LEARNING LAB: 3D PRINTING



Overview:

- How to Book Equipment
- Meet the equipment: FDM 3D Printers
 - Materials and Cost
 - Filament Printing Basics and Safety
- *Meet the equipment:* Resin 3D Printers
 - Materials and Cost
 - Resin Printing Basics and Safety
- User Responsibility
- Resources

But first...

How do these Learning Labs work?

We give you the basics and resources, you do the deep dives.

- More information on the <u>Fabrication and Robotics Lab page</u>
- This space is intended for users 13 and up. Younger users must be accompanied by a responsible adult with the relevant badge.
- How often can you book equipment? Reservations may be made:
 - Once per day
 - Up to 2 times per week
 - For a maximum of 5 times per month

(After the limit has been met, users may still access the tools on a walk-in basis if equipment is available.)



What do we have here?

Fused Deposition Modeling (or FDM)





Filament

- PLA/PETG <u>\$.07/g</u>
- Composite and TPU <u>\$.14/g</u>
- OR bring your own filament to print for free. (Remember to label your roll)

Safety

- HOT PARTS: Never touch the print head.
- The bed of the printer will also be warm.
- Moving parts may cause pinch points. Keep hands and jewelry at a safe distance.

Always clean up after yourself: clean print bed, put away materials, process print, and clean up workspaces.

What do we have here?

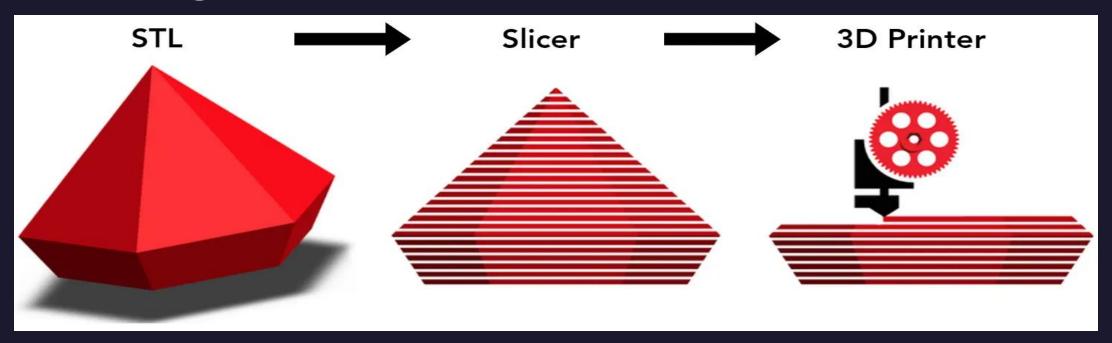
Automatic Materials System (AMS)





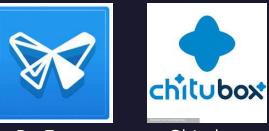
Please ask for assistance before using the single spool holder on the back of printer.

Slicing Software





SLA/Resin



PreForm

Chitubox

What file do I need? Where can I find it? Where can I make it?

When downloading or exporting 3D print-able files, you will want a **.STL file** (stereolithography).

NOTE: .OBJ or .3MF file formats may not always work for the slicing software.

<u>Where to find .STL files:</u>

- Thingiverse
- CGTrader
- NASA & NIH 3D

<u>3D modeling programs in Mac Lab:</u>

- Blender
- Fusion 360
- TinkerCAD
- Rhino

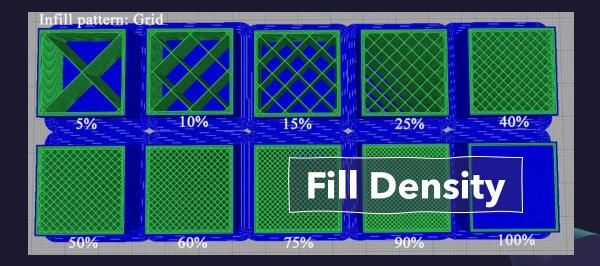
Slicer Fundamentals



Supports: Very important for prints with overhangs, especially over **45 degrees**, because you cannot print in midair.

Raft: Helps model with bed adhesion and prevents common first-layer issues.





Fill Density: Consider what your object will be doing. The greater the infill, the stronger the object will be.

Example: If the print is a coat hook that is going to hold a heavy winter coat, increase your infill. If the print is for aesthetic purposes only, then lower your infill and save some money.

You can also use a stronger infill *shape/pattern* (e.g., triangle).

What do we have here?

Resin 3D Printing (or SLA and MSLA)



Resin

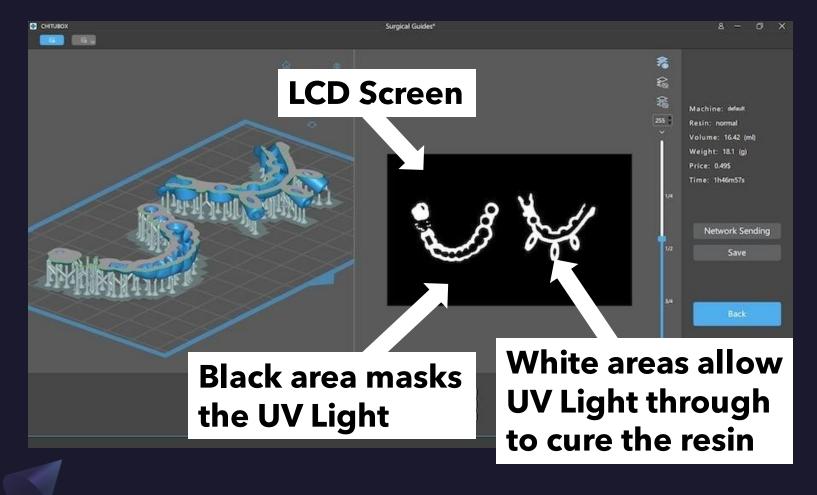
- Phrozen Sonic 8K: \$.10/g
- FormLabs: \$.20/g

Safety

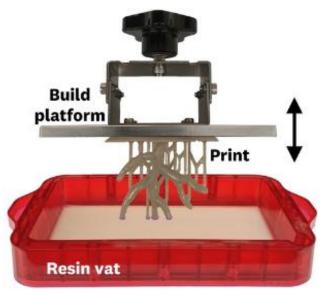
- Toxic until *fully*-cured
- Requires PPE

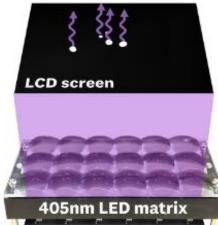
Always clean up after yourself: clean tools, safely dispose of materials, process print, and clean up workspaces with IP alcohol.

How Does It Work?

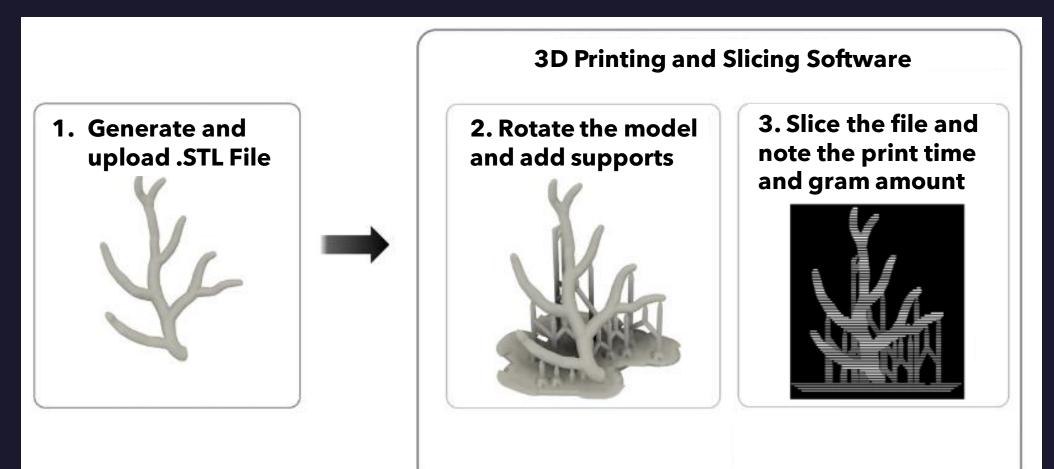


Masked stereolithography (MSLA) 3D printing mechanism

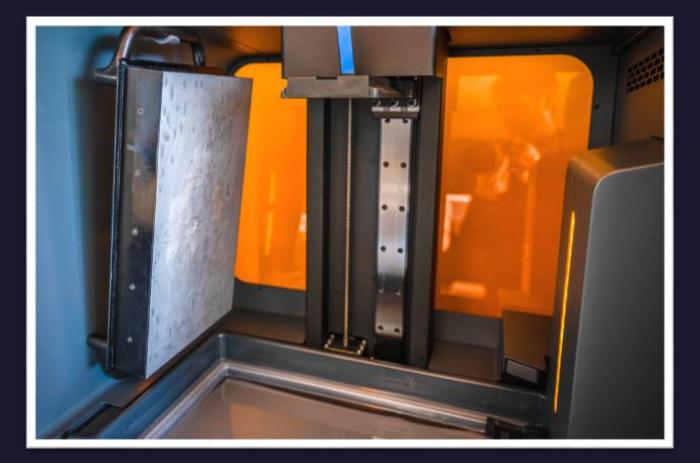




Slicing Software



Dangers of Resin Printing





- Do not touch with bare skin
- Avoid inhaling
- SLA prints are done overnight
- Use silicon mats to process
- Wipe down surfaces with IPA

Getting started with SLA Printing

Don't forget the <u>website</u>.

Prep the printer

- Step 1: wear gloves/glasses
- Step 2: gently check vat for debris *OR* ask staff to run Vat Cleaning mode
- Step 3: double-check resin level

Prep your file

- Step 1: upload your model
- Step 2: add rafts/supports
- Step 3: edit model details and settings
- Step 4: send to printer and write down print weight





Step 1: Equip PPE

Resin is **TOXIC**. Always wear chemical -resistant gloves and eye protection unless handling **fully** cured resin.

Prevent cross-contamination by protecting the workspace. You can find silicone mats, drop cloths, aprons, and 99% IP alcohol in the lab.

Step 3: Load Wash Station

Roll out the FormLabs alcohol bath (Wash L) and raise the basket. Insert all partially-cured parts and used tools into the basket.

Begin the 10-minute cleaning cycle. **DO NOT** roll the machine back under the table as the lid will open again automatically when finished.

Step 5: Load Cure Station

Move your print and supports to the FormLabs UV cure station (Cure L).

Select one of the available presets or research the time/temperature best for your resin. Thick, bulky parts may require more time in the "oven."





Safely remove the build-plate and place it on the printer's hook mount.

After allowing the excess resin to drip, you may **A)** transfer the plate to a silicone mat and remove the print or **B)** insert the plate itself into the FormLabs alcohol bath.



Step 4: Remove Supports

Remove the washed parts and allow them to dry completely. You can now roll the bath back under the table.

Put safety glasses back on! Though the resin is still unsafe to touch, now is the best time to remove support structures from the model. Remember to only use tools labeled "Resin."

Step 6: Clean Up

Wipe down any residual resin using 99% IP alcohol. It is very important to decontaminate all tools, mats, and other surfaces you may have used.

Throw any paper trash and uncured resin parts into the resin waste bin.





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Additional Rules

- Unless labeled RESIN, <u>do not</u> use Fab Lab tools near resin station.
- Avoid pouring uncured resin or cleaning solvents down the drain, as they can be harmful to the environment.
- After printing, SLA objects need post-curing using UV light to achieve their final strength and stability.
- Use same precautions when putting print in alcohol bath.
- Wear appropriate protective equipment and follow safety guidelines.
- Some SLA printers use high-powered UV lamps or lasers, which can generate significant heat.
- Improper use or malfunctioning equipment can pose a fire risk.
- Follow library and manufacturer guidelines. Reach out to staff IMMEDIATELY if problem arises.

Resources

- <u>Our YouTube Playlist</u>
- FDM Troubleshooting Guide
- <u>Bambu Lab Wiki</u> (Check this out!)
- Fusion 3 F410 Printer instructions
- Pulse Printer Instructions
- <u>Phrozen Help Center Mega 8K</u>
- FormLabs 3L

Printed FDM & Resin guides can be found attached to the closet door.



Don't forget the FPL/CFI website!!!