HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

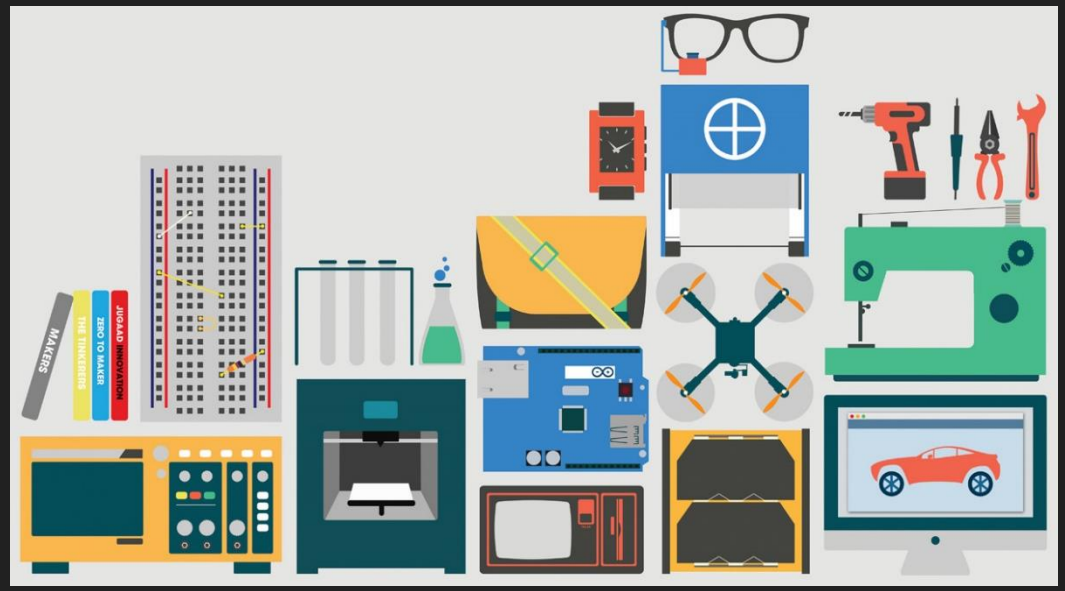
3D Printing Orientation

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

An Innovation Lab

- *Physical location that is stationary or mobile*
- Filled with resources that inspire from lab machines and tools to cardboard and duct tape.
- Facilitator who knows a little bit about everything in case they struggle with completing their ideas.
- Facilitator present that know how the resources in the innovation lab function to assist makers as needed.

****Safety precautions need to be taken for machinery and tool use.****



A maker mindset combined with an innovation lab and maker space community are integral parts of building a better world.

A Maker Space

- Space to gather as a community (physically and/or virtually) where you learn and grow together.
- Like-minded people sharing ideas and being inspired by others.
- Creates producers in a world of consumers.
- Creates an understanding of how technology and/or our world works.
- Facilitator is needed to create programming for the making area.

****It does not have to be limited to a room.****

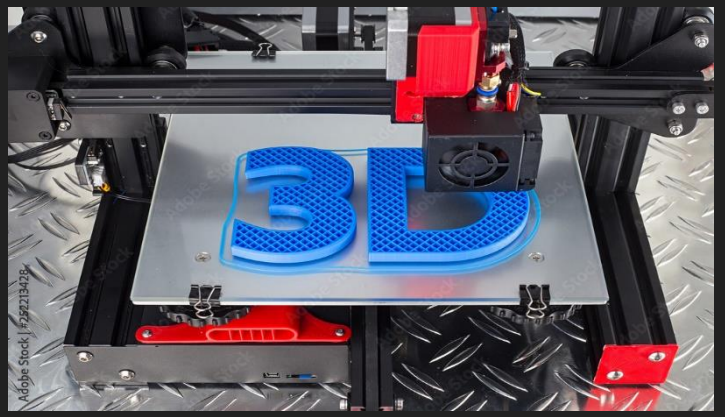
HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Patron Orientation

- Cover the entire two-part orientation with patrons
  - The Power point portion is the first part
  - A hands-on portion should follow as the second part (software, hardware or both)
  - (Encouraged but not required) Small HCPL 3D printed, laser cut/engraved swag for each patron to take is a kind gesture as well as a great word of mouth marketing tool
- Patrons may receive $1 off of their first 3D print (initial 10 grams of the final weight)
  - This is a one time only discount and must be used in one visit (even if final print us less than 10 grams).
  - Staff can use the internal notes feature of LibCal to document patron receipt of credit
- Patron inquiries about staff presence
  - Staff will assist/oversee patrons for initial 3D print job start. Patrons do not have to stay for the entire time.
  - Staff and patrons must be present for entire Laser Cutter or CNC reservations
- Patron inquiries about filament
  - 3D Printing is 10 cents a gram for the final project weight to cover the cost of filament that HCPL will purchase
  - Patrons may not bring their own filament nor request special filament colors/types

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

3D Printing at the Library



KEY POINTS:

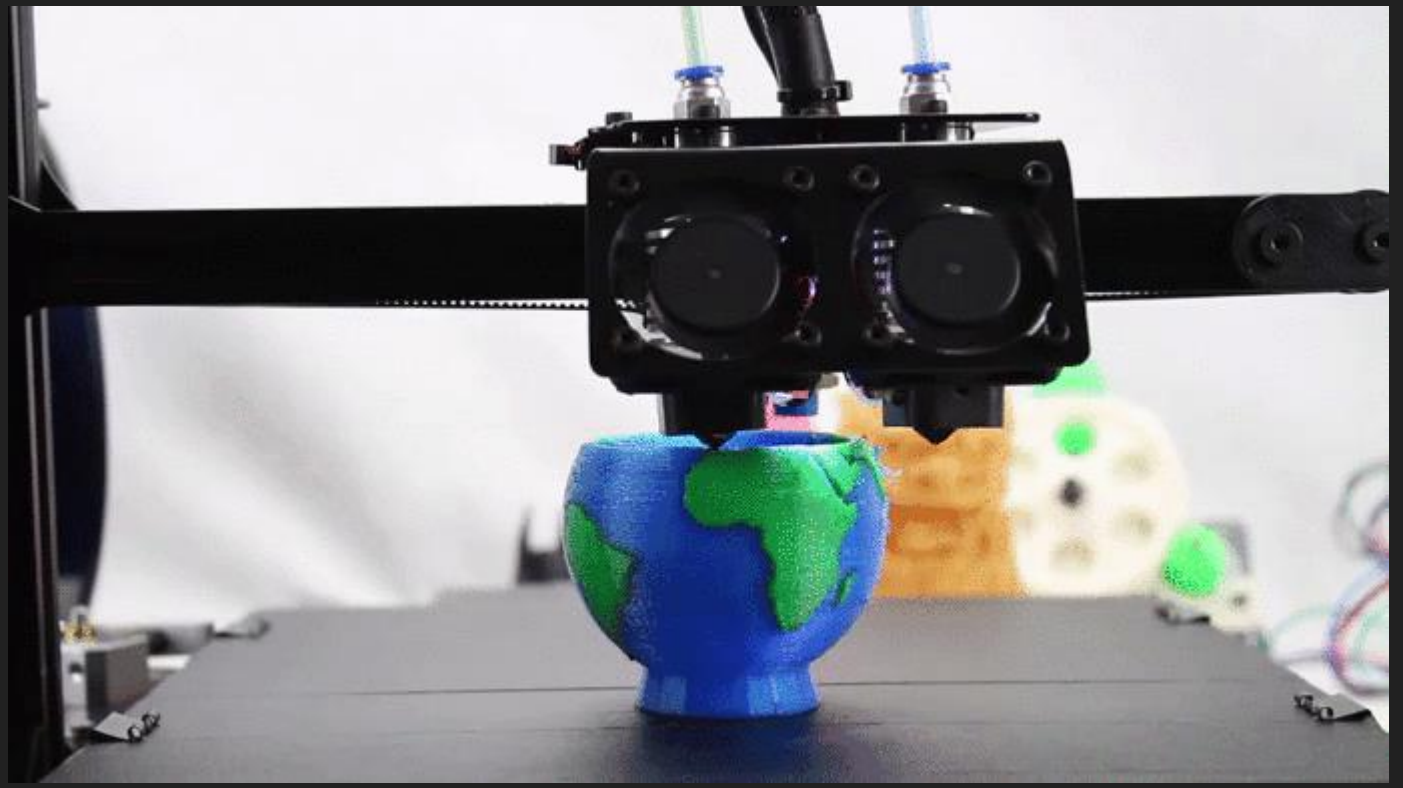
- Customers need to be present to prepare and initiate the 3D prints.
- 10 cents per gram is collected to reimburse the cost of filament.
- Items not claimed within 7 days may be discarded.
- Customers under age 12 must be accompanied by an adult guardian.
- Illegal, inappropriate items, or items which would violate copyright laws are not permitted.

The complete policy can be found at: https://www.hcpl.net/services/library-use-policies#MakerMachineUsePolicy

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

3D Printing at the Library

- **3D Printing** is about utilizing a printer that builds a part or an object from the ground up, one layer at a time.
- To understand 3D Printing and how it works, first we need to learn about the 3D Printer:
  - 3D Printers come in all different shapes and sizes.
  - Each 3D Printer has the same key components that make it work properly.
  - Each printer is unique in the types of material that it can produce.



HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

3D Printing at the Library

Print Display - shows the functions such as time to print and fill rate.

Extruder - heats up the material so it is soft and sticky and pushes it out a nozzle to create the part.

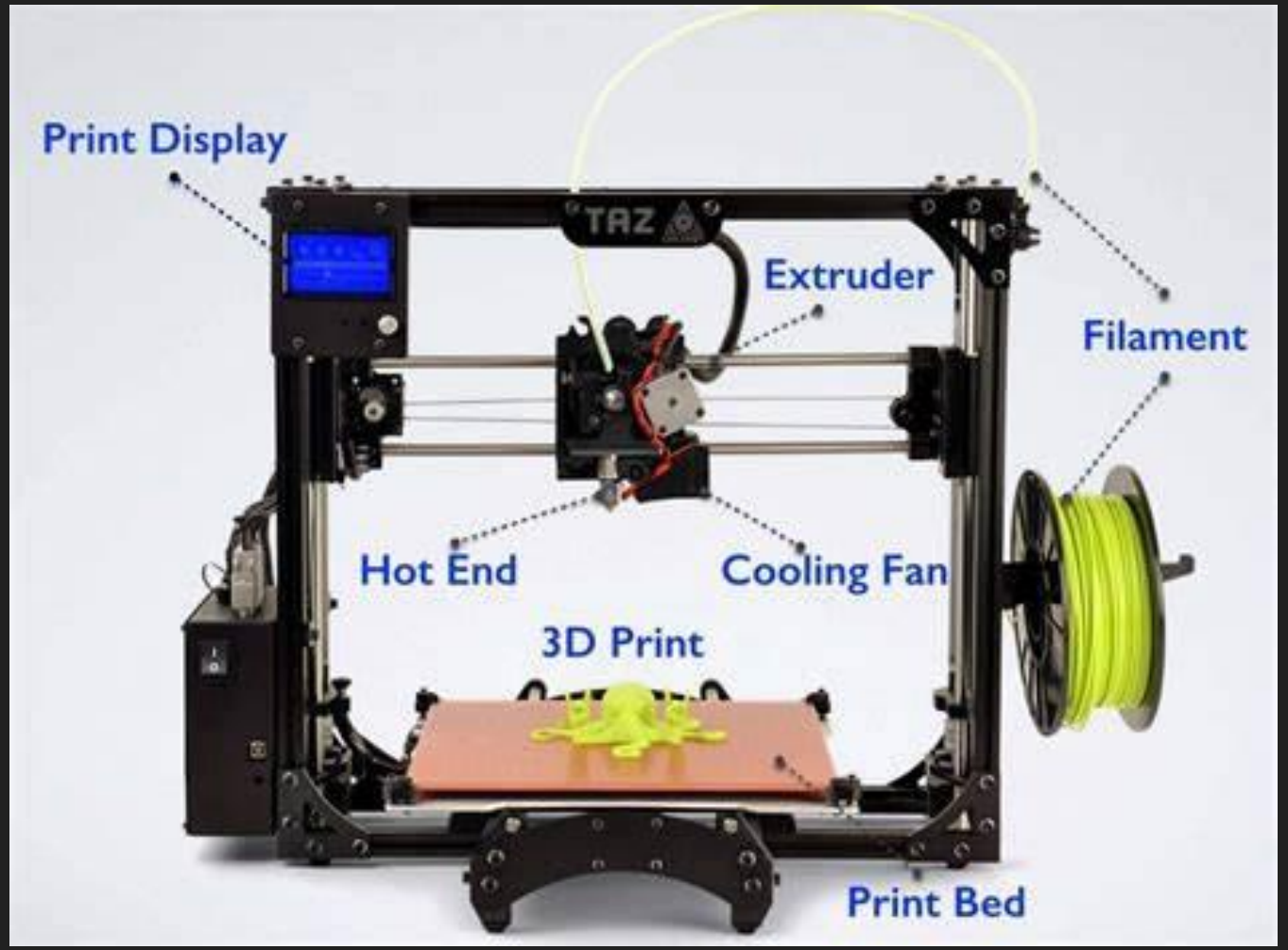
Filament - is the material that is used to create the part. Usually, the part is made from different kinds of plastic such as PLA, ABS, PETG, Carbon Fiber or Nylon

Hot End - Tip of the extruder where hot material comes out.

Cooling Fan - Fan near the extruder that cools the material as it comes out of the hot end.

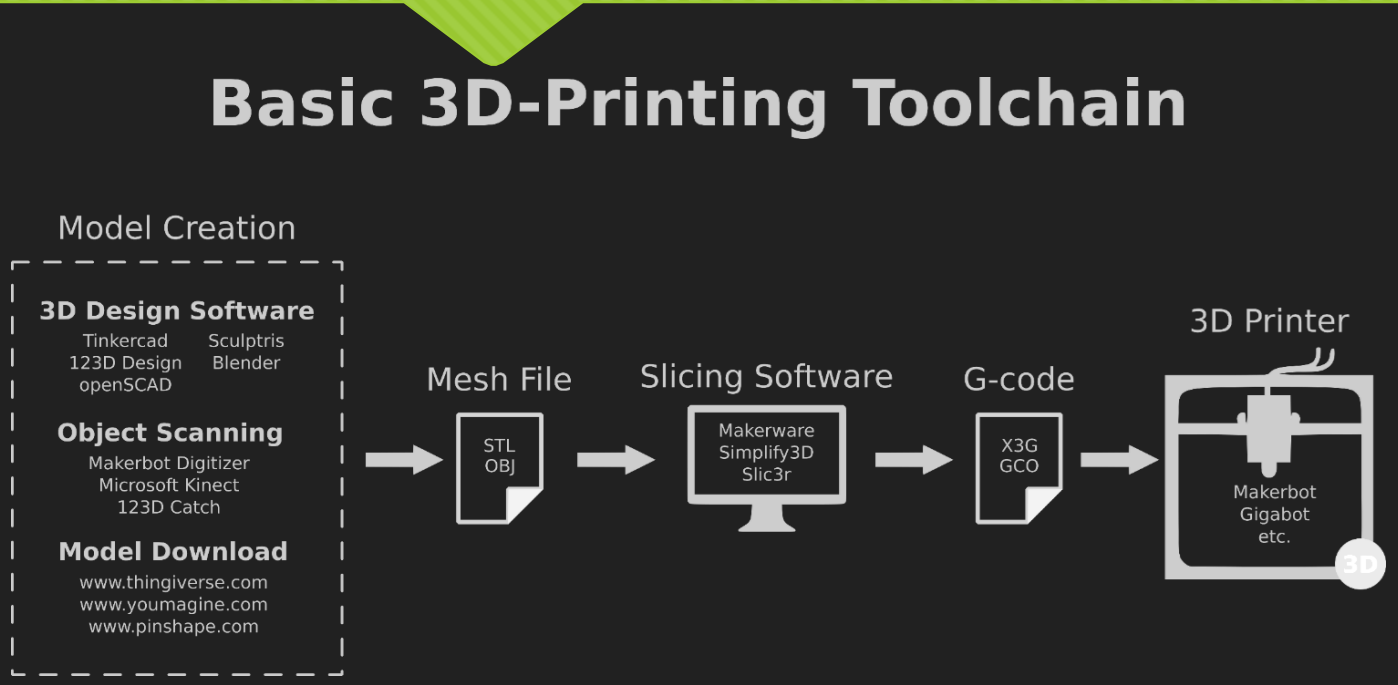
Build Volume - the three-dimensional space in which the part can be created.

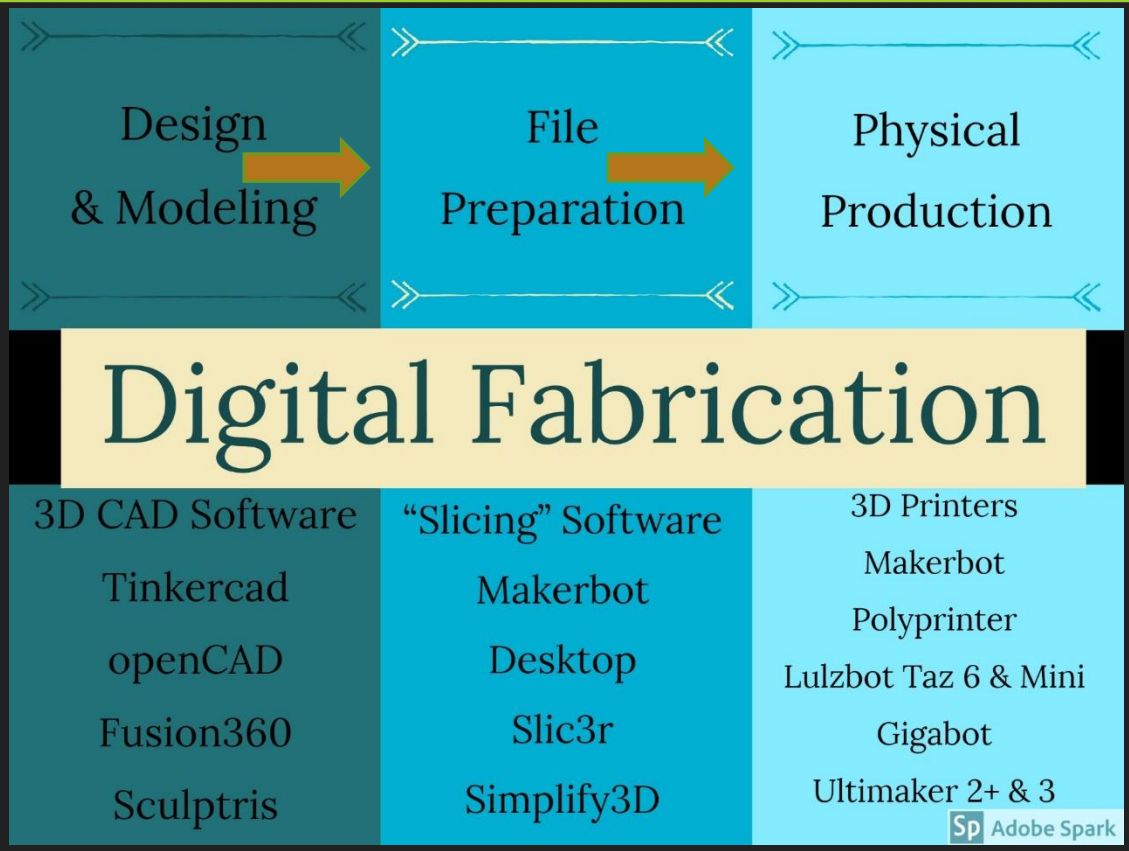
Print Bed - base in which the part is built upon.



HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Digital Fabrication





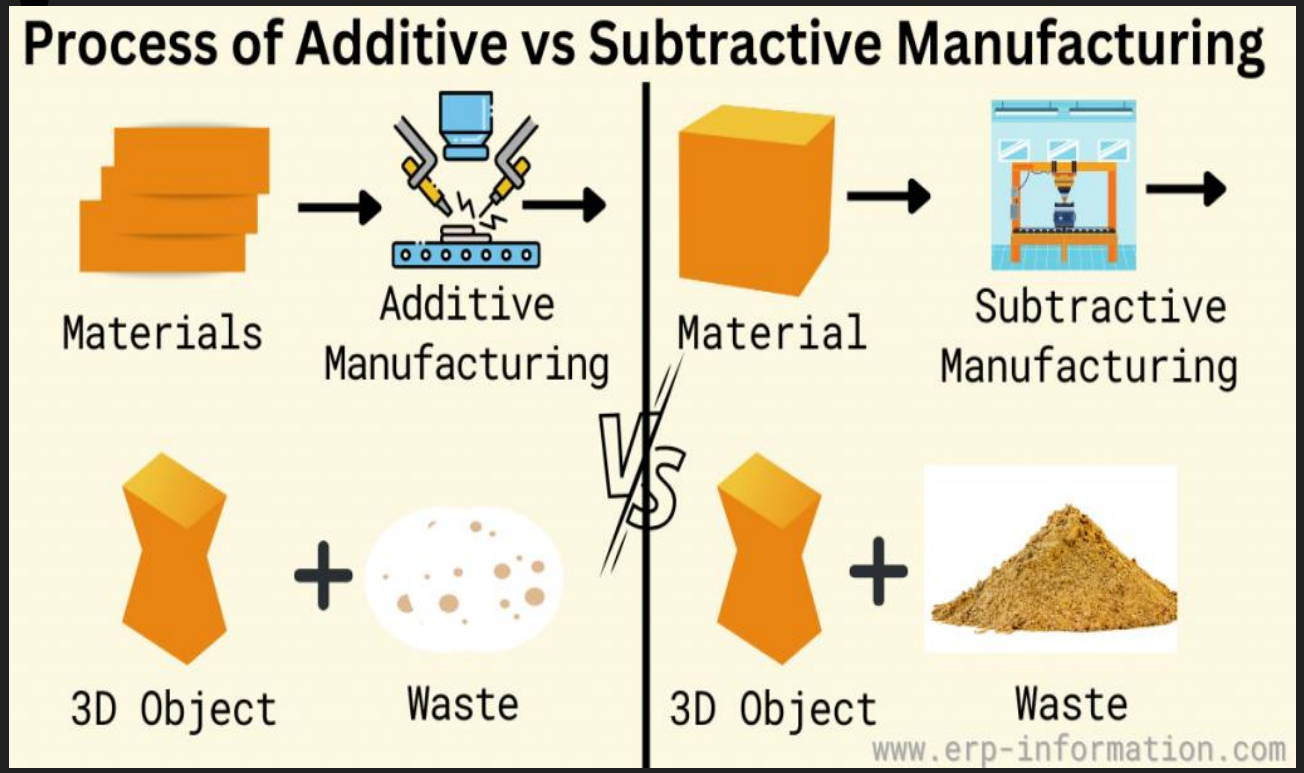
- **Digital fabrication** is a manufacturing process where the tools/machines are controlled by a computer.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Understanding 3D Printing

3D printing, also known as **additive manufacturing**, is a method of creating a three dimensional object layer-by-layer using a computer created design.

3D printing is an additive process where layers of material are built up to create a 3D part. This is the opposite of subtractive manufacturing processes, where a final design is cut from a larger block of material. As a result, 3D printing creates less material wastage.



HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Understanding 3D Printing

Regardless of the process used, the idea behind the creation of objects using 3D printing technology remains the same. You start from the production of a 3D model using computer-aided design (CAD) software to the setting up of the machine. However, the actual process used to create the physical object varies.

There are 3 main types of 3D printing processes that you are likely to encounter, and they are as follows:

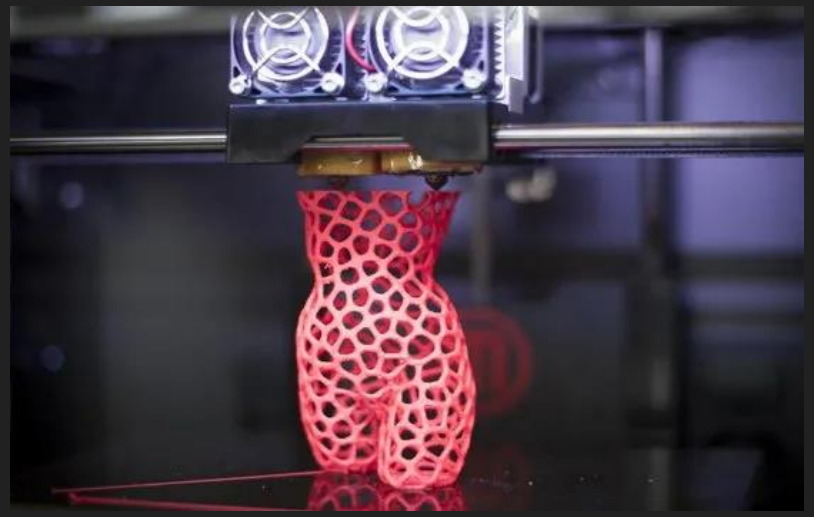
- Stereolithography (SLA)
- Selective Laser Sintering (SLS)
- Fused Deposition Modeling (FDM)

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Understanding 3D Printing

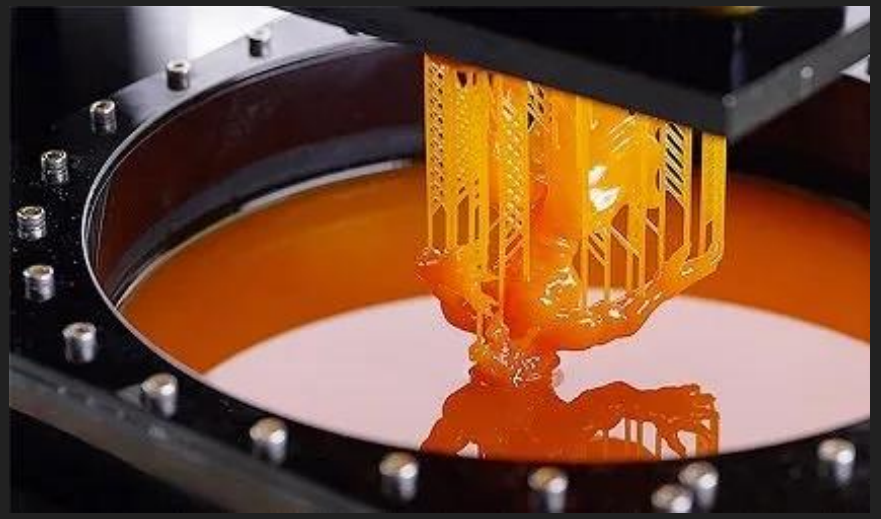
FDM

It is the most reliable and user-friendly method and the based on the fairly straightforward concept. In this, the production material that is used, often different types of plastics are fed through the heated printer nozzle by using a spool.



SLA

The working of SLA is totally opposite of FDM. There is a tank of photopolymer resin comprising of liquid plastic, which is sensitive to the UV light. By using the ultraviolet laser, the process of printing can easily be controlled and strikes the top layer of liquid resin. That causes curing of liquid into the solid layer.



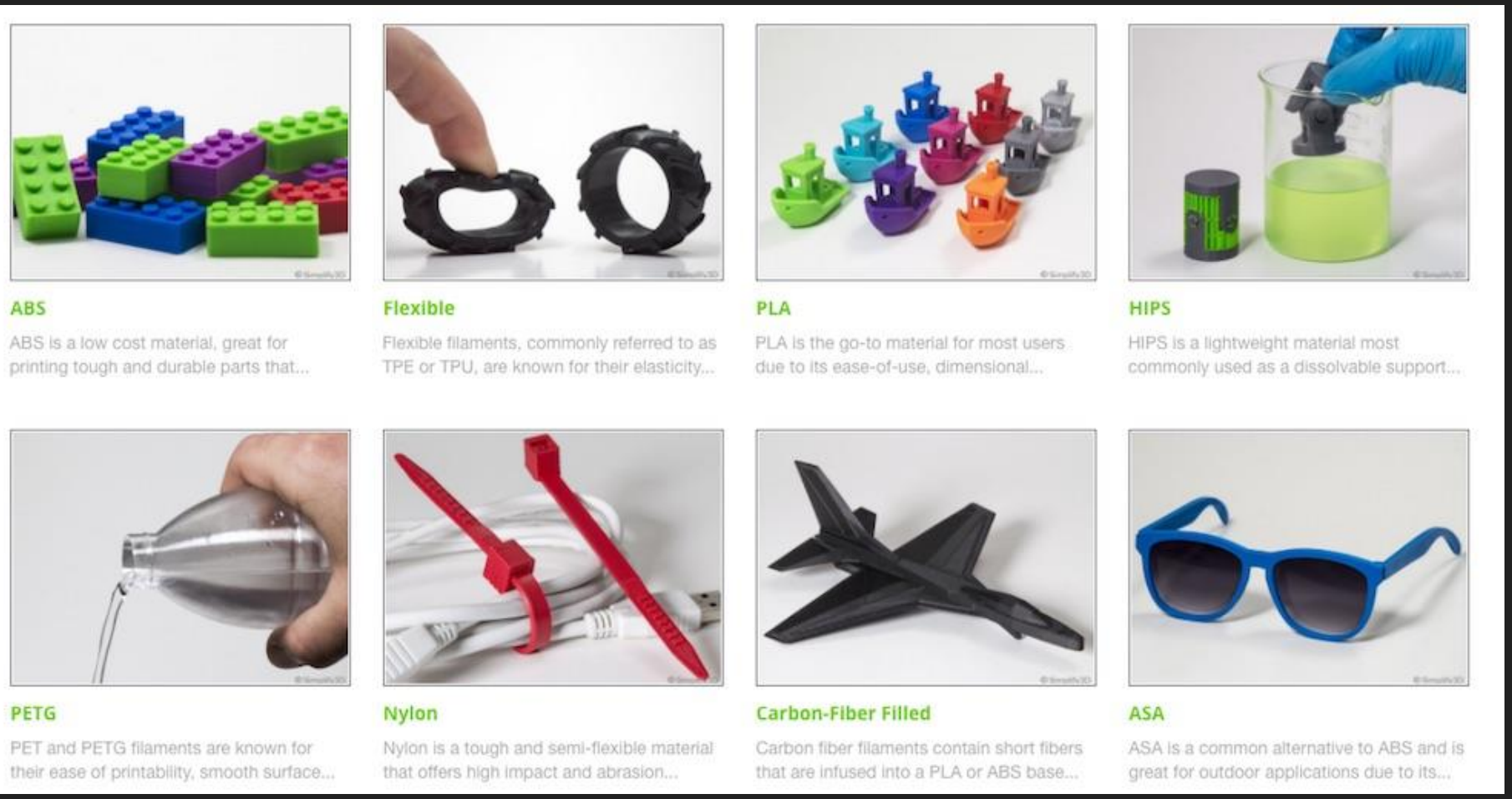
SLS

SLS 3D printing makes use of powdered materials in order to create different printing objects as compared to the FDM and SLA printing. SLS printers also work on the laser technology in order to facilitate the printing process. In this process, the powdered material is heated to the temperature, which is above or below the material's melting point.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Printable Materials: Filaments

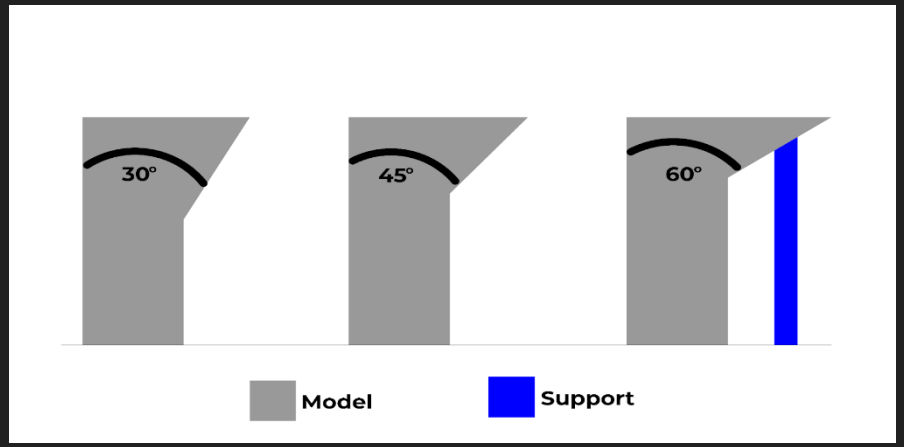
Some of the most common filament types that can be found at HCPL are listed here. Check with your branch and/or maker specialist first. For more information about the different types of filament & their practical usage visit: Filament Guide or scan the QR code!

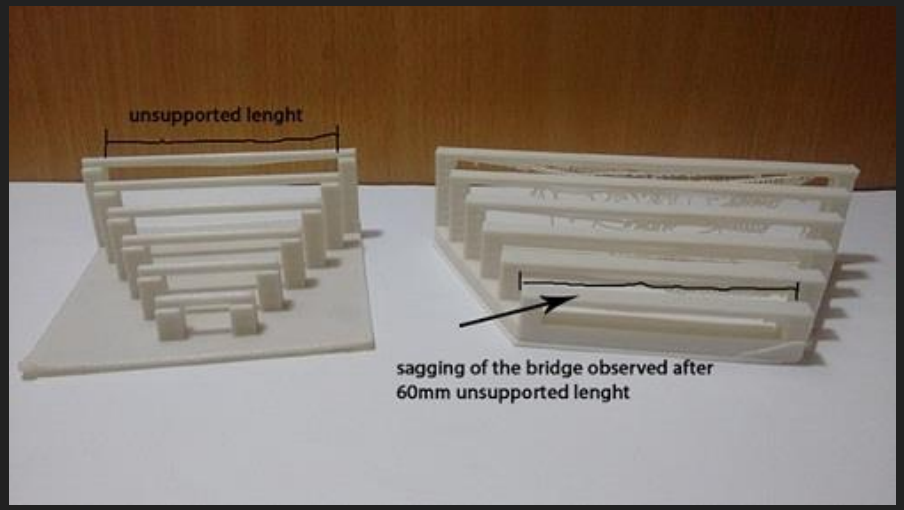


HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

3D Printing Design: Basic Considerations

- Should have a flat surface to go on print bed
- "Overhangs" should be less than 45° from vertical
- "Bridges" should be less than 25 mm
- Walls and fine details should be 1 mm or larger





HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

AutoCAD tools: Tinkercad Keychains

www.tinkercad.com

Tinkercad is just one of many freely available 3D CAD tools. Here is a video of designing your very own personalized keychain for printing!

FreeCAD

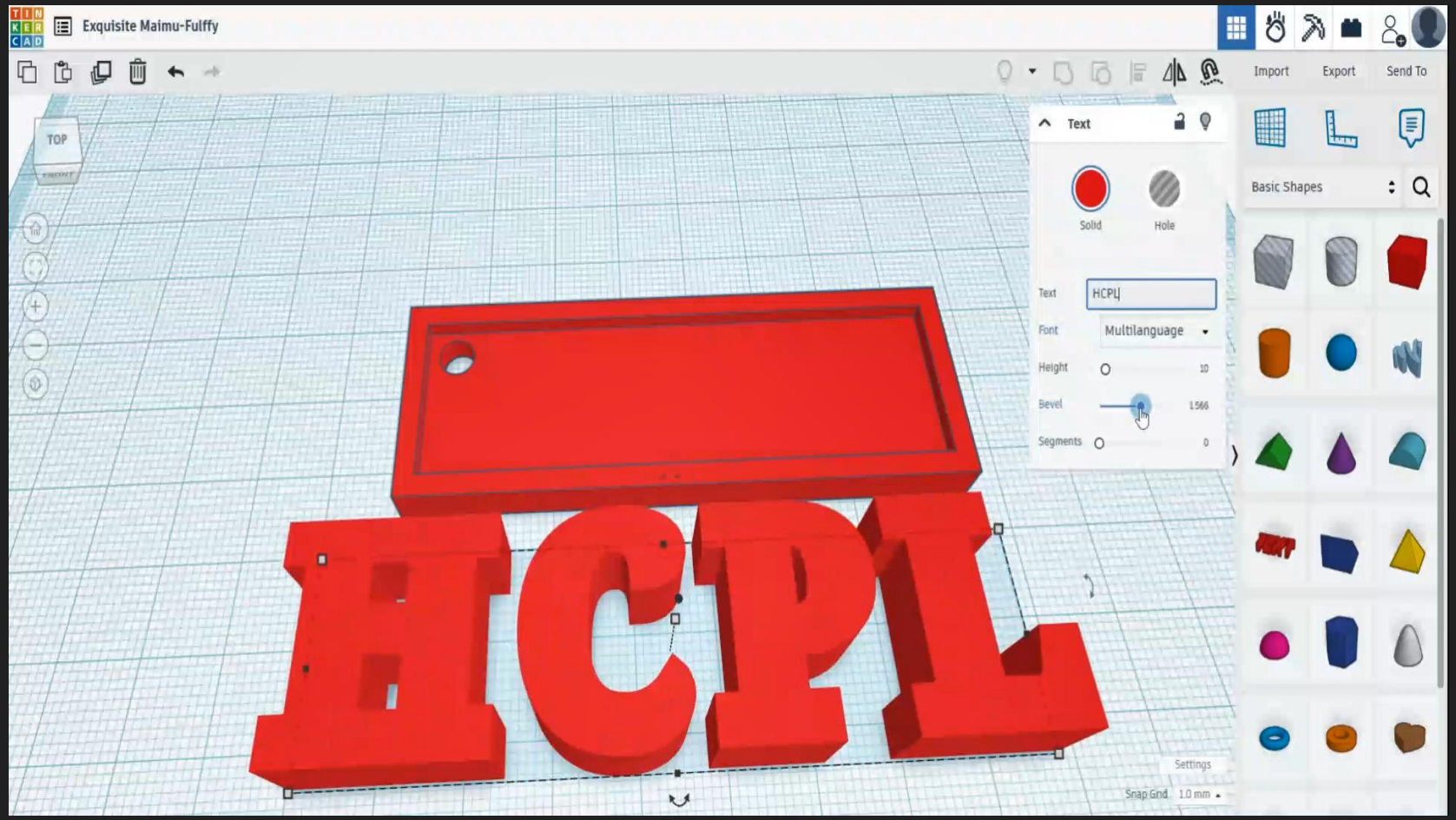
openSCAD

Fusion 360

Sculptris

OnShape

CAD: Computer-Aided Design



HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

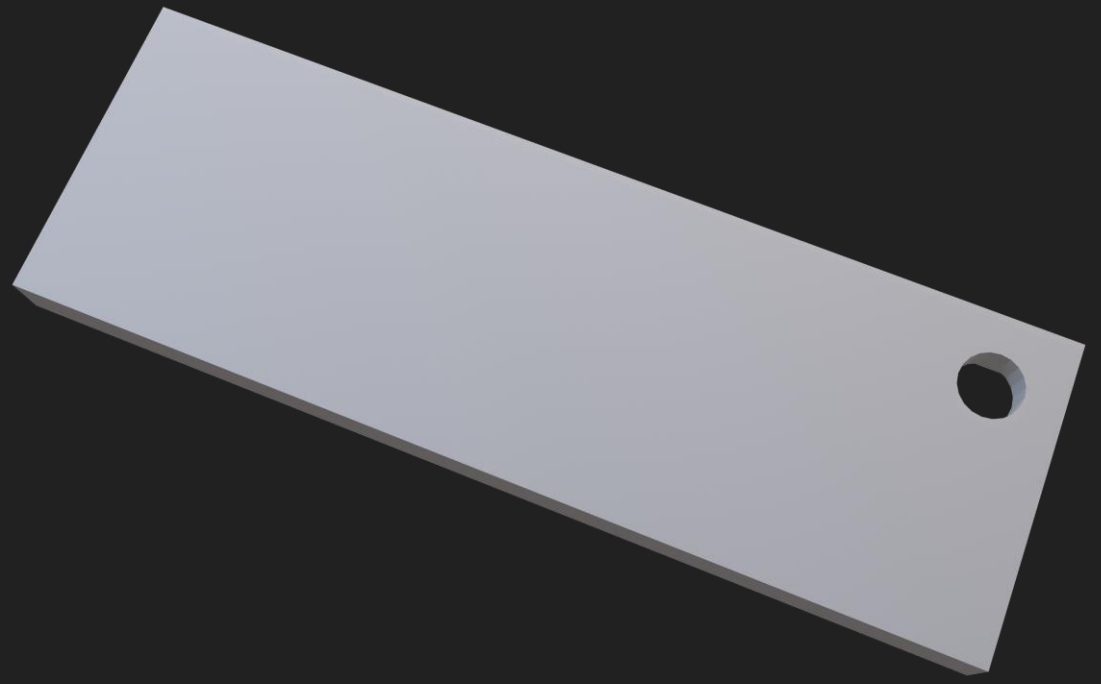
Fused Filament Fabrication (FFF)
Fused Deposition Manufacturing (FDM)

Fused filament fabrication (FFF), also known as fused deposition manufacturing (with the trademarked acronym FDM), is a 3D printing process that uses a continuous filament of a thermoplastic material.[1] Filament is fed from a large spool through a moving, heated printer extruder head, and is deposited on the growing work. The print head is moved under computer control to define the printed shape.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Fused Filament Fabrication (FFF)
Fused Deposition Manufacturing (FDM)

Once a model has been created in a CAD program it can be used numerous ways such as 3D printing, 3D Modeling, Laser cutting, & More!



HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Fused Filament Fabrication (FFF)
Fused Deposition Manufacturing (FDM)

Look at how I can manipulate my model that I just designed in Tinkercad by importing it into my PowerPoint. This helps with presentations and prototyping by actually showing a 3D representation of my design.

HARRISCOUNTY PUBLICLIBRARY
your pathway to knowledge

File Preparation (Slicing)

ideaMaker
Free to download software that can be used to find and download a variety of slicing templates from the ideaMaker Library. It contains slicing files that are created for different filaments and printers for use with ideaMaker without struggling with calibration.

KISSlicer is a powerful, easy-to-use, and fast cross-platform app that slices. STL files into printer-ready G-code files. Keep It Simple Slicer.

Free to download software that can be used for many 3D printers. It is recommended for 3D printing experts and pros. Newcomers may find the software intimidating due to "feature overload".

Free to download software that can be used for the Lulzbot, Dremel Digilab, Monoprice as well as the Ultimaker printers.

Commercial ($$) software that works for most 3D printers.

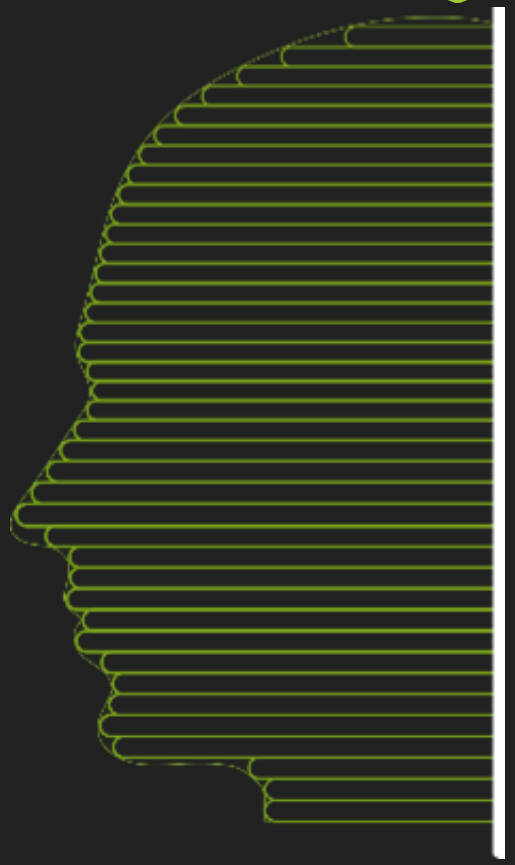
**NOT EVERY SLICING SOFTWARE GIVES THE SAME FINISHED PRODUCT.
(even those that have Cura as their base)**

Free to download software but it only works for Makerbot printers.

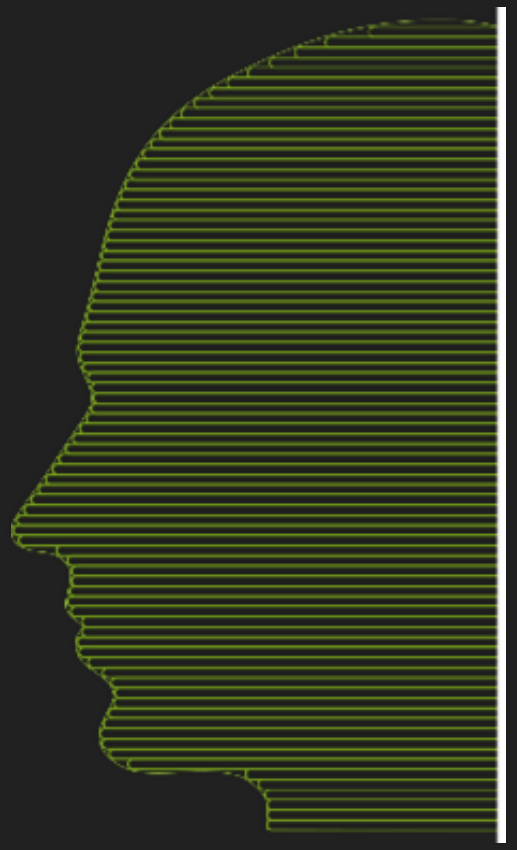
An open-source, feature-rich, frequently updated tool that contains everything you need to export the perfect print files for your 3D printer. Only Prusa printers receive auto-update features and additional profiles.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Slicing: Layer Height (Resolution)



"Low Resolution"
thick layers



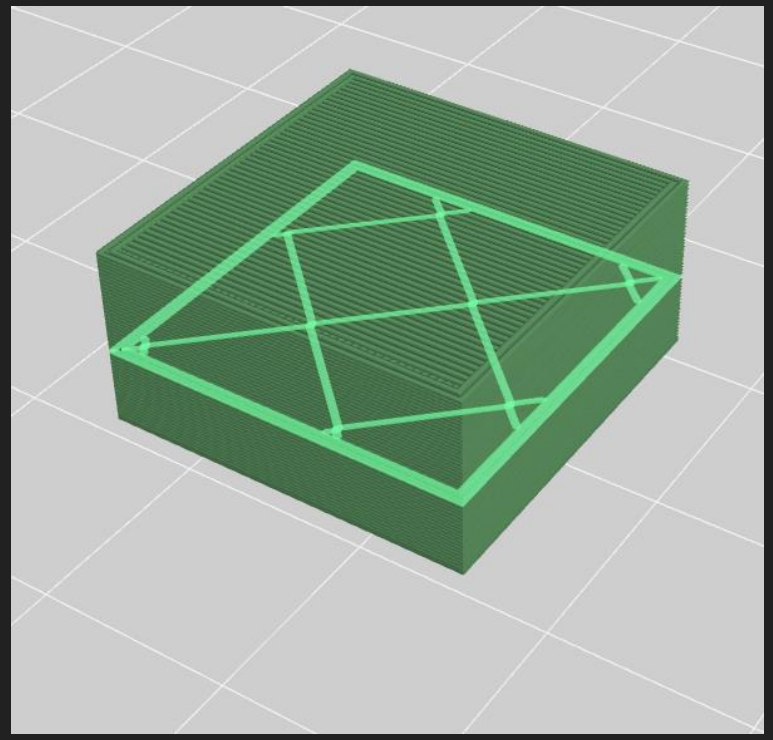
"High Resolution"
thin layers

Layer height primarily affects surface finish, object detail and print times.

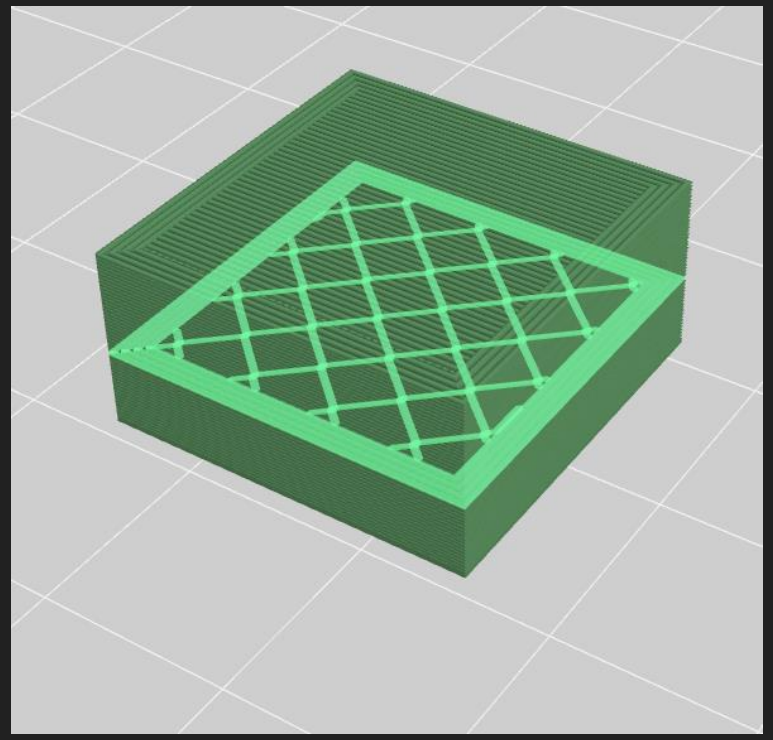
In the slicing software you generally start by choosing the High Detail, Standard or High Speed print setting.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Slicing: Infill and Shell Thickness



10% Infill, 2 Shells

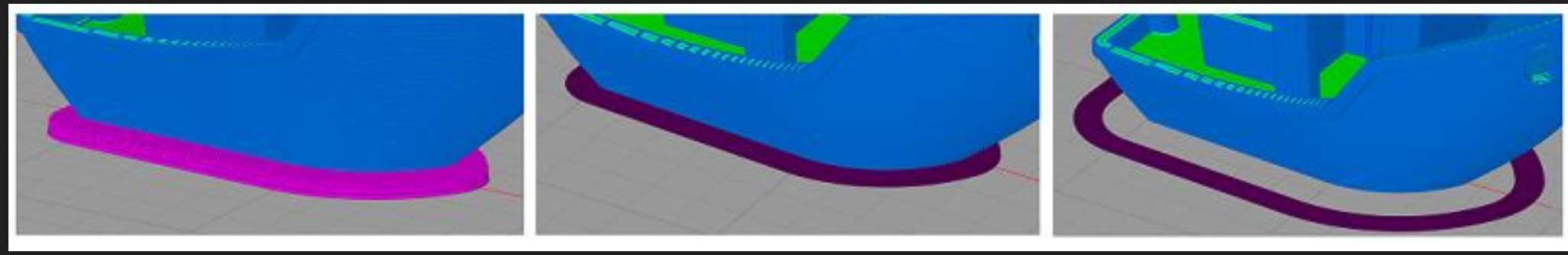


25% Infill, 4 Shells

Infill patterns and percentages can be adjusted in a slicer program. The more infill you use, the more durable your object will be but it will also increase the amount of time it takes the object to print. Most Slicers default at 15% which is decent depending on the size of your object. Always check this setting first before printing.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Slicing:
Comparing types of bed adhesion



Raft

Brim

Skirt

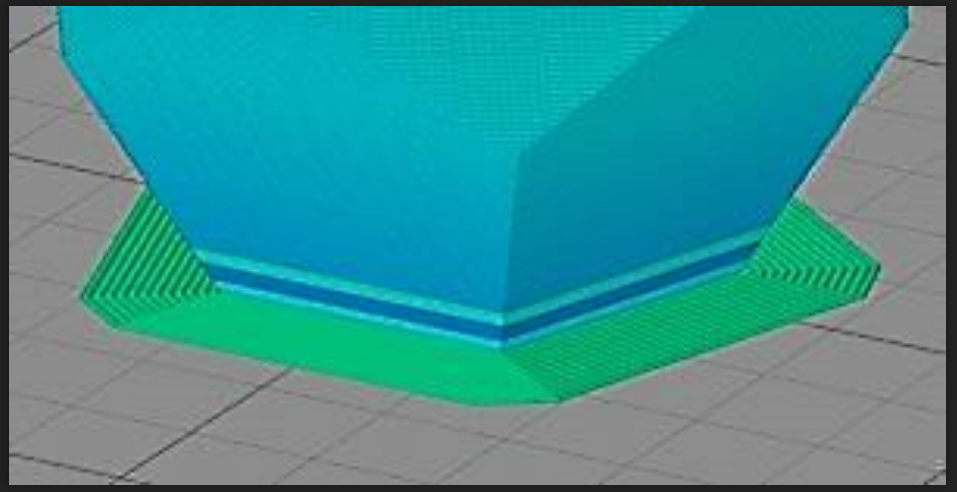
Bed adhesion is a major part of obtaining the best finished printed product. Sometimes some assistance may be needed, especially with larger objects. Here are a few tools that can be added in the slicer to assist with adhesion.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Adhesion improvement: using a Brim

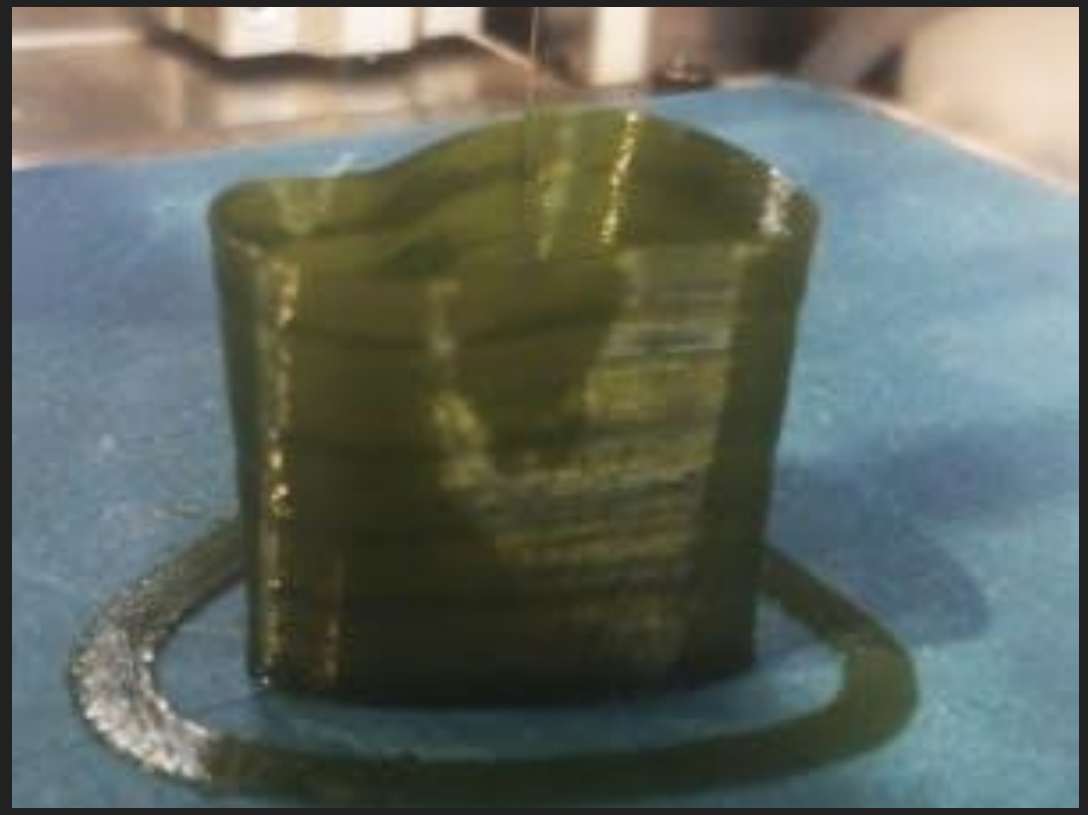
A very thin layer attached to the build plate then the 3D printed object only at the perimeter of the base.

It does not touch under the object.

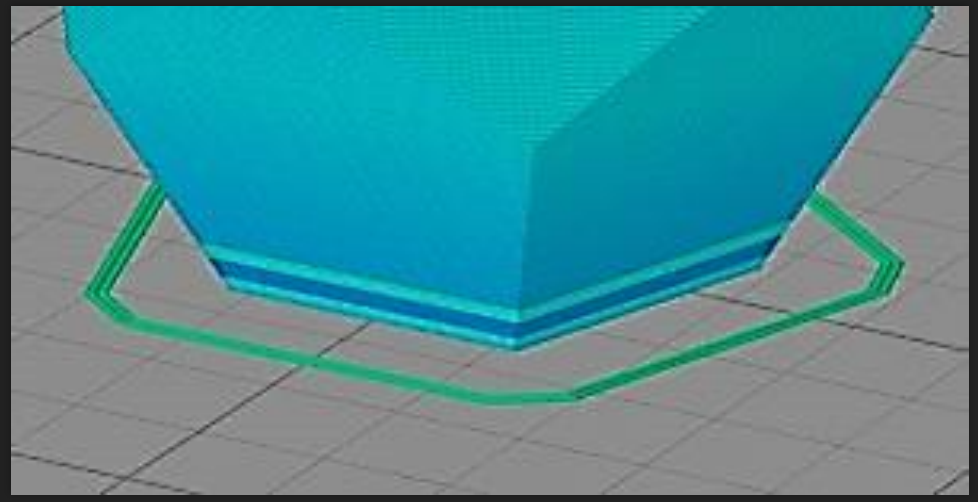


HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Adhesion improvement: using the Skirt



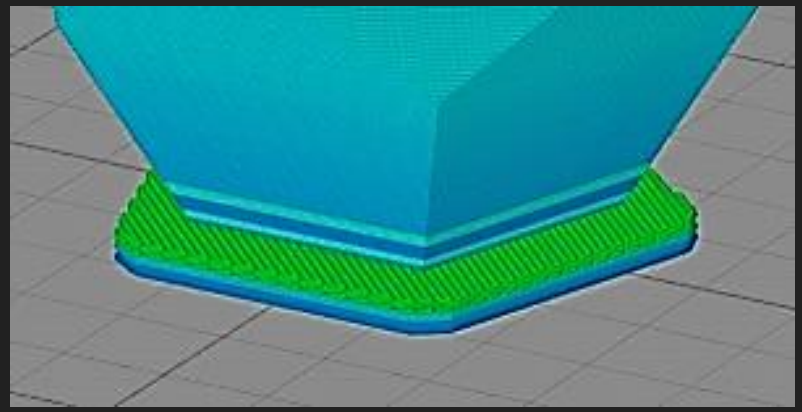
Does not attach to the 3D printed object at all and prints a couple of layers around its perimeter.

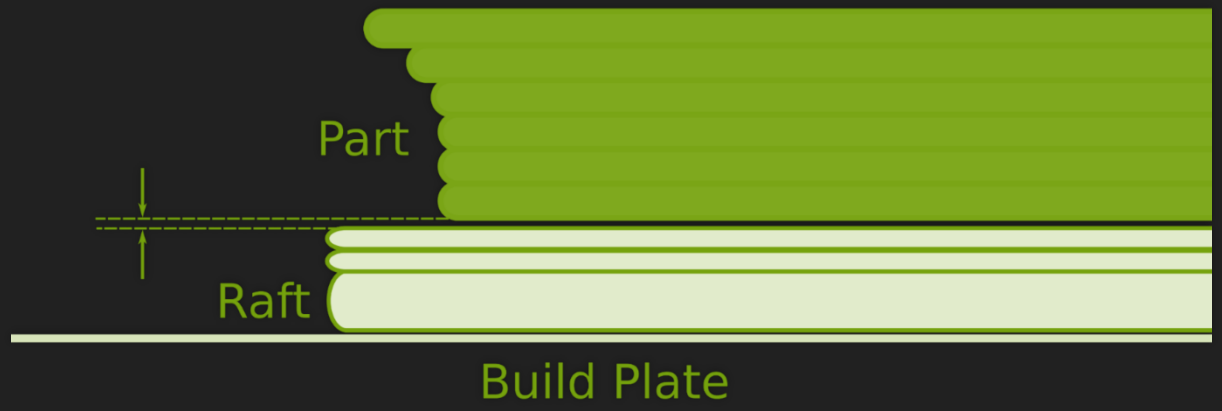


HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Adhesion improvement: using the Raft

A temporary base structure that attaches to the build plate. Layers, infill percentage and specific distance away from the sides of the object are predefined in the software.



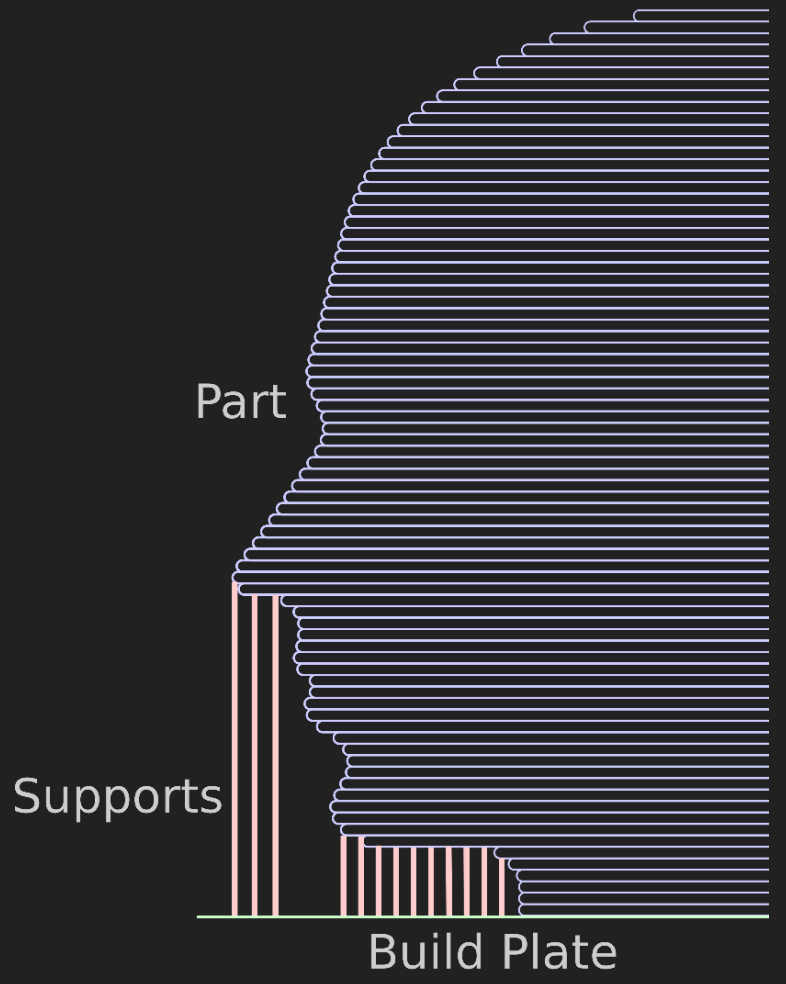


The final object is printed on top of a completed raft. The finished print will have the raft attached to the project and require careful removal.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Slicing: Supports

A support structure is the added part that supports an overhang or bridge when slicing the model, which needs to be removed after printing.



HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Model & Design: Downloads

www.thingiverse.com

Repository of user-created 3D models

There are many free online resources

PRINTABLES.COM

YOUMAGINE.COM

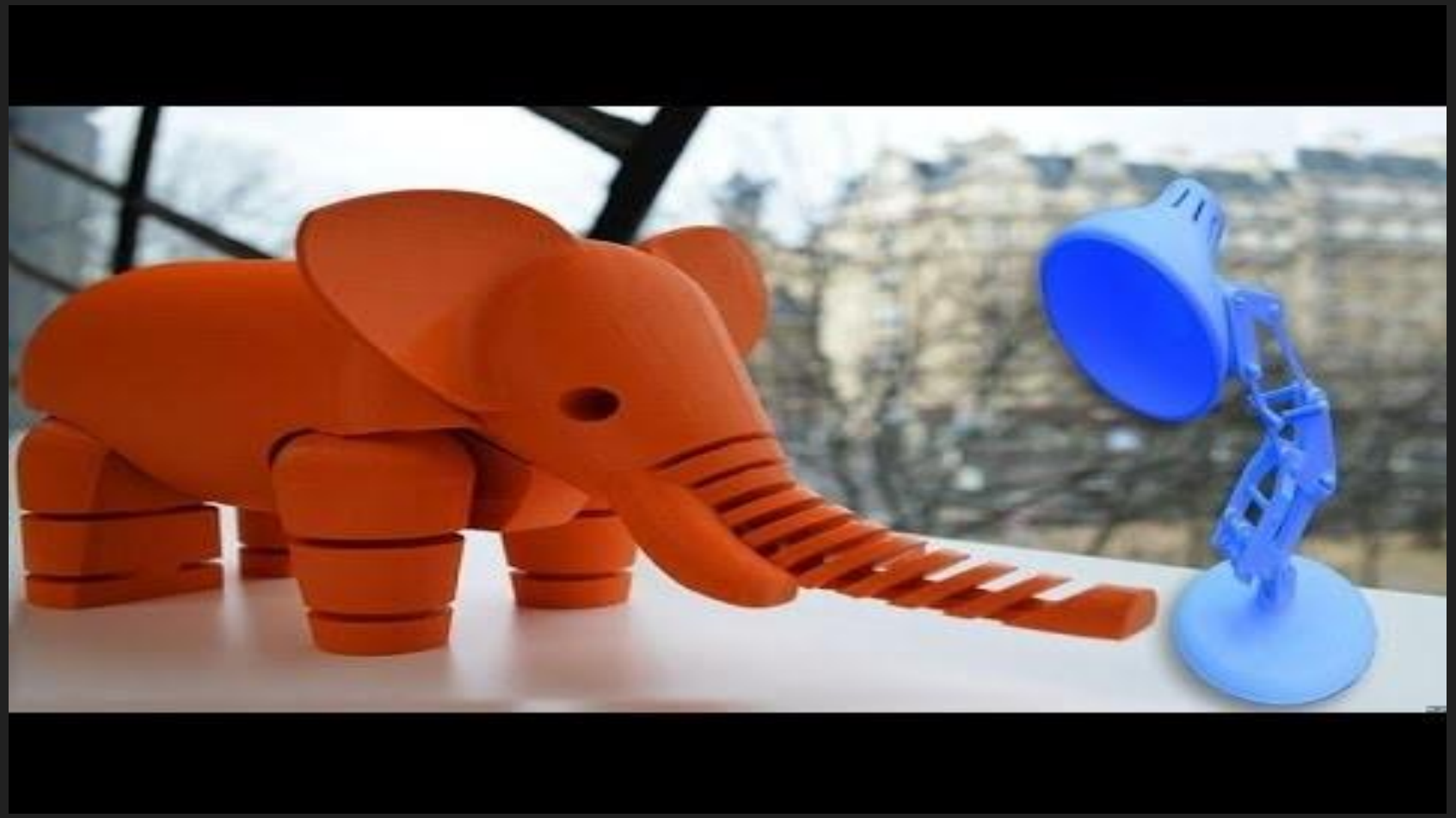
GRABCAD.COM/LIBRARY

CREALITYCLOUD.COM

PINSHAPE.COM

MYMINIFACTORY.COM

BUT NOT EVERYTHING IS "PRINTABLE"



HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Benefits of 3D Printing

- **Rapid prototyping:** 3D printing allows you to upload complex designs from a CAD model and print them within hours.
- **Cost efficiency:** A small, low-complexity 3D print may only cost $0.50, while a large, high-complexity print may cost around $400.
- **Design flexibility:** 3D printing allows for parts with complex shapes, which would otherwise be impossible to produce.
- **Improved quality:** The manufacturing process eliminates occasional human error.
- **Quick printing:** Garments can be printed in under 24 hours.

HARRISCOUNTY PUBLICLIBRARY
your pathway to knowledge

Sign up for Maker Central

hcpl.beanstack.org

It is required that you enroll in the Maker Central Challenge to learn about maker machines, how to use them, and book them for your use.

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

maker central @hcpl

Earning Your Badge

- Access the "Maker Central Challenge" (available from **hcpl.beanstack.org**)
- Create an "Individual" account
  - You don't need to sign up if you already have a Beanstack account for the Summer Reading Program
- After signing in you may enroll in the Maker Central Challenge if it is not already checked.
- Staff will register your orientation completion in the Beanstack system within 2 business days
  - You will receive a confirmation email for receipt of your badge
  - After being badged just click on the rewards tab to access the 3D printer reservation form.
- Earn a $1 credit for 3D printing after obtaining your **first** 3D-printing badge!
- Upon completion of the full orientation, you may earn additional printer specific 3D-printing badges. Utilize other 3D printer models by simply scheduling the machine at that branch. (Retaking the full orientation class is not required.)
- Enjoy the perks of being a badged HCPL Maker!

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Public Display

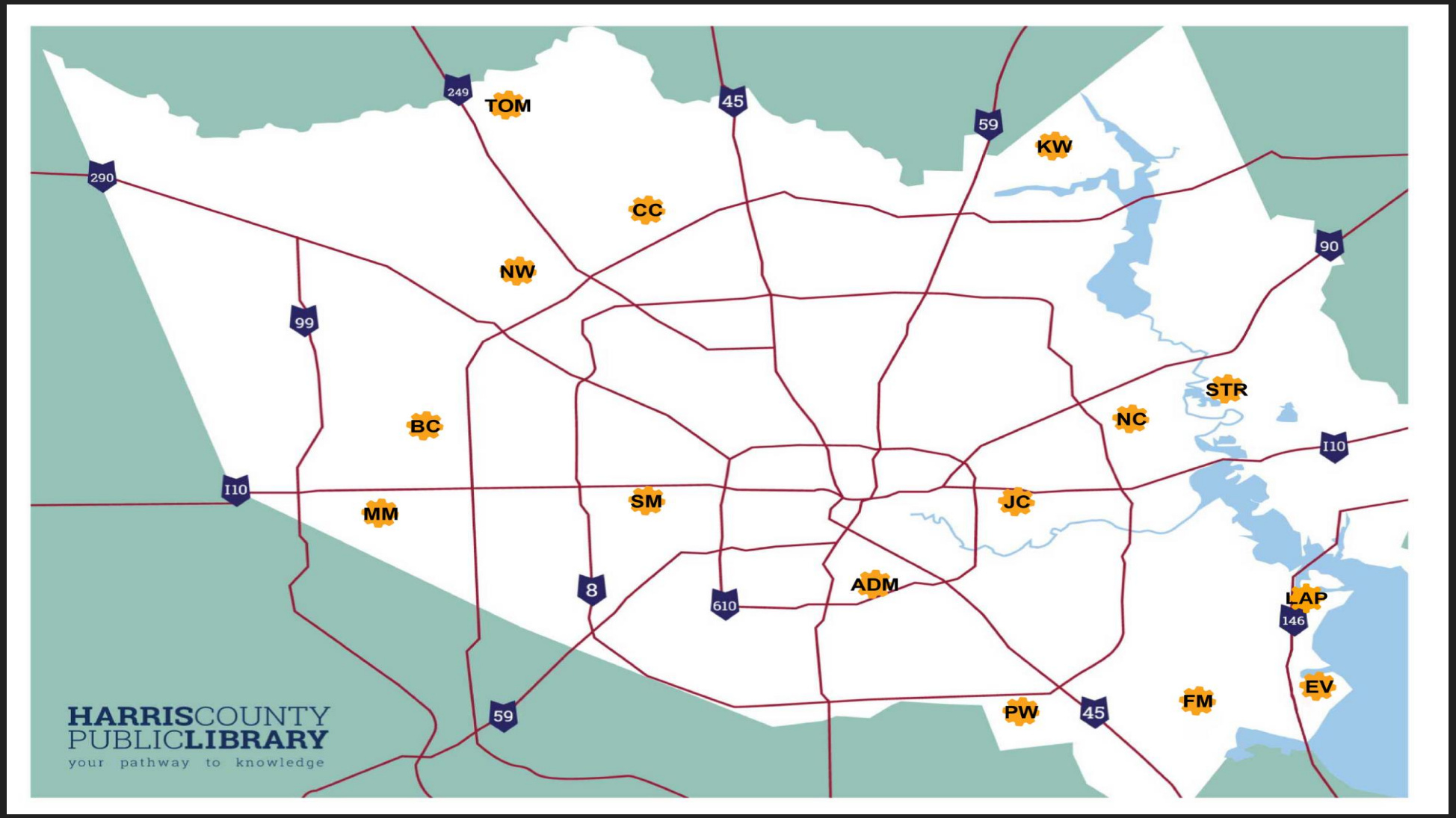
maker central @hcpl




Follow us on social media platforms @HarrisCountypl & use the hashtag #HCPLmadeit

We would love to display what you have created in our libraries for others to see!

Digital Fabrication Opportunities @ HCPL



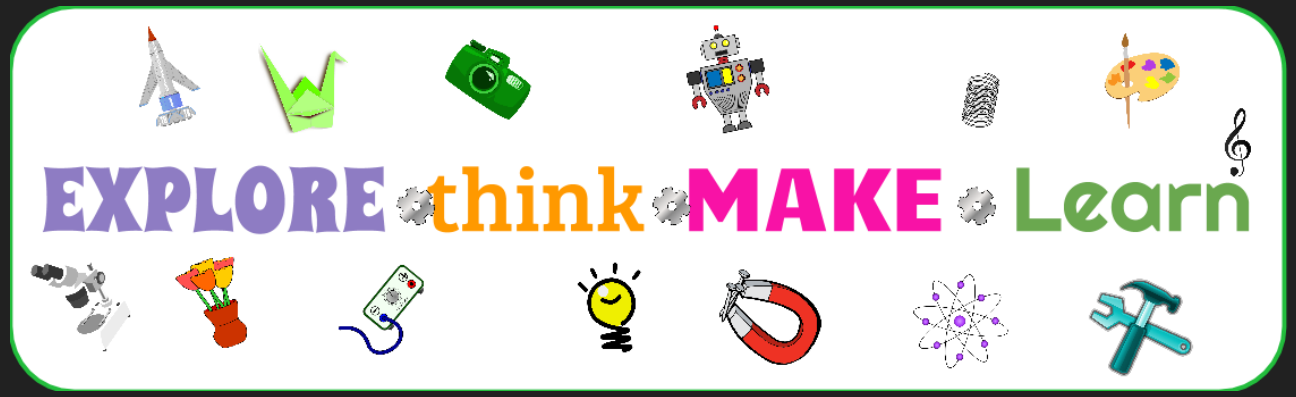
HARRISCOUNTY
PUBLICLIBRARY
your pathway to knowledge

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Harris County Friends of the Library

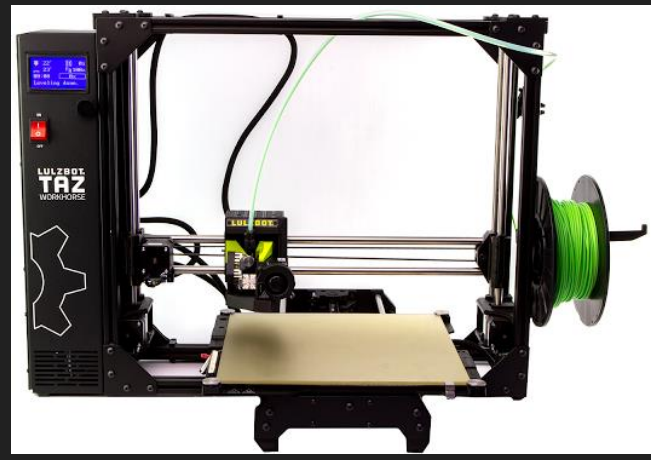
maker central @hcpl

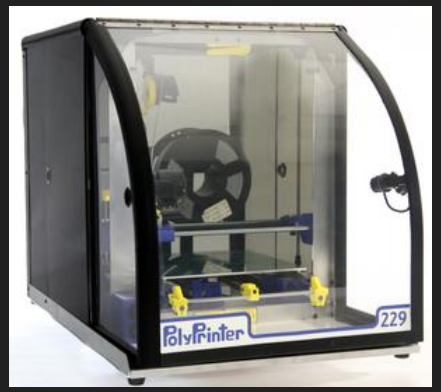
3D printing and other services are made possible with support from the Harris County Friends of the Library and other generous donors.



HARRISCOUNTY PUBLICLIBRARY
your pathway to knowledge

Current 3D printer machines available





HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

maker central @hcpl

Presenter Contact Information

Name: Kenneth Thomas
Email:Kenneth.Thomas@hcpl.net
Phone: 713-274-6688

Maker Central Lab – Houston: Administration
Innovation Lab – Clear Lake: Freeman Branch
iMaker Space – Seabrook: Evelyn Meador
Tomball Innovation Lab – Tomball: LSC/Tomball Community Library
Innovation Lab – Katy: Maud Marks Branch
Innovation Lab – Houston: Northwest Branch Library
Innovation Lab – Houston: Parker Williams Branch Library

HARRIS COUNTY PUBLIC LIBRARY
your pathway to knowledge

Thank you!!

Please don't hesitate to contact Kenneth via email and copy makercentral@hcpl.net.

maker central @hcpl