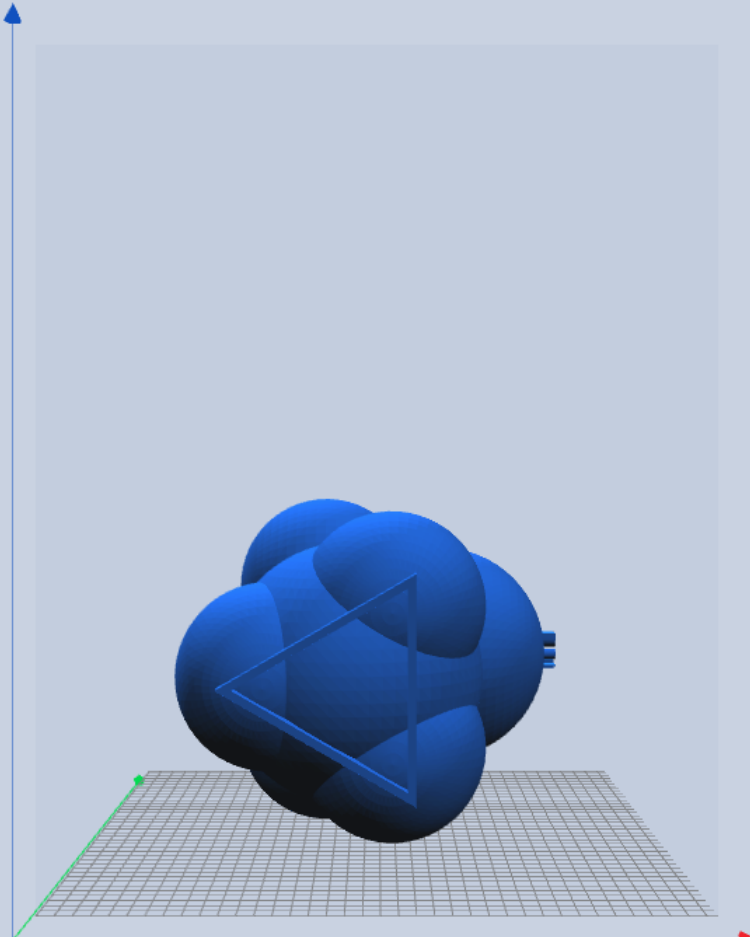
Scale Lock Scaling Ratio ON

All 100%

Rotate i

X 0° Y 0° Z 0°

x: 131mm y: 127mm z: 113mm mm in



3D visualization of the uploaded STL file (Ethanol-2016.STL) in a coordinate system. The object is a blue, multi-lobed, cloud-like shape. The coordinate system shows X, Y, and Z axes. The dimensions are X: 131mm, Y: 127mm, and Z: 113mm. The unit is set to mm.



Dashboard

Upload

Approve

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Library

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GENERAL

TRANSFORMS

ADVANCED

Units



mm

in

Scale

Lock Scaling Ratio

All

40%

Rotate



X

Y

Z

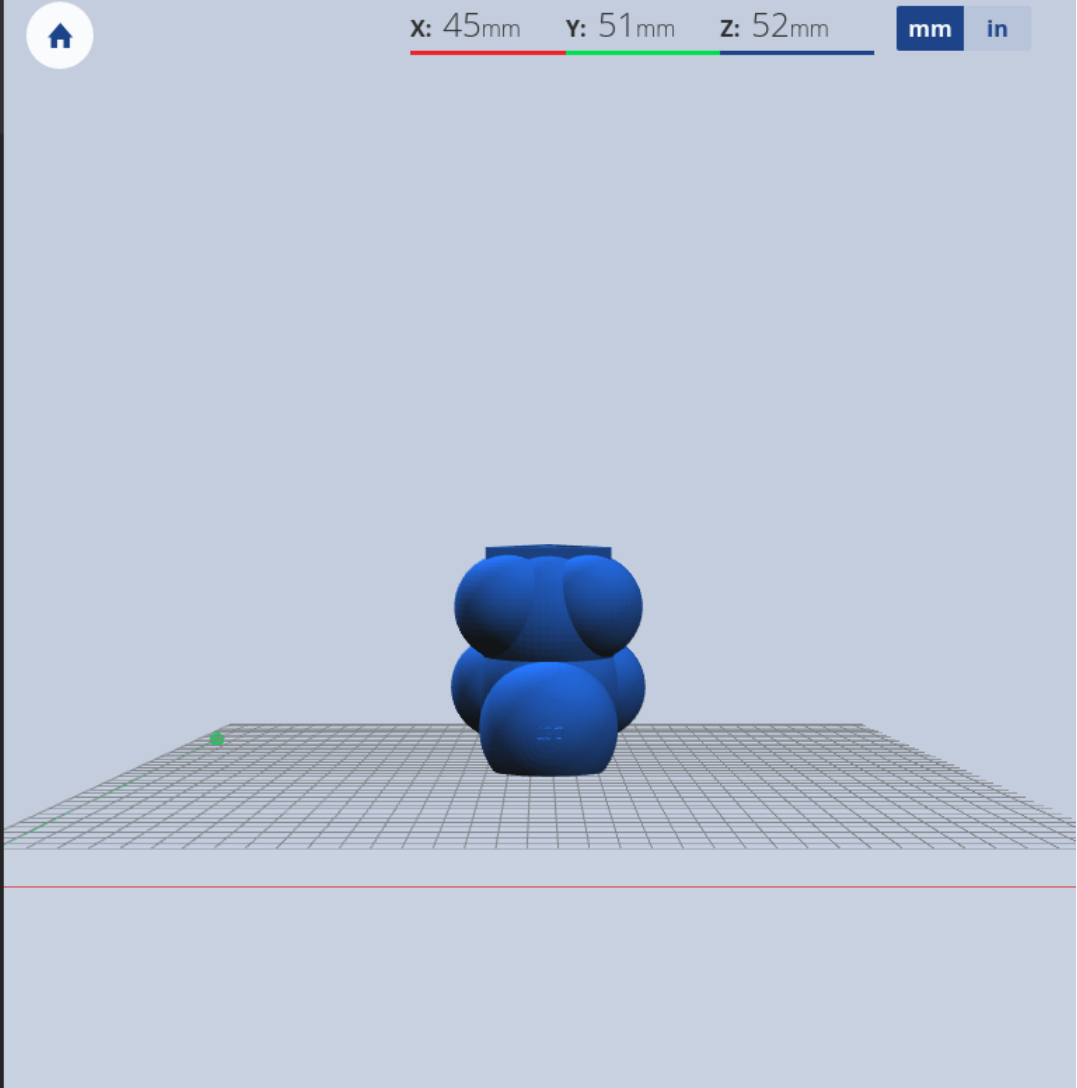
273°

90°

0°

X: 45mm Y: 51mm Z: 52mm

mm in





Dashboard

Upload

Approve

Queue

Library

Support

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RAPID PROTOTYPING TECH - ...

Ethanol-2016.STL

GENERAL

TRANSFORMS

ADVANCED

Support Material

ON

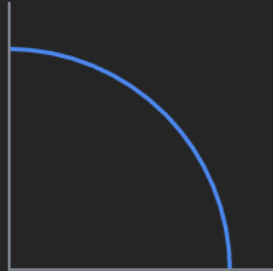
Support Angle

auto



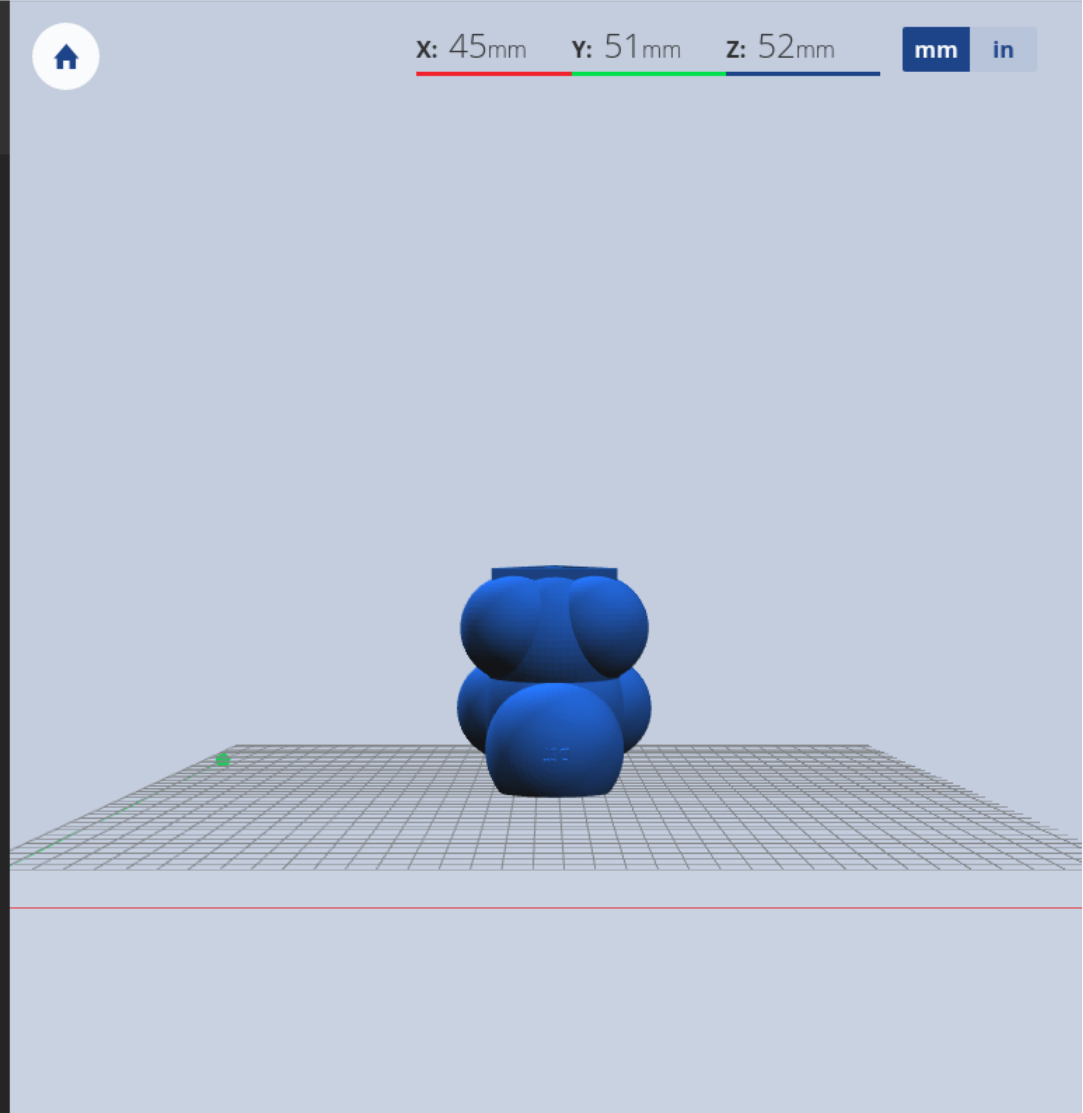
Support Pattern

Rectilinear



X: 45mm Y: 51mm Z: 52mm

mm in

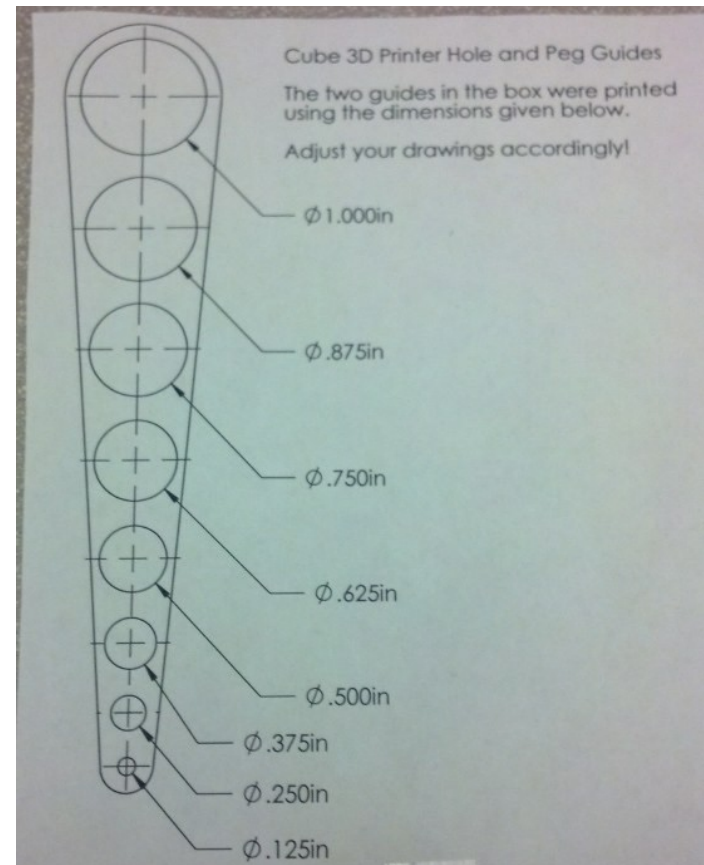


Post-Processing Steps

- Snap off any supports or raft.
 - Cutting tools are on the table next to the printers.
- Use a hot knife to remove stray material and retouch plastic that turned white.
- Sanding or filing might also be helpful.
- Machining? Painting? Gluing? Fake fur?
 - It's up to you!

Test Object (Mike Taylor)

- Compare requested size vs. actual.



Design Rules

- Shafts will be slightly **thicker** than intended.
- Holes will be **narrower** than intended.
- Do you want a 2.5 mm hole? On a 1st generation Cube:
 - Use 3.0 mm for a horizontal hole.
 - Use 3.7 mm for a vertical hole.
- Minimum widths for walls?

When Things Go Wrong



Alternative Printing Choices

- Objet printer in Larry Hayhurst's shop.
 - Finer resolution, smoother finish.
 - Can print dissolvable support material.
 - Pay by the cubic centimeter.
- Stereolithography facility at Pitt.
- Shapeways
 - High end 3D printing service; many materials. e.g., ceramics.
 - Library of models and applications.
 - 8 day turn-around; fast shipping.