
Tech Talk
Practical 3D Printing

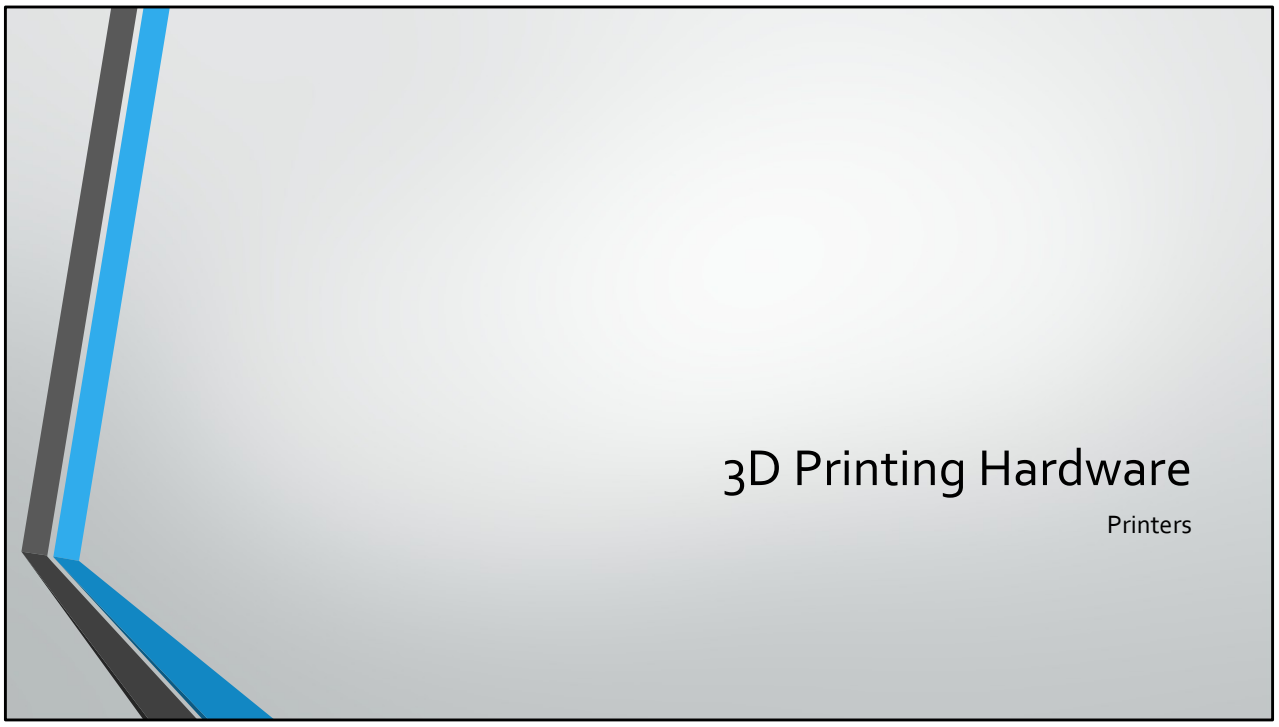
Agenda

- Start 3D Print
- Hardware
  - Printers
  - Materials
- 3D Models
  - Finding
  - Building
- Slicing Models
- Prepping Printer
- Printing
- Finishing Models

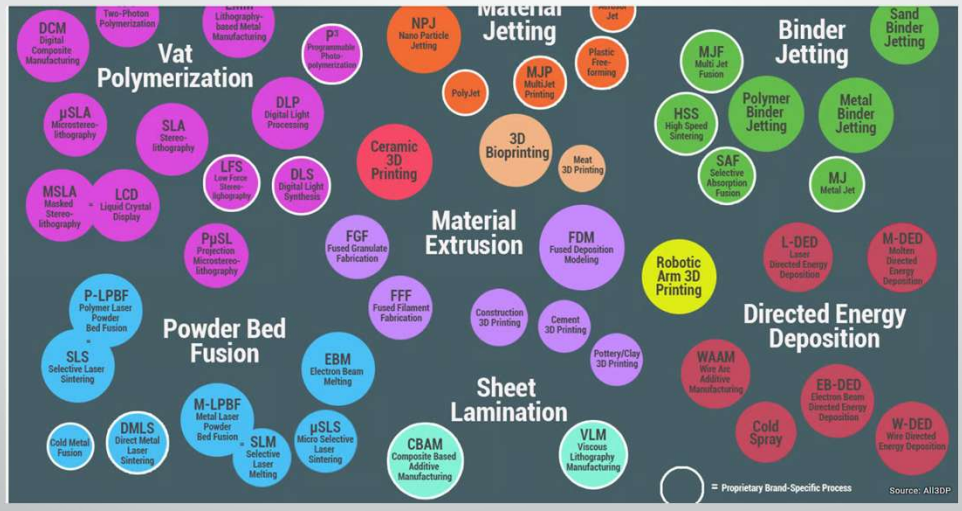

Start 3D Print
Printers

Start Print

- Feeding in filament
- Clean Build Plate
- Start Print


3D Printing Hardware
Printers

Hardware - Printers



Hardware – Home Printers

FDM – Fused Deposition Modeling
- Uses rolls of filament
- Melts filament and layers into pattern to create part

https://youtu.be/FqQAjkZOBeY?si=_lSDR3Lk1NPrib7z

SLA – Stereolithography
- Starts with as a liquid in a tub
- uses a UV laser to cure liquid photopolymer resin into solid, highly precise, and smooth-surfaced 3D parts layer by layer

https://youtu.be/VTJq9Z5g4Jk

Hardware – Home Printers

Advantages of FDM

- Cost-Effective: FDM machines and materials (filaments) are generally affordable compared to other 3D printing technologies.
- Wide Material Selection: Supports a diverse array of thermoplastics (PLA, ABS, PETG, Nylon).
- Ease of Use: Simple to operate and maintain, making it ideal for beginners and desktop use.
- Rapid Prototyping: Fast printing speeds allow for quick creation of proofs-of-concept and functional parts.
- Large Build Size: Capable of printing larger, robust models compared to SLA.
- Minimal Post-Processing: Generally requires less cleanup than resin-based methods.
- Prototal UK
- Prototal UK

Disadvantages of FDM

- Low Resolution & Surface Quality: Produces visible, stacked, and rough surface textures, limiting fine detail.
- Weak Layer Adhesion (Anisotropy): Parts are weaker along the z-axis (between layers) than the x-y axes, which can lead to structural failure.
- Warping and Shrinkage: Thermoplastics can shrink, leading to warping, especially with materials like ABS.
- Support Structures: Complex, overhanging, or hollow geometries often require supports that must be removed.
- Longer Print Times for Complex Parts: While fast for single, simple parts, print time increases significantly with complex geometries.
- Nozzle Issues: Prone to nozzle clogging.

Hardware – Home Printers

Key Advantages of SLA 3D Printing

- Superior Accuracy and Detail: SLA produces extremely smooth surfaces with high-resolution details, reaching tolerances of 0.05 mm.
- Isotropic Properties: Unlike FDM, SLA parts are not porous and have uniform strength in all directions (isotropic).
- Functional Materials: A wide range of specialized resins exist, including castable, flexible, high-temp, and transparent materials.
- Watertight Parts: Ideal for, medical, and dental models, as well as casting patterns.
- Support Structures: While necessary, they are usually "light-touch" and easy to remove.

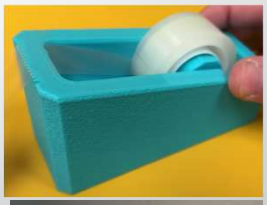
Key Disadvantages of SLA 3D Printing

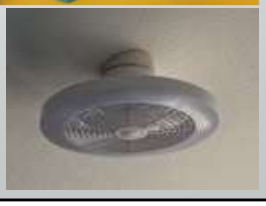
- Extensive Post-Processing: Parts must be washed in solvent (usually isopropyl alcohol) and post-cured with UV light, which adds time and labor.
- Brittleness: Many standard SLA resins are brittle, meaning they are less durable than thermoplastic parts.
- UV Sensitivity: Parts can degrade, turn brittle, or discolor over time if left in direct sunlight.
- Smaller Build Volume & Cost: Compared to FDM, SLA printers often have smaller, more expensive build platforms and materials, and the resins can be messy to handle.
- Support Dependence: Almost all parts require supports, which can leave marks and require additional finishing.

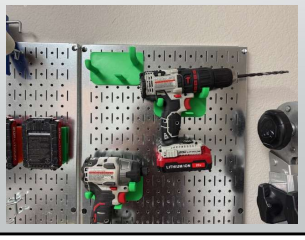
Hardware – Home Printers

FDM - Common Home Applications:

- Repair and Replacement Parts: Creating durable replacements for broken knobs, handles, brackets, or clips.
- Organization and Storage: Printing custom solutions such as cable organizers, desk organizers, tool holders, drawer dividers, and battery cases.
- Home Improvement and Utility: Making functional items like soap dishes, clothes hangers, shelf brackets, mop/broom holders, and custom hooks.
- Kitchenware and Organization: Creating food-safe or functional kitchen tools such as bag clips, sponge holders, and measuring cups.
- Home Decor and Lifestyle: Printing personalized vases, planters, lamps, photo frames, coasters, and wall art.
- Hobbies and Gaming: Producing tabletop gaming miniatures, RC car parts, drone components, and custom puzzle cubes.



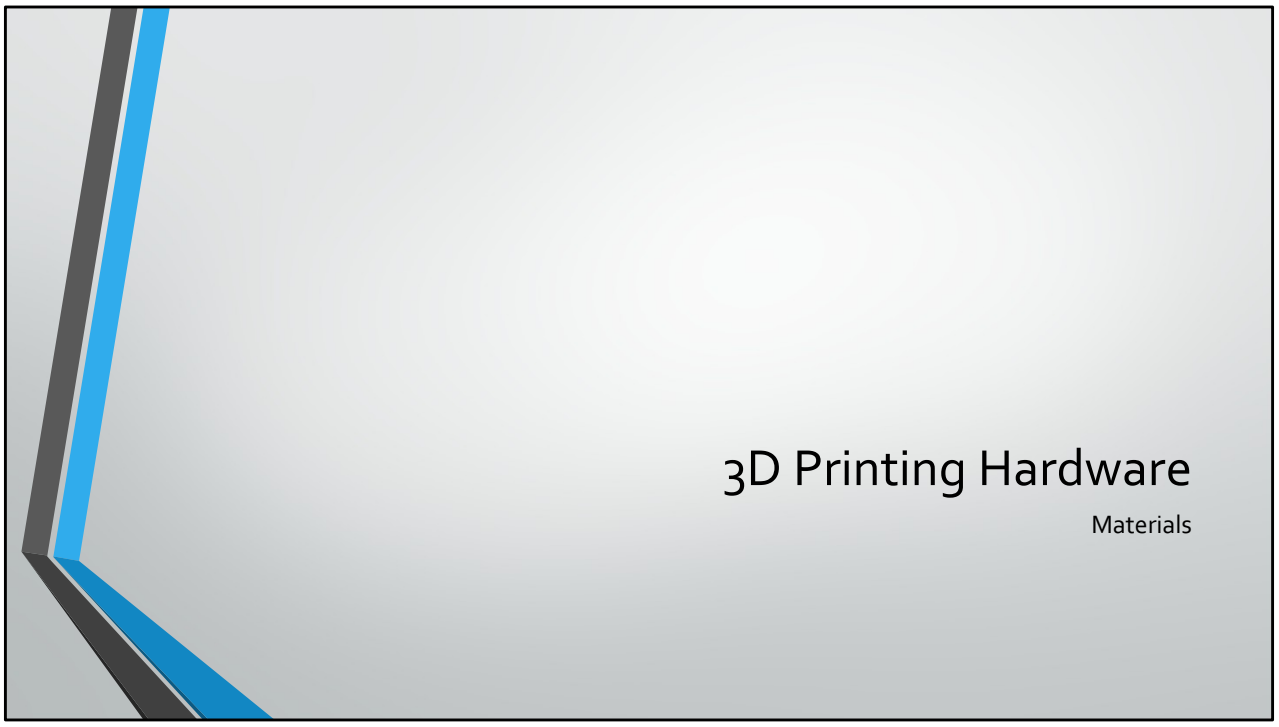




Hardware – Home Printers

SLA - Common Home Applications:

- Miniatures and Gaming: Printing detailed tabletop role-playing miniatures, wargaming figures, and collectible statues.
- Replacement Parts and Repairs: Creating small, precise, or hard-to-find broken items like custom brackets, knobs, gears, or chair feet.
- Jewelry and Art: Designing and casting custom rings, pendants, or detailed artistic models due to the high resolution of SLA.
- Hobby and DIY Customization: Making, modeling, and modifying small items like drone parts, custom toy pieces, or decorative items.
- Prototyping: Developing functional, high-resolution models for personal inventions.
- Key Materials and Considerations:
- Resin Types: Standard resins for general models, tough resins for functional, durable parts, and flexible resins for gaskets or soft components.
- Post-Processing: SLA requires cleaning in isopropyl alcohol and curing under UV light, making it less "plug-and-play" than FDM printing.


3D Printing Hardware
Materials

FDM Materials

SLA Resins (Materials)

Standard Resins: Great for draft prototypes and visual models. Examples include Formlabs Standard Resin or Anycubic Basic Resin, which offer good surface detail at a lower cost.

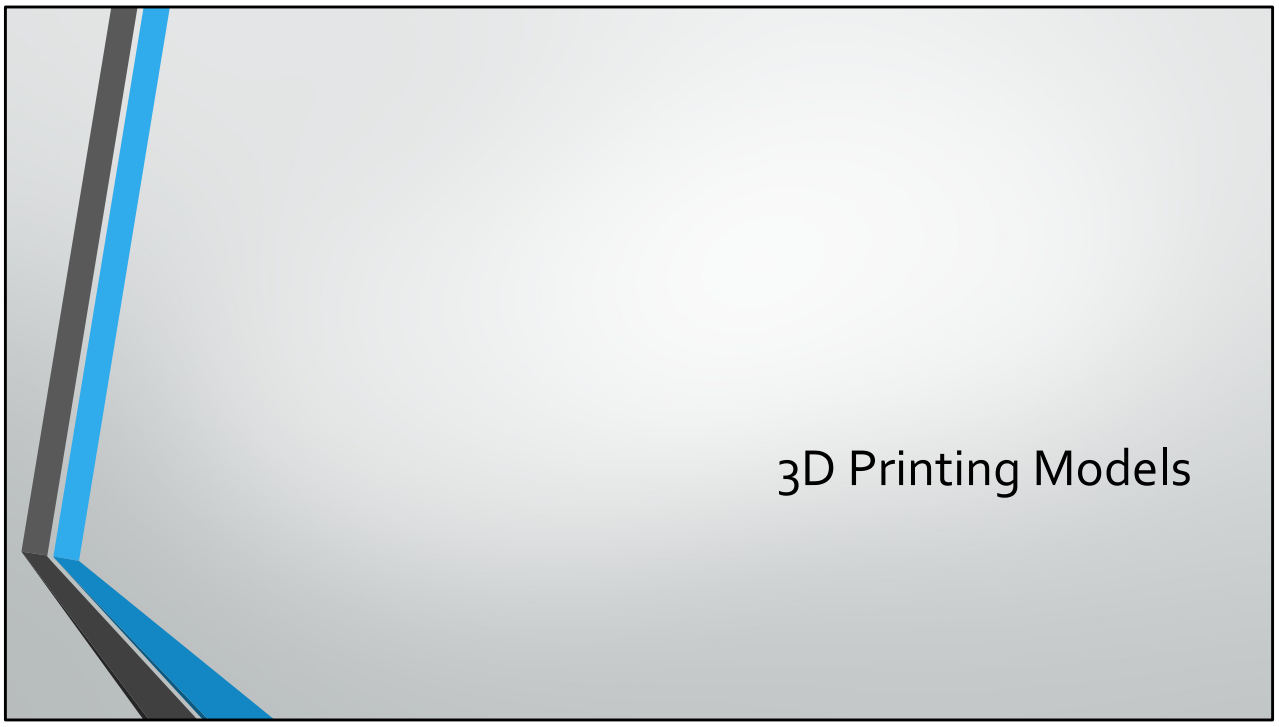
Engineering Resins: Designed for added toughness, heat resistance, or impact strength. Options like Formlabs Tough 2000 Resin or Siraya Tech Blu Resin support functional snap-fits, enclosures, and load-bearing features.

Clear Resins: Perfect for transparent parts, lenses, and light pipes. Clear materials such as Formlabs Clear Resin or Elegoo Transparent Resin deliver excellent optical clarity with post-polishing.

Biocompatible Resins: Essential for medical and dental applications, including surgical guides or dental models. Resins like Formlabs Dental SG Resin are certified for patient contact with proper post-curing.

High-Temperature Resins: Suitable for automotive and industrial tooling applications. Resins like Formlabs High Temp Resin can withstand temperatures exceeding 230 °C, enabling short-run functional testing or mold-making.

Castable Resins: Used by jewelers and miniaturists to produce patterns for investment casting. Castable Wax Resin, for example, burns out cleanly and delivers high-resolution features for precious metal casting.



I am going to focus on FDM printing.

3D Models - Finding

- Thingiverse: With over 2.4 million monthly visitors, this is the most popular, content-rich, and longest-running repository for free STL files.
- Printables: Run by Prusa3D, this site features high-quality models,, a strong community, and a well-organized interface.
- MakerWorld: Operated by Bambu Lab, it offers a wide variety of models, often with pre-sliced files for immediate printing.
- Thangs: A 3D model search engine that searches across multiple platforms, featuring a 3D viewer for inspecting models before downloading.
- Cults (Cults3D): Features a large selection of,, creative designs for decor, jewelry, and fashion, with many free options.
- GrabCAD: Primarily for engineering-focused,, industrial CAD models and assemblies.
- YouMagine: A large, open-source community, repository for 3D printer designs.
- NASA 3D Resources: A specialized site for high-quality, educational models of space equipment and planets.

3D Models - Building

- AI Generated Models
  - Tripo AI: Currently considered the top AI for 3D printing due to high-quality outputs and direct support for multicolor 3D printing (exporting vertex colors for Bambu Studio).
  - Meshy AI: A leading platform for generating 3D models from text or images, known for its speed and user-friendly interface.
  - Sloyd AI: Specializes in rapid, customizable, and parametric 3D models (props, furniture,, architectural details) with a very low cost per model.
  - Rodin (Hyper 3D AI): Recognized for high-quality, professional-grade resolution and topography, suitable for detailed models.
  - LumaLabs Genie: A free, accessible AI tool for creating 3D models quickly.
  - Backflip: Designed specifically for 3D printing, focusing on more rigid, engineer-like, and printable structures.
  - 3DAI Studio: An all-in-one platform providing access to multiple generators (including Meshy and Rodin).

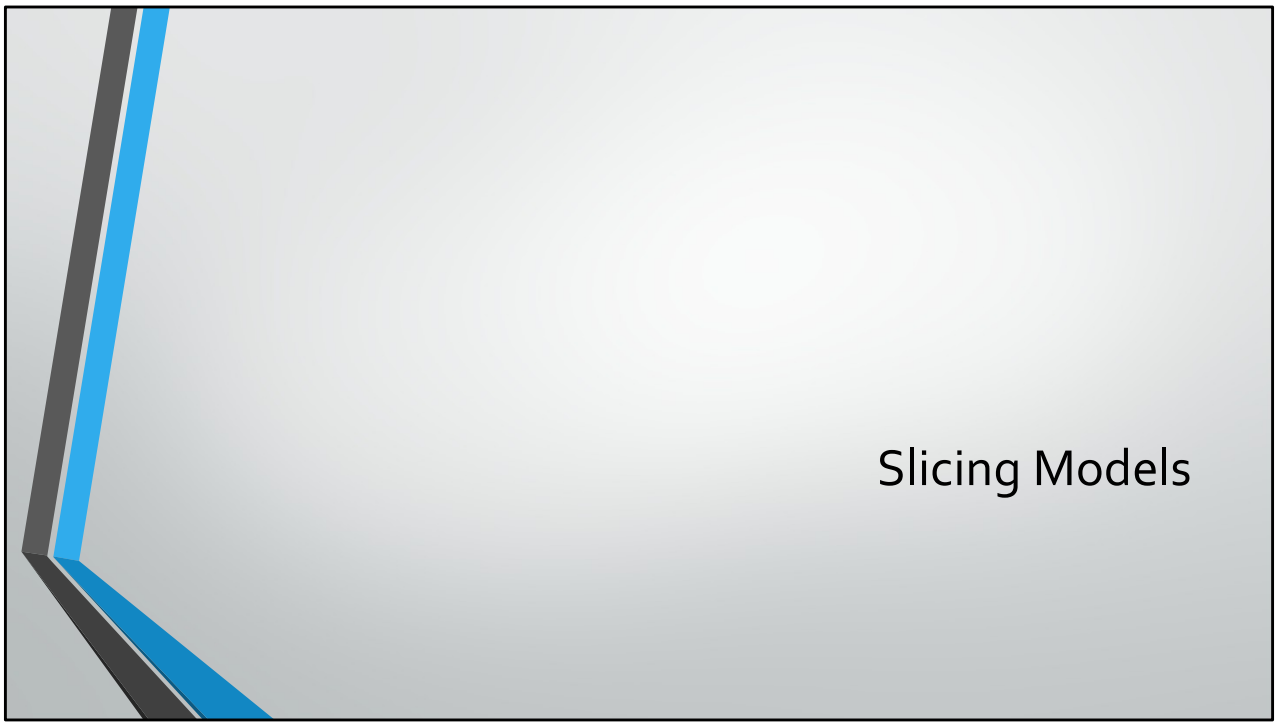
3D Models - Building

- TinkerCAD – Free - very simple to use, great for beginners
- Fusion – Free for Personal Use – slightly more complex
- FreeCAD – Free, Open Source – more complex

Prints will shrink.

3D Models - Building

- Demo of TinkerCAD



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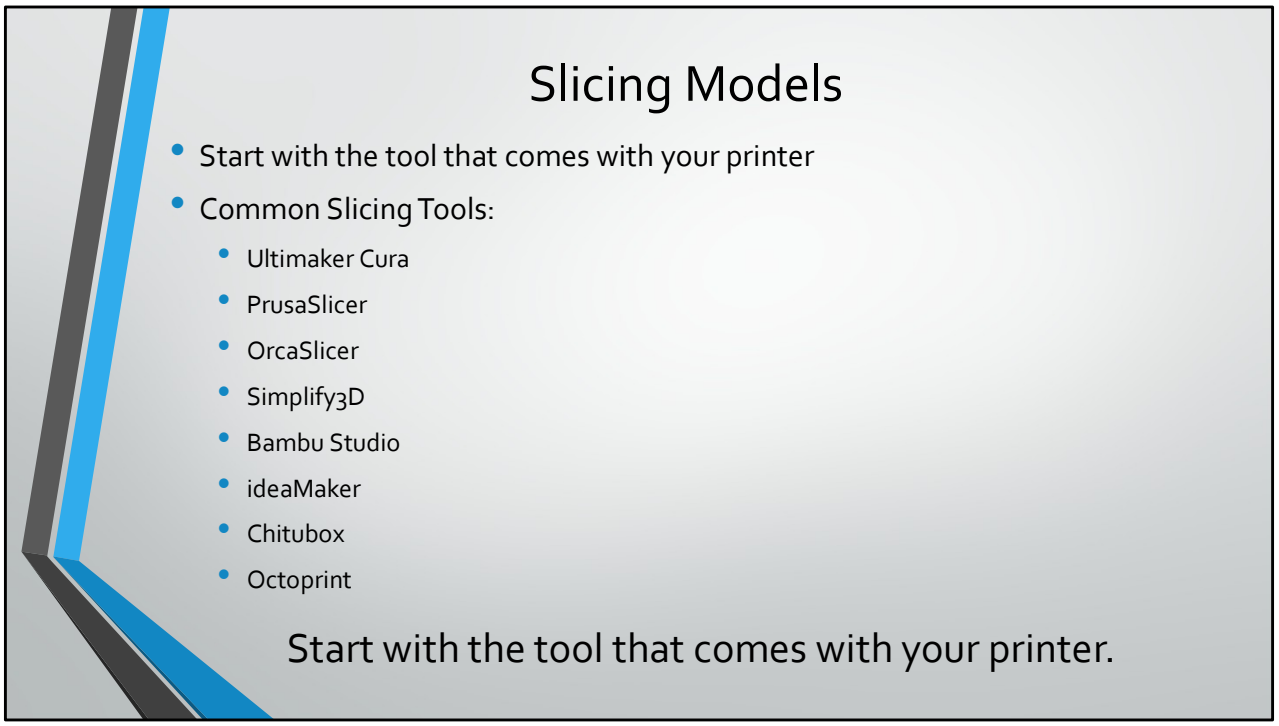
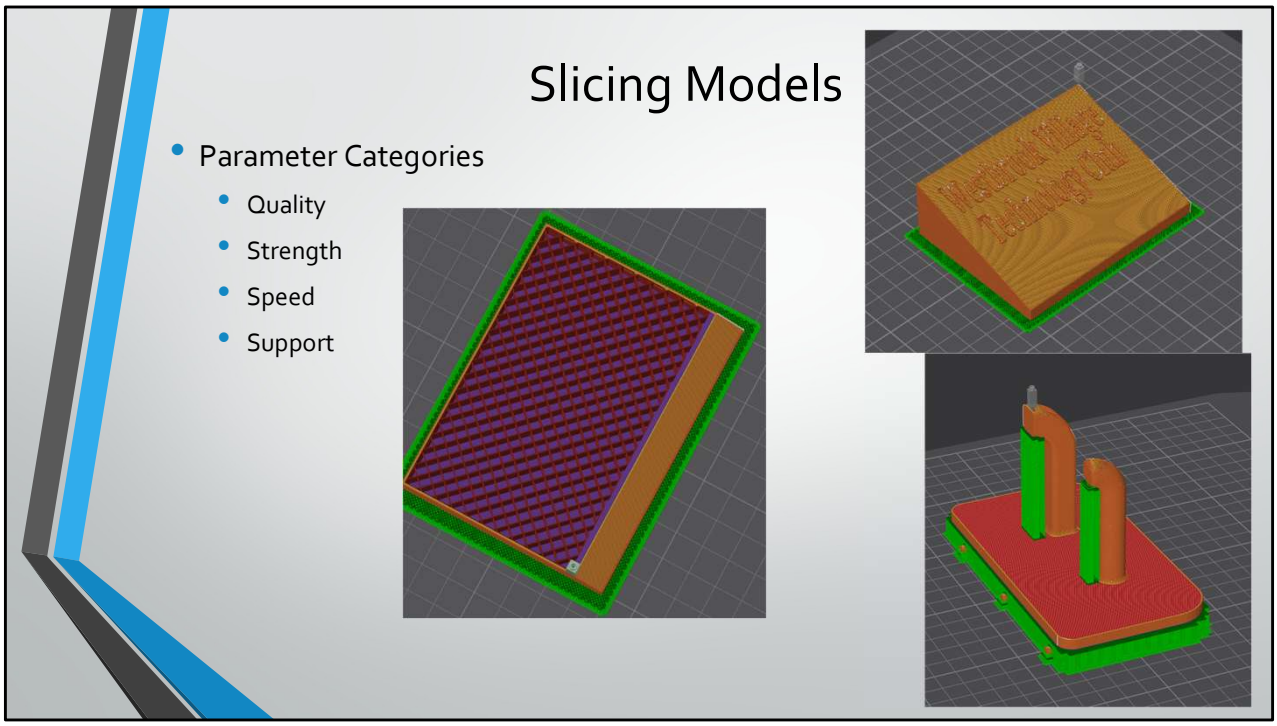


UltiMaker Cura (Best Overall/Most Popular): Widely regarded as the industry standard, Cura is free, open-source, and compatible with most FDM printers. It is known for its user-friendly interface, vast plugin marketplace, and excellent, regular updates.
PrusaSlicer (Best for Customization): Evolved from Slic3r, this open-source slicer is optimized for Prusa printers but supports a wide range of others. It is highly regarded for its speed, advanced features, and superior organic supports.
OrcaSlicer (Best for Advanced Users/Calibration): A powerful fork of Bambu Studio and PrusaSlicer, OrcaSlicer has gained massive popularity for its built-in calibration tools, multi-plate management, and support for Klipper firmware.
Bambu Studio (Best for Bambu Lab Printers): Specifically designed for Bambu Lab printers, this software offers an optimized experience, allowing users to control and monitor prints directly. It is a fork of PrusaSlicer and supports advanced features like multi-color printing.
Simplify3D (Best Premium/Professional): A paid ($199) slicer known for its speed, superior support generation, and ability to handle complex models. It is considered a robust choice for professional users, despite being a paid option in a market filled with free alternatives.
ideaMaker (Best for Raise3D/Versatility): Developed by Raise3D, this free, 64-bit

slicer is known for its fast slicing speed and advanced, customizable support structures.
Chitubox (Best for Resin/SLA): A dominant, free slicer for resin-based (SLA/DLP) 3D printers, it excels in hollowing, support generation, and model editing.
Slic3r (Best Open Source Pioneer): A pioneering, free, and open-source slicer that focuses on rapid G-code generation, honeycomb infill patterns, and high adaptability for expert users.
Lychee Slicer (Best Flexible/Resin & FDM): A popular choice that works with both resin and FDM printers, known for its user-friendly interface and advanced, automatic support generation, particularly in the Pro version.
OctoPrint (Best Remote Management): While technically a host system, OctoPrint features an integrated slicer (via CuraEngine) allowing for remote monitoring, control, and slicing directly via a web browser, often paired with a Raspberry Pi.

Slicing Models

- Slicing is converting the model into codes that get send to the printer to control printer movement.



Quality
- Layer Height
- Wall Thickness
- Overhangs

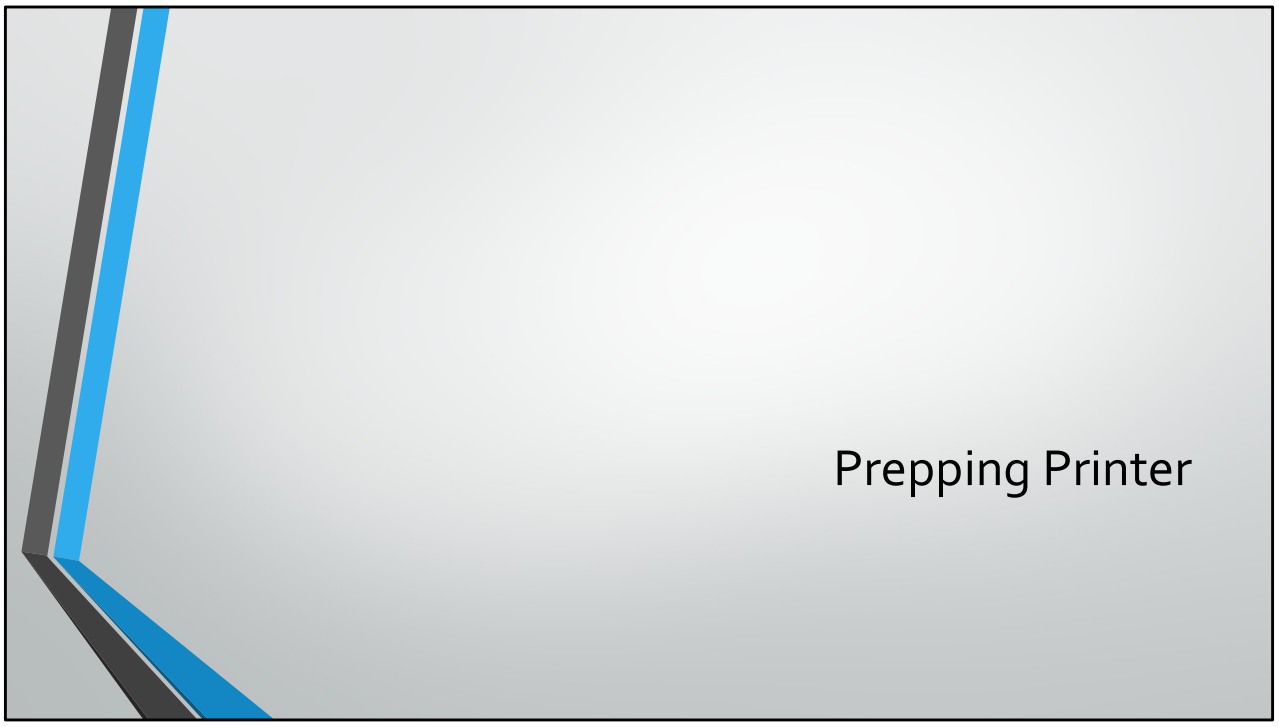
Strength
- Infill Percentage
- Infill Pattern

Speed
- Print head speed
- First layer, additional layers

Support
- Raft – Outline on bottom
- Type of Support

Slicing Models

- Demo in Creality Print software.

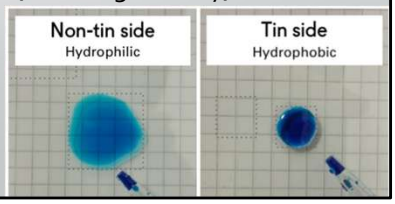


I am going to focus on FDM printing.

Prepping Printer

What is substrate that the model is build on?

- Glass/Borosilicate Glass: Popular for providing an extremely flat surface and good adhesion, especially when combined with hairspray, glue sticks, or specialized adhesives. (One side is the print side.)
- Aluminum: A standard, durable, and conductive material for heated beds.
- PEI (Polyetherimide): Highly regarded for holding plastic well at high temperatures and allowing prints to release easily upon cooling.
- BuildTak/Polymer Sheets: Generic, durable surfaces that offer superior adhesion for PLA and ABS.
- Painter's Tape (Blue Tape): Often used on cold beds for PLA, offering an easy, inexpensive, and removable surface.



Prepping Printer

Cleaning Substrate:

- **Glass – use solvent like Acetone**
- **Metal plate – Isopropyl Alcohol.**

Read your printers instructions!

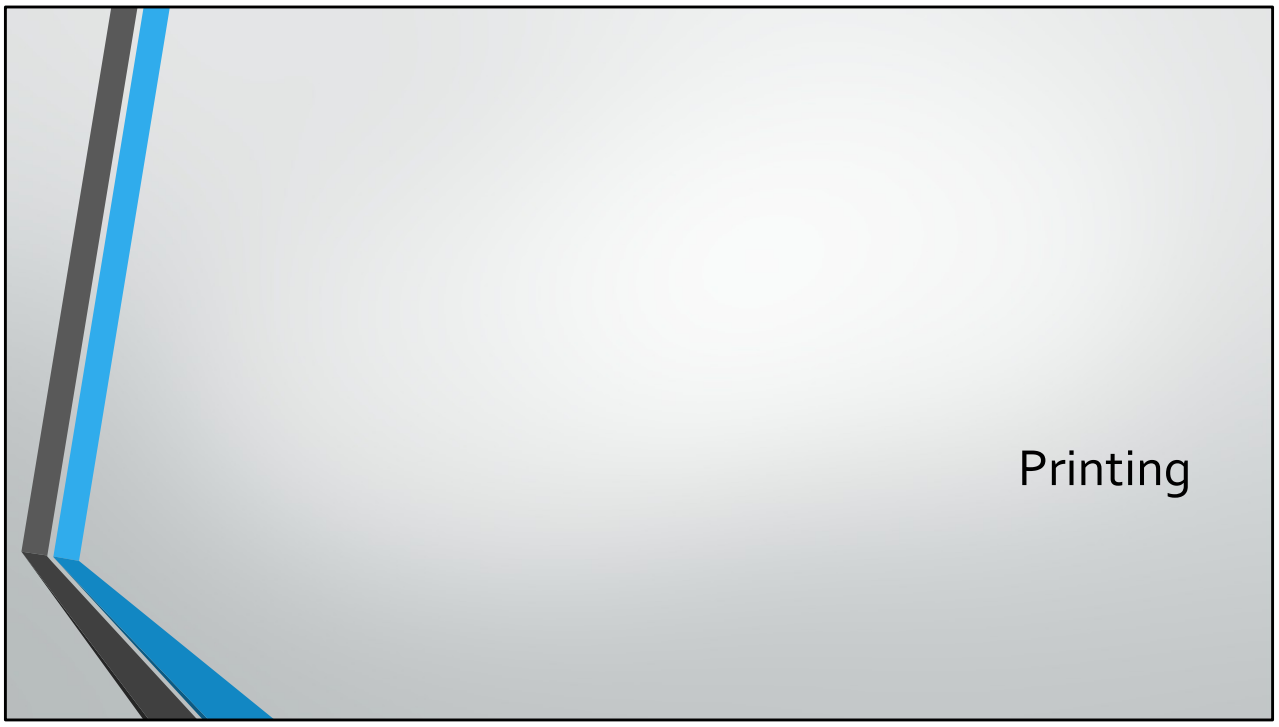
Prepping Printer

Adhesion Enhancers:

- **Glue Stick/Hairspray:** The most common adhesives for glass or PET beds.
- **PET/Kapton Tape:** Heat-resistant tape used for protecting beds and improving adhesion.
- **ABS Slurry:** A mixture of acetone and ABS plastic used to guarantee, for example, ABS prints stick to the bed.

Prepping Printer

- Critical Items
  - Make sure filament is not hung up.
  - Make sure you have enough filament.
  - Make sure build plate is clean.
  - Make sure you have used adhesion helper if necessary.



I am going to focus on FDM printing.

Printing

- Demo in Creality Print software.

Printing

- Remove Print from Printer

I am going to focus on FDM printing.

Finishing Models

- Remove excess (Raft, support, etc.)
- Can make smoother with solvent vapor
- Can glue parts together with solvent and resin or epoxy
- Inserts for screws