THE SFA MAKERSPACE

WHAT IS 3D PRINTING?

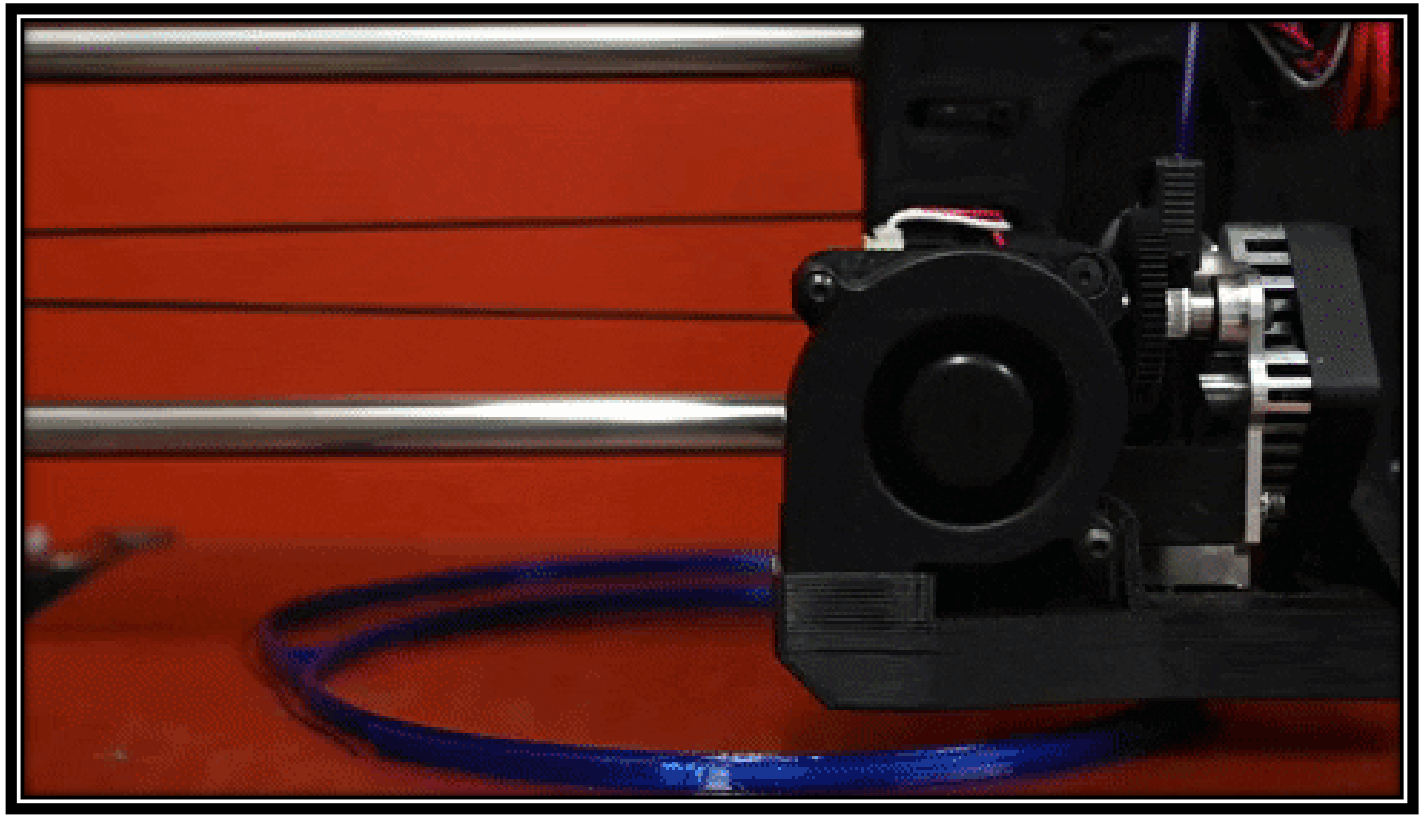
LEARNING OBJECTIVES

1. Identify and define the major types of 3D printing technologies
2. Understand the 3D printing process (FDM)
3. Identify and define key components of a 3D printer

Additive Manufacturing

Parts are built by adding material layer by layer.

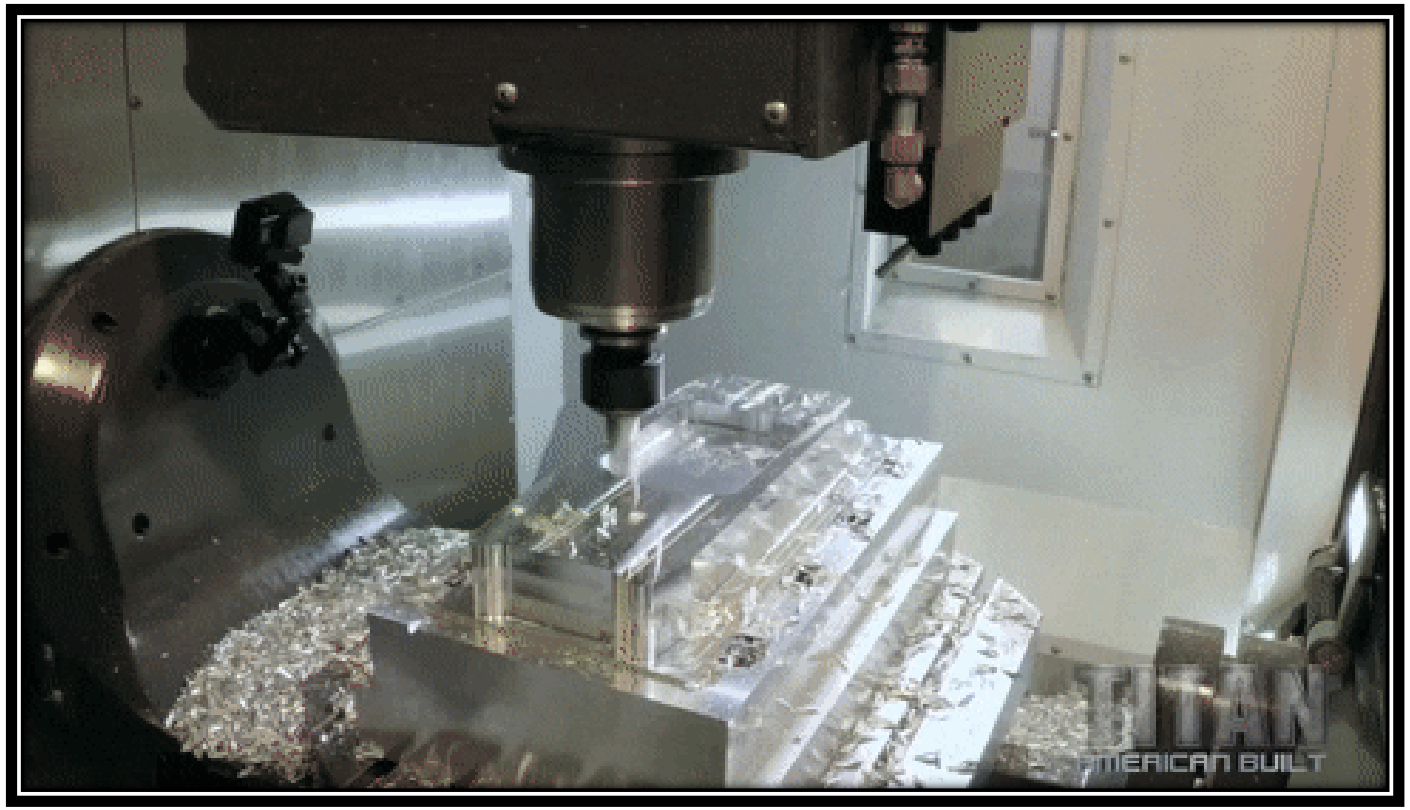
Produces less waste, but parts are only as strong as the bond between layers.



Subtractive Manufacturing

Parts are made by removing material.

Parts are as strong as the raw material they're made from, but typically results in more waste.



Different 3D Printing Technologies

Common 3D Printing Technologies

Material Extrusion (“3D Printer” FDM Printer)

Vat Photopolymerization (Resin Printers)

Less Common 3D Printing Technologies

Powder Bed Fusion

Material Jetting

Binder Jetting

Direct Energy Deposition

Sheet Lamination

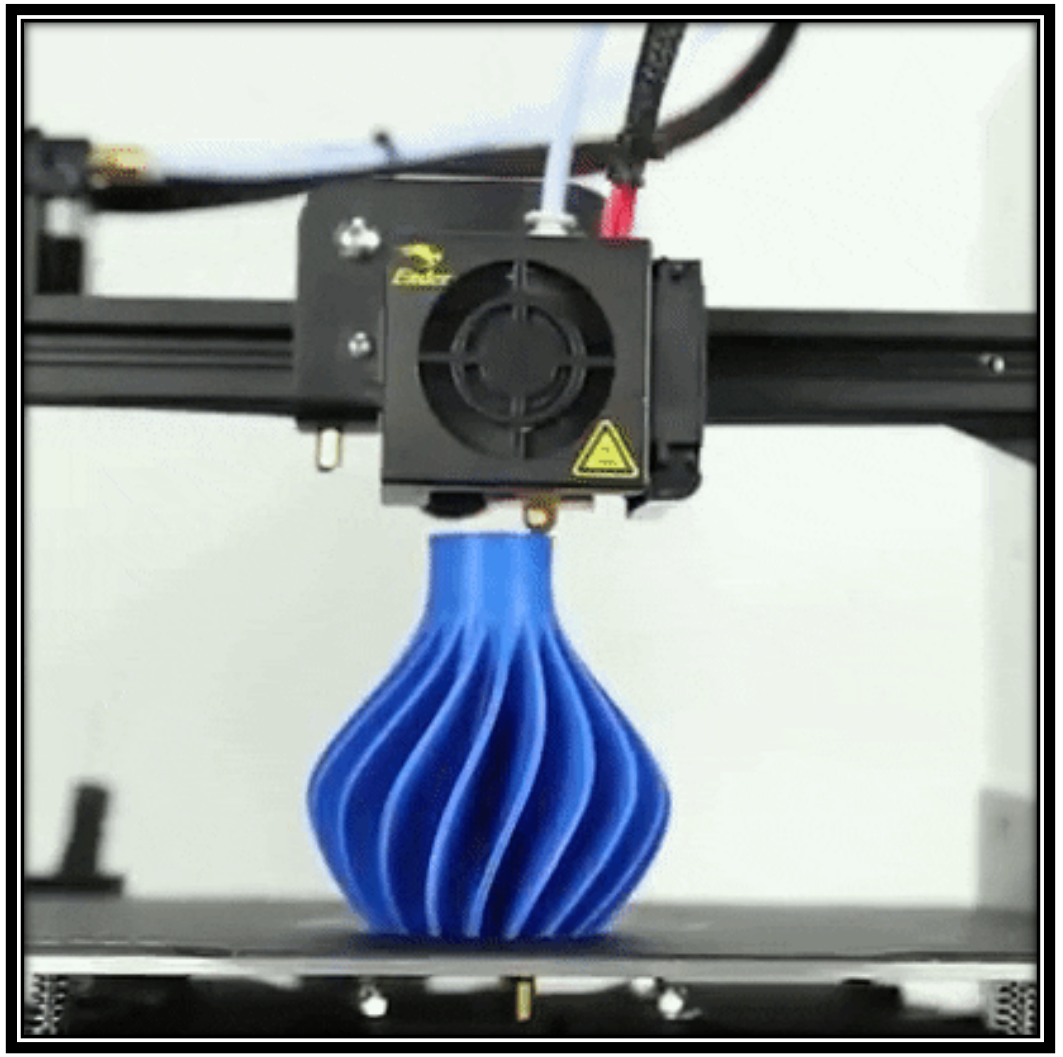
Material Extrusion

How it Works

Thermoplastic filament is heated and extruded layer by layer, like a hot glue gun, on to the build plate to create a part.

Technologies

FDM (Fused Deposition Modeling) also referred to as FFF (Fused Filament Fabrication)



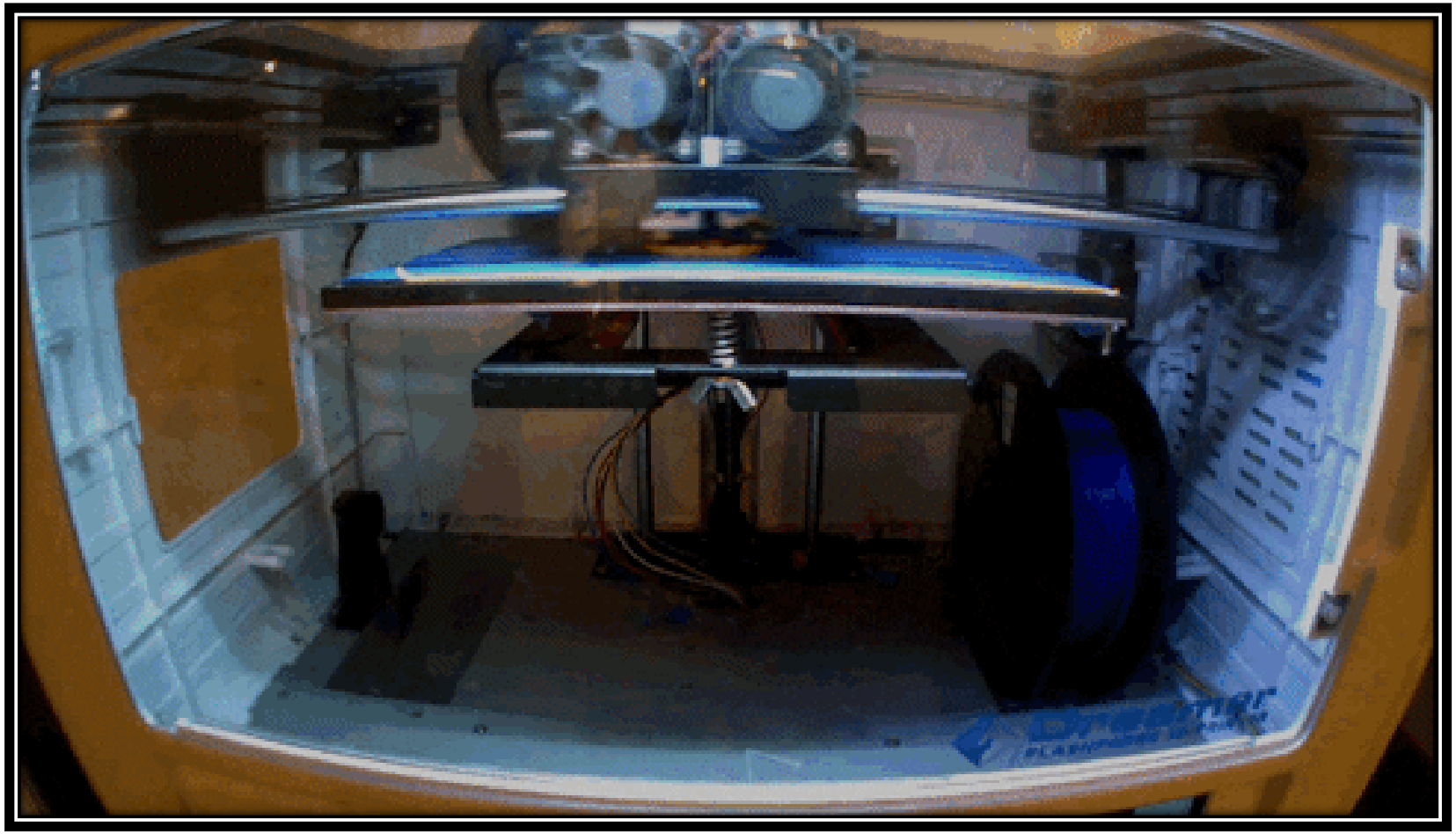
Material Extrusion

Strengths

- Safe
- Easy to use
- Inexpensive
- Material Variety

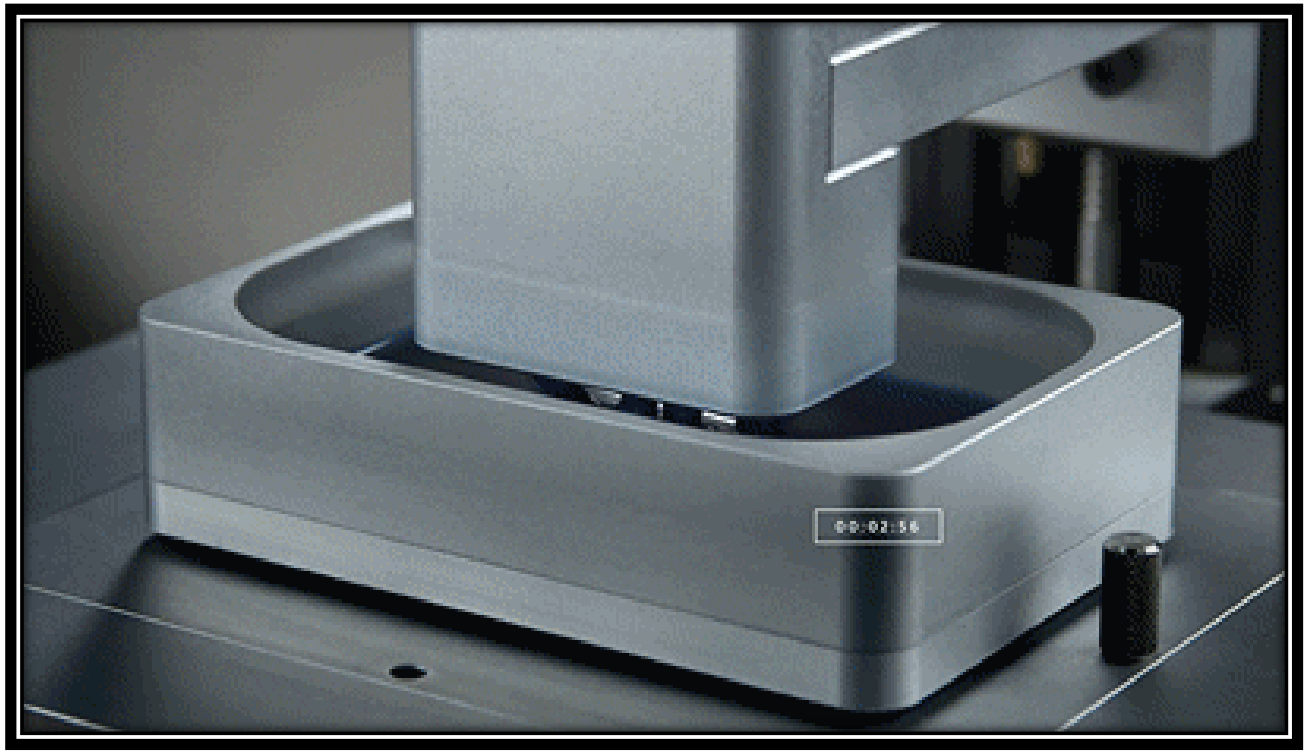
Weaknesses

- Longer print times
- Limited Detail
- Dimensional Accuracy
- Complex Geometries



Vat Photopolymerization

A build plate is submerged into the bath of uncured resin, and UV light cures the resin layer by layer as the plate lifts upward. (Also known as resin printers)



Technologies

SLA (Stereolithography)
DLP(Digital Light Projection

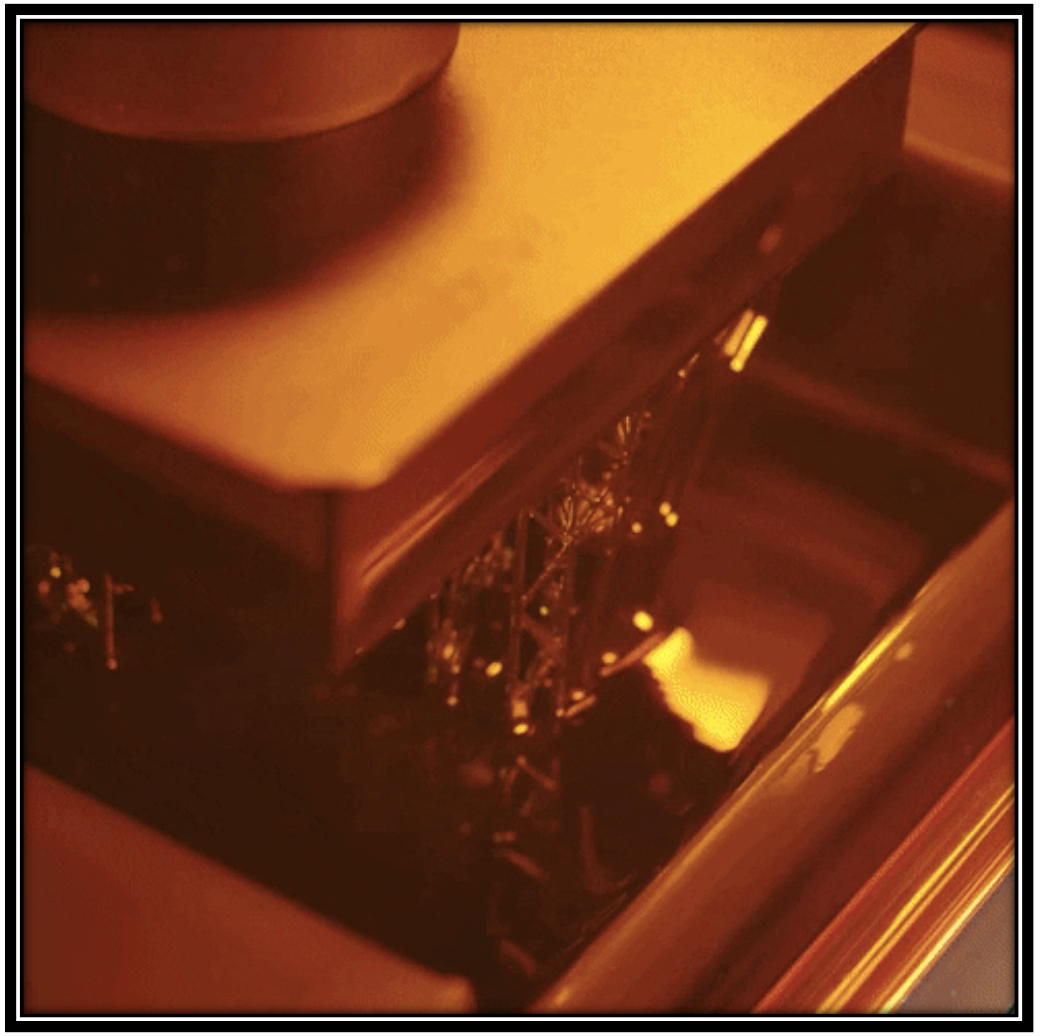
Vat Photopolymerization

Strengths

- Highly detailed parts
- Fine surface resolution
- Transparent /semi-Transparent Prints
- Faster Print times for multiple parts

Weaknesses

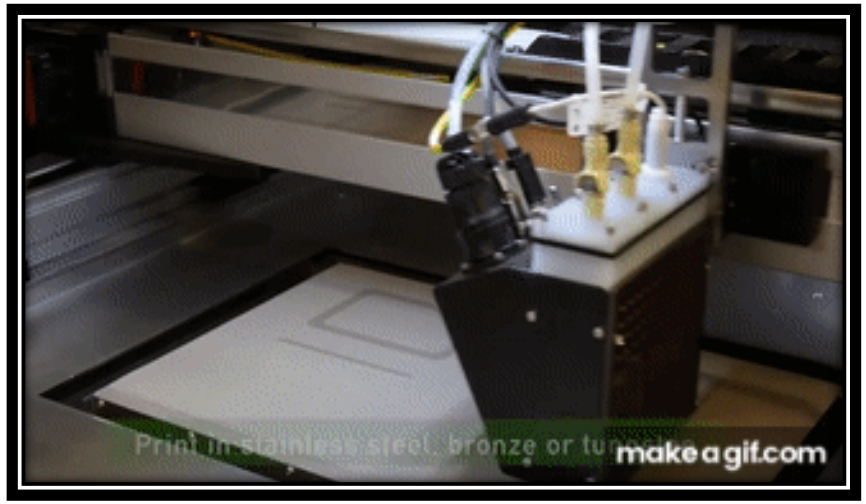
- Parts require lots of post processing (Washing and Curing)
- Need safety equipment to handle resin
- Parts can be more fragile depending on material used



Less Common 3D Printing Technologies

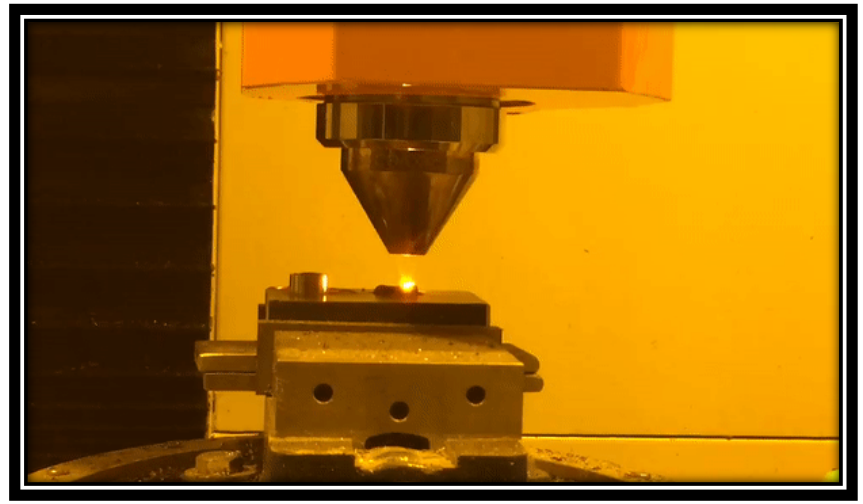
Powder Bed Fusion

Uses layers of powder (metal/nylon) and a high powered laser to fuse each layer. (SLS, DMLS, EBM)



Binder Jetting

Uses layers of powder, adhesive and ink layer by layer to create a 3d object.



Direct Energy Deposition

Nozzles carry raw powder material (often metal) and a high-powered laser, and fire simultaneously to deposit material onto a surface. Can be used to fix existing parts.

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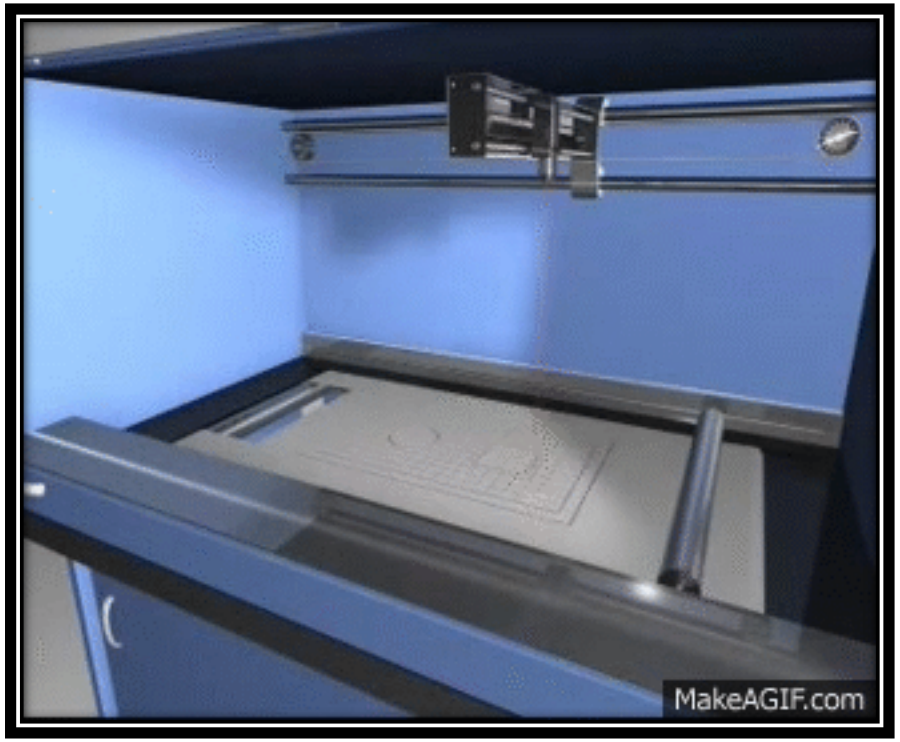
Less Common 3D Printing Technologies 2

Material Jetting

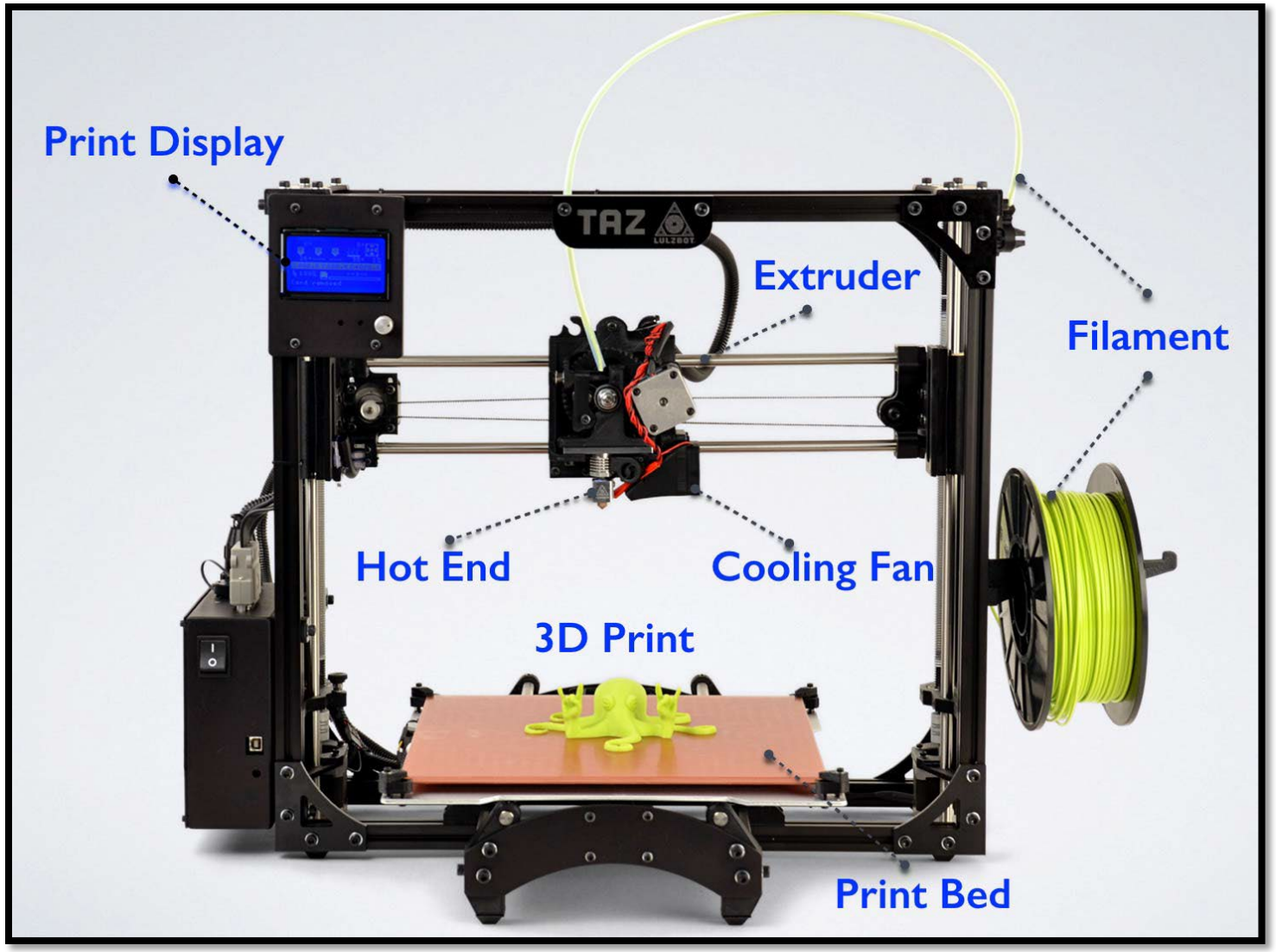
Like an ink jet printer except it deposits UV sensitive resin from several print heads.



Sheet Lamination

Thin sheet of materal is feed into chamber cut and bonded to the layer below it. Works with paper and thin metal.

Parts of a 3D Printer (FDM)



Filament: Material used to build 3D printed parts

Print Display: Settings Menu for 3D printer.

Extruder: The “hot glue gun" of your 3D printer; it uses filament to draw out the layers of 3D printed parts

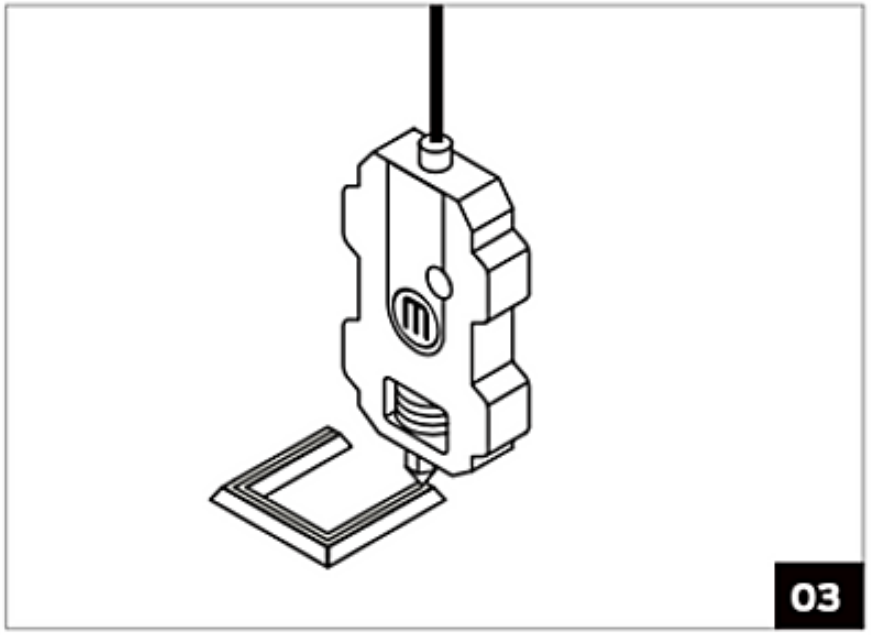
Cooling Fan: Cools hot end and prints while printing.

Build Plate/Print Bed: Surface on which 3D prints are built

Gantry: Moves the carriage in the x-axis and z-axis

Carriage: Carries the extruder

What is the 3D Printing Process?



01: FDM printing starts with a digital 3D model, most often generated from a 3D modeling program.

02: The 3D model is sliced into 2D layers using a slicing software and then sent to the printer.

03: On the printer, filament is fed into an extruder that draws out each slice, layer by layer, onto the build plate. Over time, these 2D layers stack on top of each other to build a 3D print.

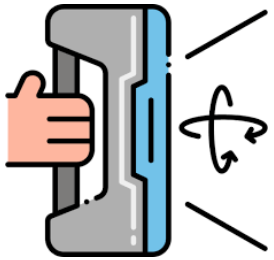
Step 1: Get a 3D Model!

To 3D print, you must start with a 3D file. Here are a few ways to get one:

•**Design** a model to print in a 3D design software or computer-aided design (CAD) program.

AUTODESK® FUSION 360™ blender® TINKERCAD AUTODESK® TINKERCAD® SOLIDWORKS SketchUp

•**Scan** an existing physical object with a 3D scanner.



•**Find** a model online from websites like *thingiverse.com* or *Cults3d and Printables*

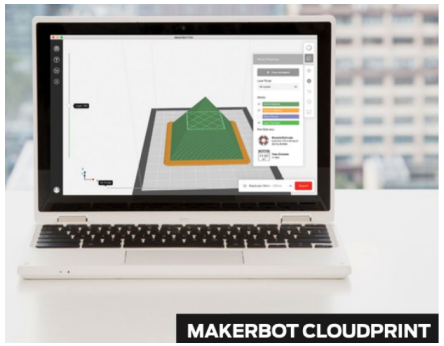
MAKERBOT THINGIVERSE Printables by JOSEF PRUSA Cults.

Step 2: Pick a 3D Printer

Printer	Slicer		Detail Level	Type of Material
Lulzbot Taz 6,Pro 2, Mini 2	CURA	Cura Lulzbot Edition	Lowest best for Larger Prints (exception for mini 2)	2.85 mm PLA/ABS/PETG ect.
Bambu Labs X1 Carbon		Bambu Studio	Good Detail but not for very small prints	1.75 mm PLA/ABS/PETG ect.
Prusa MK2 & Prusa Mk4 (Coming Soon)	Prusa Slicer	Prusa Slicer	Good Detail but not for very small prints	1.75 mm PLA/ABS/PETG ect.
Anycubic Photon Mono X	Lychee Slicer 3 Slicer for SLA 3D printers	Lychee Slicer	Great Detail even for very small prints limited size	UV Resin
Form 3 +		PreForm	Best Detail even for very small prints very limited in size	UV Resin

Step 3: Slice your 3D model

Before printing a model, prepare the file in in the Required Slicing Software. Follow these steps:



- **Edit** the print settings.
- **Decide** if you want to print more than one part.
- **Slice** the model to prepare for printing, which translates the model(s) into a language the 3D printer can understand.

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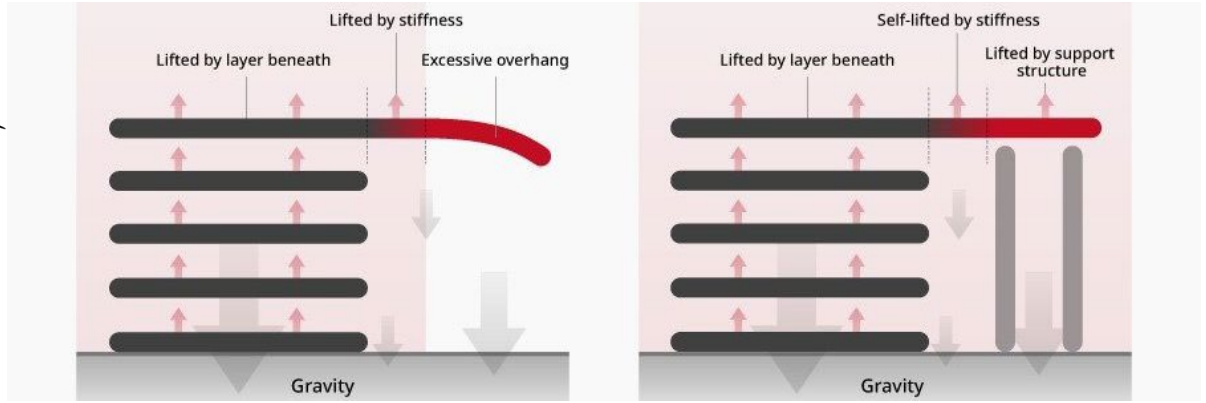
Lychee Slicer 3
Slicer for SLA 3D printers

Prusa Slicer

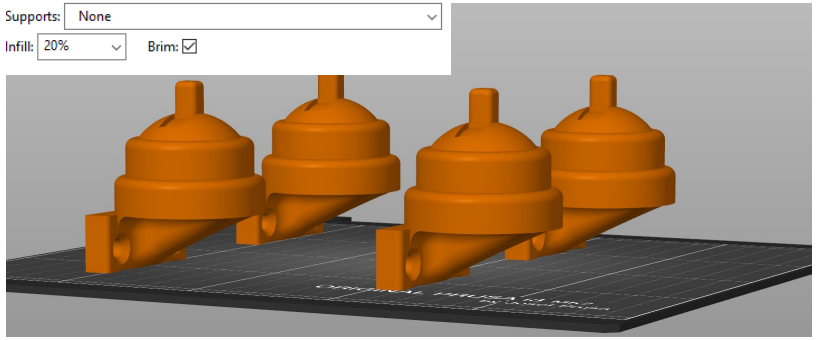
Prusa Slicer

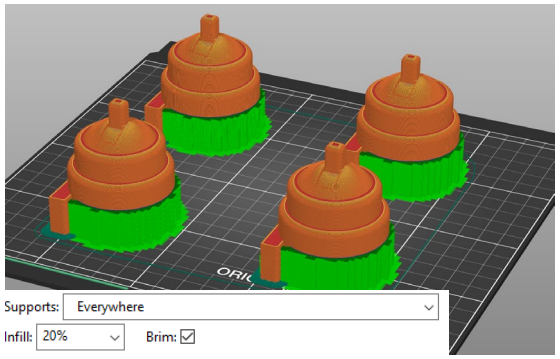
Step 3: Slice your 3D model Cont.

Think about gravity!!



If there are overhangs on your model it will require supports to be generated.





Step 4: Load your Sliced Program onto the 3D Printer

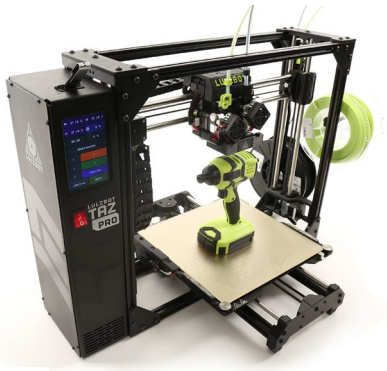
Send your sliced file to your desired 3D printer and let it print.

This can be done in several ways

SD Card
Upload online

The print time will depend on many factors, including:

- Your print settings
- The size and complexity of the model



Step 5: Enjoy your 3D Print!

What is 3D Printing Used for?

Technology: Designers at Peloton use MakerBot 3D printers to prototype their cutting edge indoor bikes.

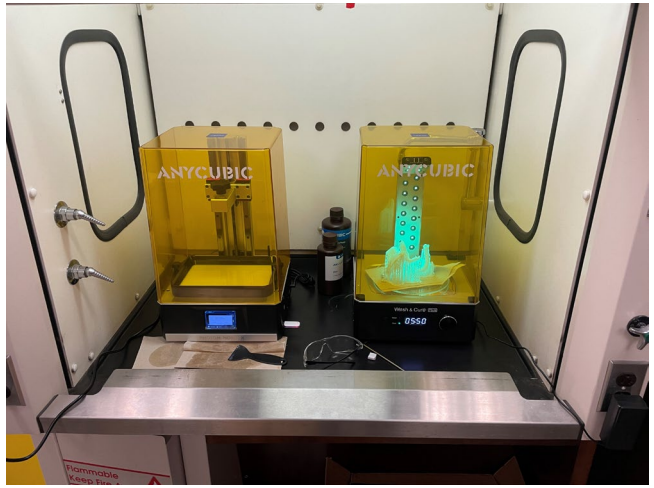
Medical: Open source 3D printable prosthetics allow people all over the world to print low-cost assistive devices.

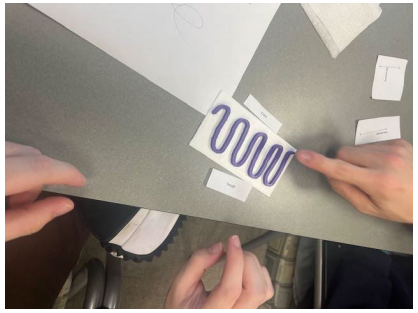
Engineering: Engineers at Lockheed Martin use MakerBot 3D printers to fundamentally redesign space telescopes.

Product Design: Canary develops, tests, and refines smart security systems using 3D printing.

Architecture: Perkins + Will, an architecture firm in New York City, uses 3D printing to test new building ideas.

Entertainment: The Legacy Effects team created a full-scale, detailed alien suit using 3D printing.





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