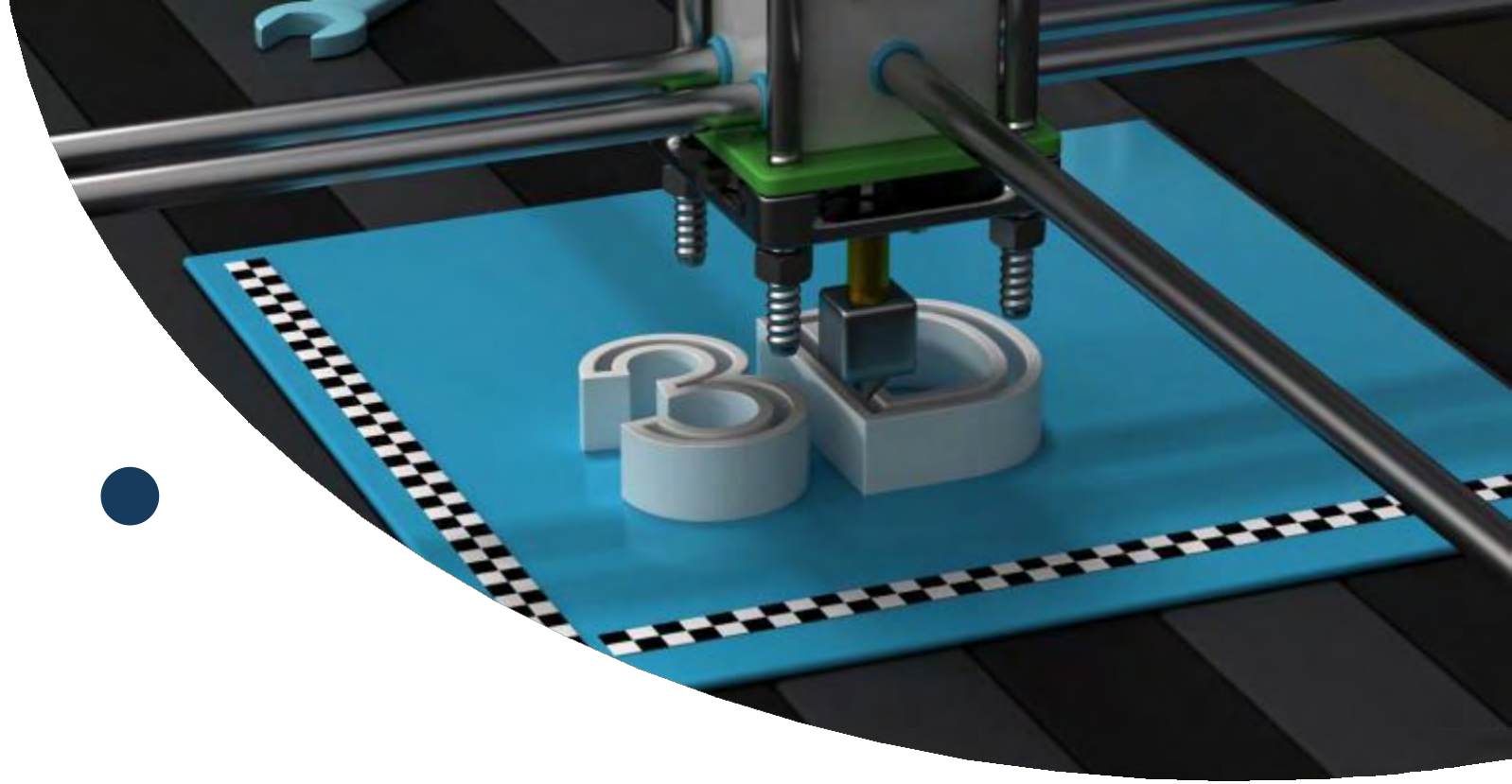


- 3D Printing -

Basics and AppliedTechniques

Sun City Palm Desert Technology Club

Sun City Palm Desert Technology Club

The Sun City Palm Desert Technology Club has purchased the industry standard prosumer 3D printer, the Bambu Lab X1-Carbon with AMS.

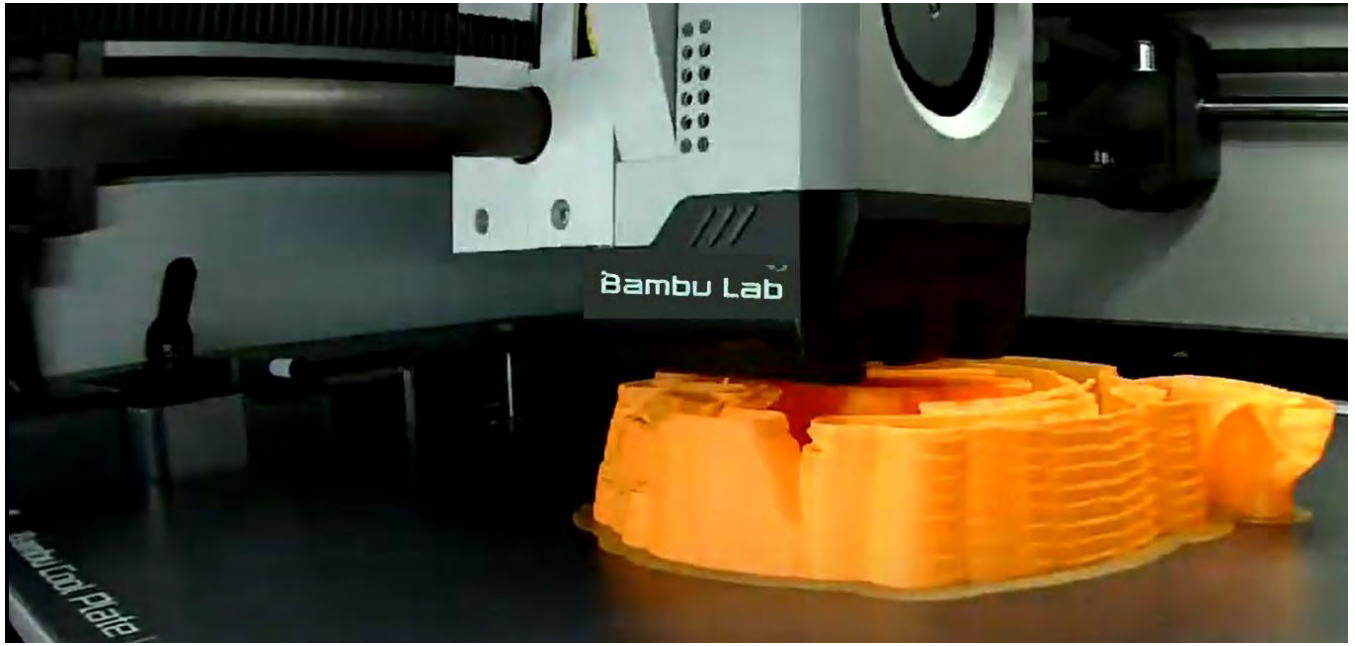
Now that our 3D printer mentor team has been assembled and trained, we are ready to train SCPD residents as members of our club on how they can use this fantastic 3D printer to create their own objects. There are literally millions of predesigned models or you can design your own.

Let's now watch a video that explains what 3D printing is, and how our 3D printer works https://youtu.be/f94CnlQ0eq4

What is 3D Printing?

3D printing, also called additive manufacturing, is a process of making three dimensional objects from a digital file, by laying down successive layers of a squeezable material until the object is created. We will be using a biodegradable, plant-based plastic called PLA, short for Polylactic Acid.

Each of these 3D printed layers can be seen as a thinly sliced cross-section of the object. This process is called Fusion Deposition Modeling or FDM



FDM Printing Uses

- **Easiest and Cheapest form of 3D Printing**
  - $299 (ToyBox) - $4,000 (Raise3DPro2)
  - Government: $1,000,000+ (NASA)
- **Great for inventors to prototype**
- **Construction Industry**
  - 3D Printed Houses
    - Palari Group 15 3D Printed homes
    - 1,450 sq ft (Rancho Mirage)
- **Automotive Industry**
  - NASCAR – replacement parts
- **Aerospace Industry**
  - NASA – ISS tools, Mars Dwellings
- **Education Industry**
  - STEM/STEM, Robotics

DESERT X
MARCH 8 – MAY 11, 2025
COACHELLA VALLEY, CA

This Artist uses a custom 3D printer to create walls of mud

Basic 3D Printing Terms

CAD	• Computer Aid Design: software that creates 3D models
FDM	• Fusion Deposition Modeling is the type of 3D printing used in class, like a computerized hot glue gun
Filament	• Printing material that is coiled on a spool
G-Code	• Generated code sent to the printer as the blueprint for the print job
STL and 3MF	• STL or Stereo Lithography is the basic file format used to code 3D models. A 3MF file has full information to print a model
Slicing Engine	• Software that allows user to enter in printing settings and creates the G-code and other information for printing

SCPD USES PLA FILAMENT

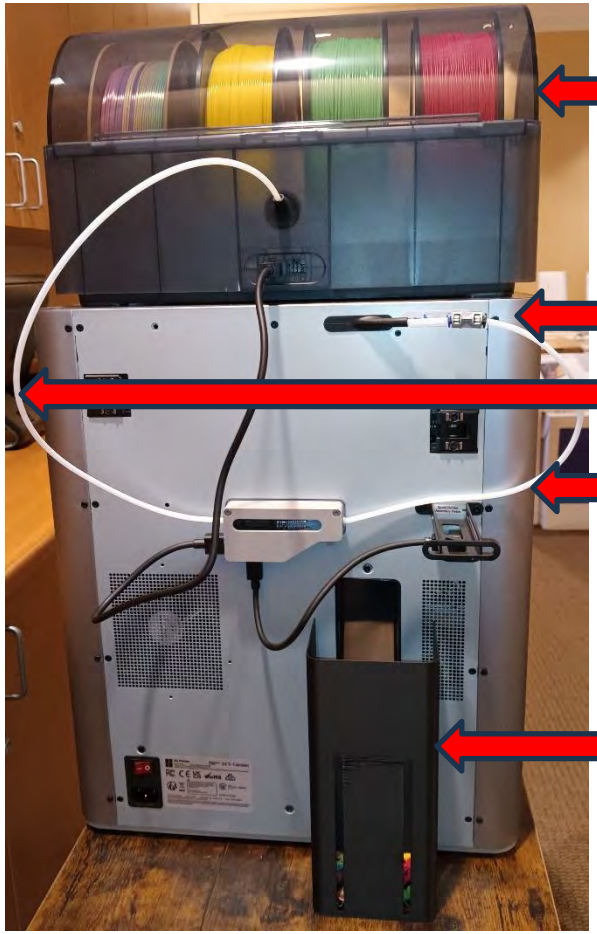
- **Polylactic Acid (PLA)**
  - Thermoplastic polyester made from reusable materials such as fermented plant starches like corn, cassava, sugarcane or sugar beet pulp
  - PLA has a low temperature melting point (180°C - 220 °C or 356°F - 428°F) and is considered biodegradable; Printing Bed Temp of 35°C - 60°C or 95°F - 140°F
  - Great for prototyping, easy to print, inexpensive but brittle
  - In 2023 PLA was the 2nd highest consumed bioplastic in the world
  - Other applications of PLA besides 3D Printing include mulch film for farming, biodegradable cups, tea bags and more

SCPD uses the Bambu Lab X1C 3D Printer

AMS Stores 4 Spools of Filament

Touchscreen Control Panel

Front View of 3D Printer



AMS Stores 4 Spools of Filament

Filament is fed to the print head here

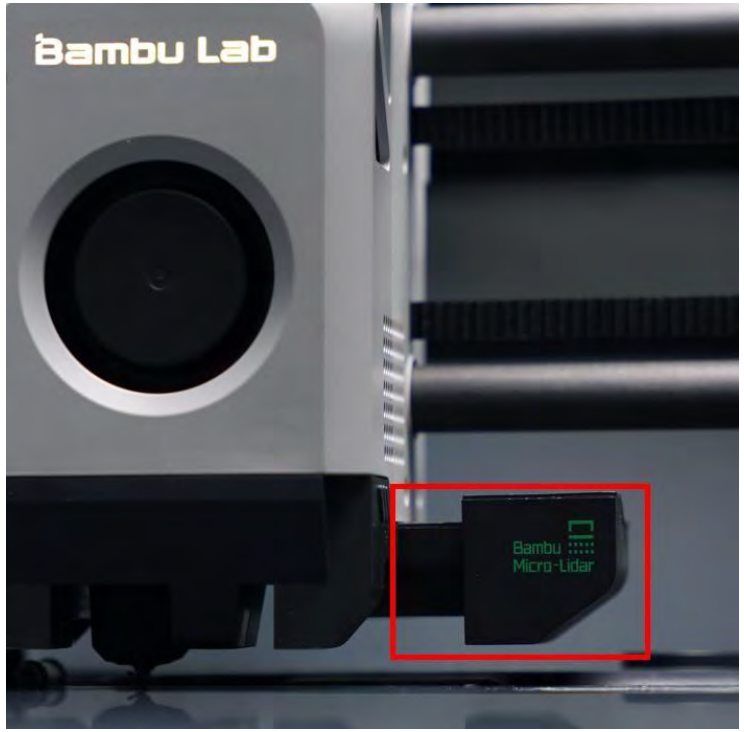
PTFE Bowden tubes

These tubes transport the filament from the spool to the print head

Box to collect excess filament sent down the purge chute

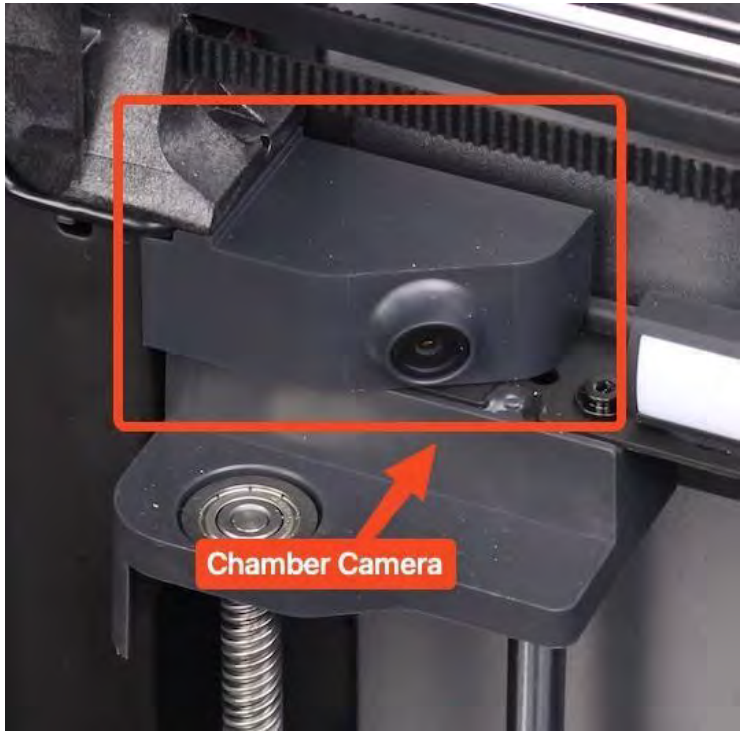
Rear View of 3D Printer

Bambu Lab X1C Basics



The **Micro Lidar Scanner** helps the printer level the bed, calibrate the filament extrusion rate, and scans the first printed layer for defects. Very Handy!

The **AMS** allows the user to switch between up to 4 different filaments during a print. This allows for some interesting design choices and the ability to change filament colors mid print.



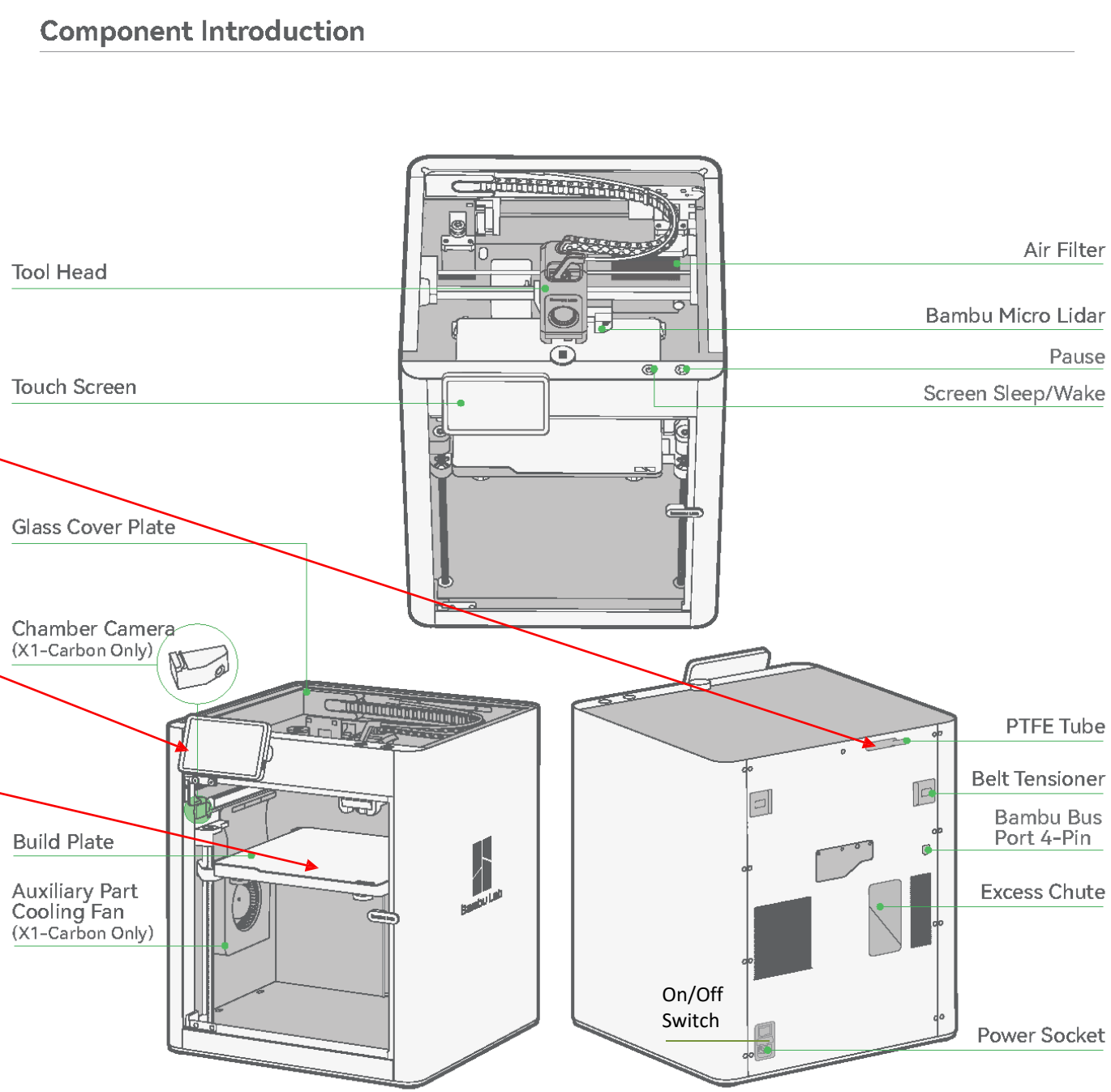
The **Built-in Camera** allows for wireless monitoring and control through the slicing software.

**All wireless functions are connected through the printer's Wi-Fi.*

Bambu Lab X1-Carbon

We use the Bambu Lab X1-Carbon 3D printer at the SCPD Technology Club!

- The filament enters the printer through the back. (Filament is what we call the plastic stock we use with the printer to create parts)
- A front facing computer interface for working with the printer. (the LCD on the front also has a slot for MicroSD cards but we do not use those at SCPD)
- The build plate can be lifted out of the machine for easy part removal. (The "build plate" is the specially crafted surface which parts are printed onto)



We have a culture of safety at the Technology Center, will do our best to keep you safe, but it takes common sense and ALL of us to follow…

THE FOUR MAIN RULES:

1. *SAFETY FIRST & ALWAYS!*
2. *DON'T TOUCH UNTIL TAUGHT!*
3. *LEAVE CLEANER THAN FOUND!*
4. *ASK IF UNSURE OR NEED HELP!*

3D Printing Safety

DON’T TOUCH THINGS LABELED HOT! THE EXTRUSION NOZZLE (TIP) IS 500 DEGREES F!

DON’T TOUCH THE MACHINE WHILE IT’S RUNNING! FINGERS CAN BE CRUSHED AND GEARS MAY BREAK

3D Printer Rules
What You Can't 3D Print

No realistic or prop weapons, guns, projectiles, or items of a profane or obscene nature.

Everything you print will be on display to visitors while printing. If it's not OK to be seen, it's not OK to print!

Staff will cancel any print jobs that don't follow the rules, or if jobs fail mid-print!

3D PRINTING LEVEL 1 and 2 CLASSES OVERVIEW

LEVEL 1 CLASS

Single Color Basic Print

- You will pick out a small or simple print and we will quickly get the printing started.

Basic 3D Printing Concepts

- We will talk through various parameters and concepts in 3d printing such as: Layers, Filament types, supports, slicing, orientation, and others.

LEVEL 2 CLASS

Two Color Basic Print

- You will pick two colors and we will walk through how to set up a multi-colored print in Bambu Studio.

Intermediate 3d Printing concepts and Bambu Studio Specific Features

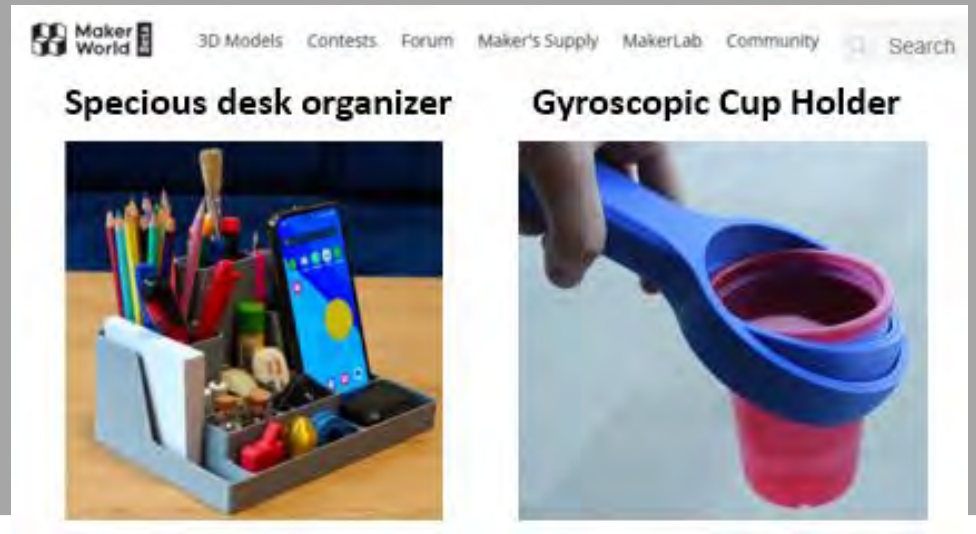
- We will talk through some intermediate 3d printing cocepts and slicer features, some of which are unique to Bambu Studio.

3D Print Models

Only 2 ways to get model files):

- **Download predesigned models** from sites such as: https://makerworld.com
  - Limited to what others have designed. Not your design!
  - You can make some small changes to the models (shrink or grow).

- **Design your own models** in a CAD (Computer Aided Design) program.
  - SCPD Technology Club offers a class in 3D design Using Fusion 360.



How does an FFF/FDM printer work?

A Fused Filament Fabrication (FFF) or Fused Deposition Modeling (FDM) printer produces plastic parts by using precise computer control to extrude stock material through a nozzle at a consistent rate onto a build platform (or plate).

Because the nozzle can be precisely moved relative to the build plate in 3 dimensions (X, Y, Z), the printer can be used to deposit stock material anywhere within the bounds of the printer.

But where do we put our stock material in order to create our part? In the Automatic Material System or AMS that sits on top of our 3D printer.

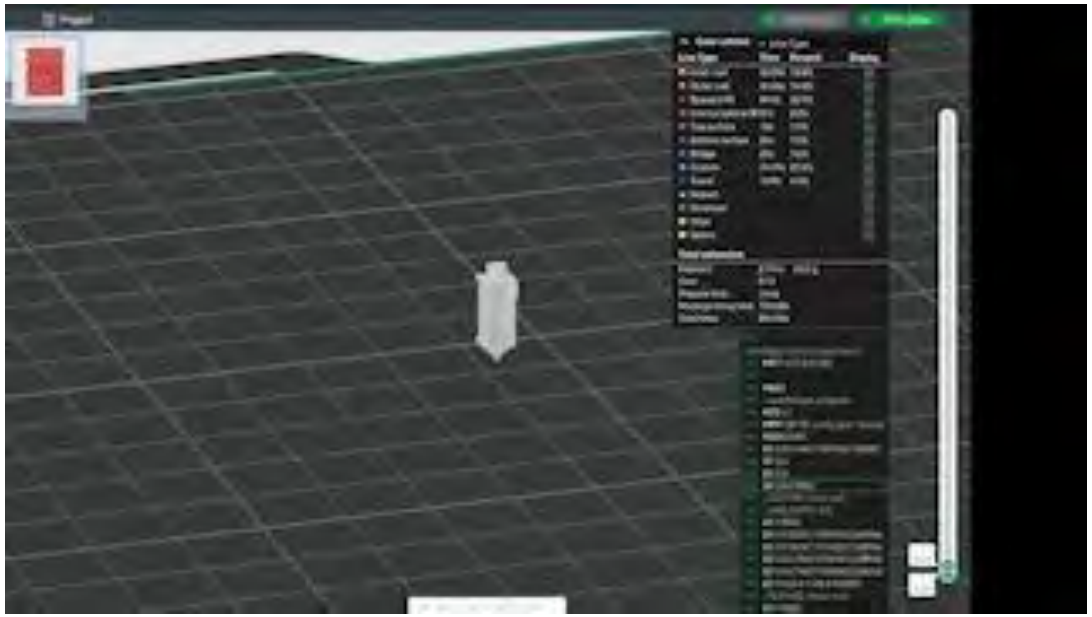
What instructions do we give the printer?
3D printer Slicing software is designed to give the printer the necessary printing instructions.

What does slicing software do?

3D printer slicing software fundamentally translates the geometry information found in a mesh file (e.g. STL or 3MF) into machine instructions which the 3D printer can understand.

The 3D printer can be thought of as a machine which draws lines made of plastic.

The Slicing software transforms our model file into a series of accurately placed plastic line "drawings" which are precisely stacked on top of one another to produce a part. Thus, slicing the model into horizontal slices or lines of filament.



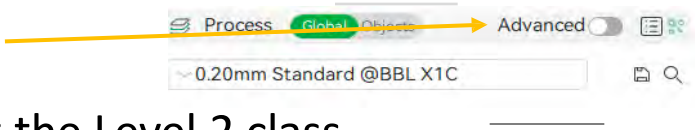
We use the Bambu Studio slicer program at the SCPD Technology Center.
You can learn all about it and how to use it at **https://wiki.bambulab.com/en/bambu-studio**

What does slicing software do?

The previous slide talked about big-picture concepts. The slicing software turns model files into 3D printer instructions. However, there are many process considerations and variables which the software works with in order to produce the machine code.

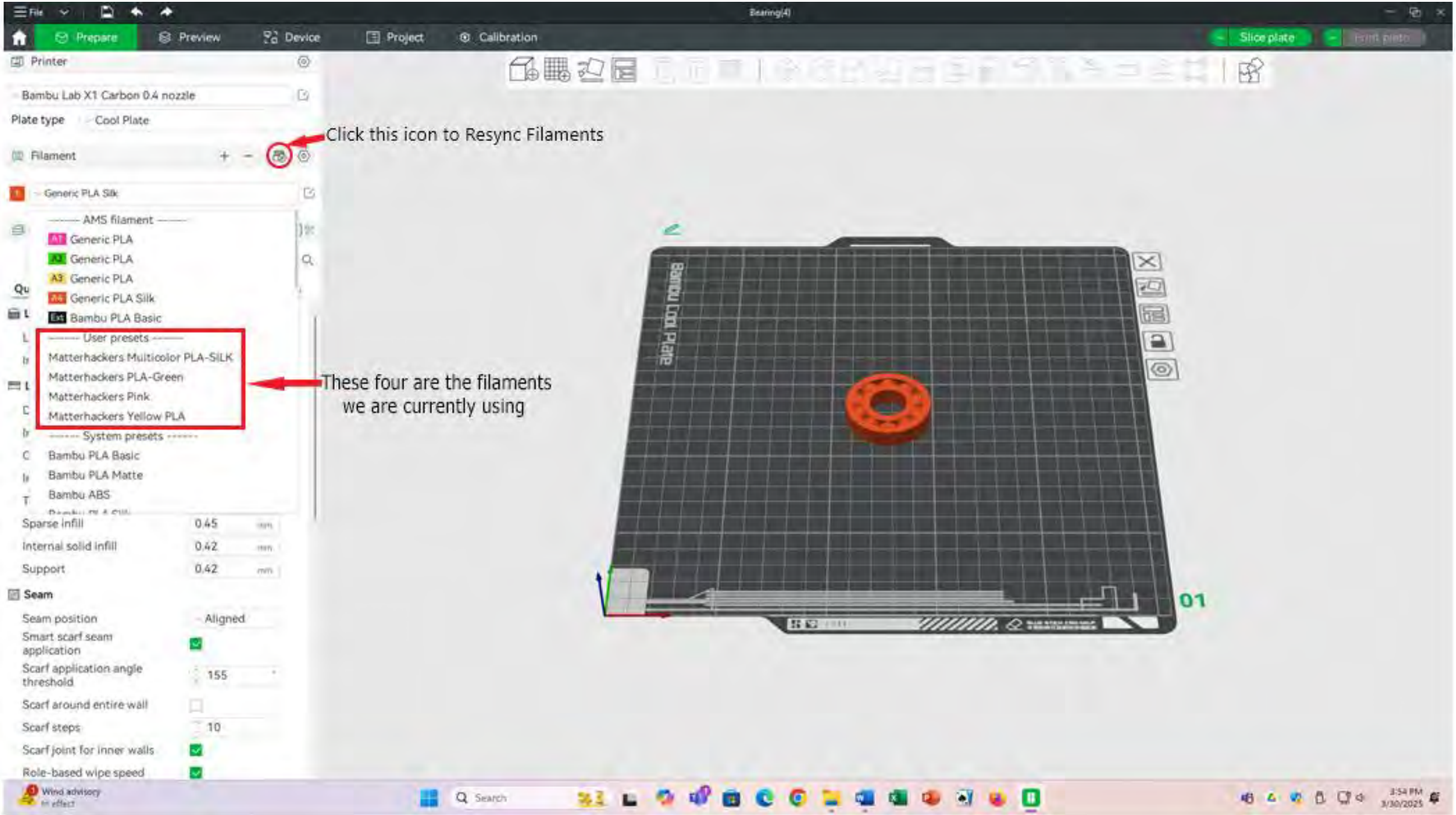
We have control over most of these variables, although much of the time we do not need to adjust them: with the Bambu X1 Carbon the default settings seem to work very well for most cases.

As such, for this class we'll be considering the "Non-Advanced" settings.

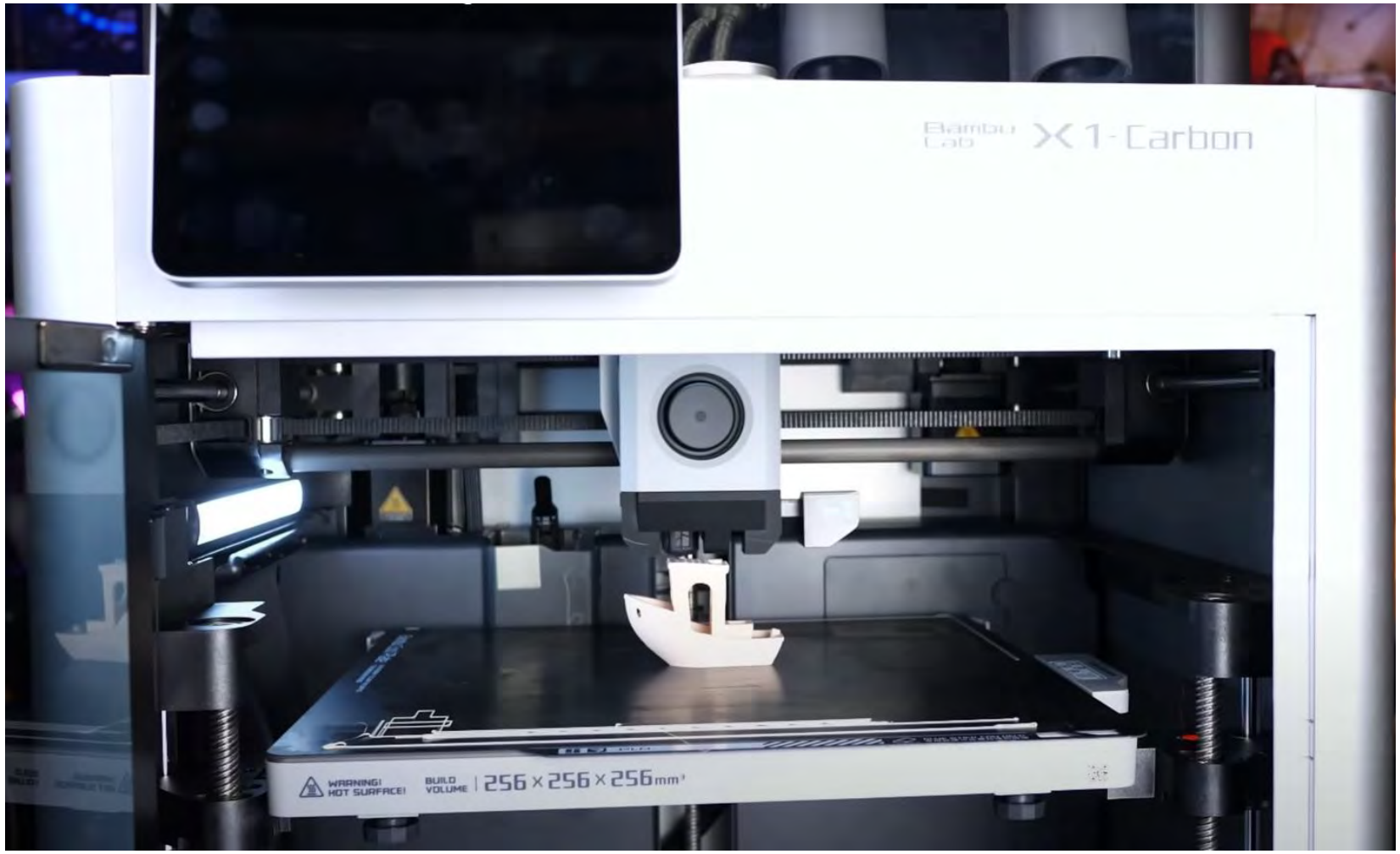


If You'd like to discuss the advanced settings, we can explore them during the Level 2 class.

Our “Steps needed to print a 3D model” PowerPoint slide will show you the broad but detailed steps needed to make a 3D print. Then you can work with a mentor in a one-on-one session to actually do your first print. We have a more detailed step by step check list to help guide you, when you actually print your model.


Prepare
Preview
Device
Project
Calibration
Slice plate
Printer
Bambu Lab X1 Carbon 0.4 nozzle
Plate type
Cool Plate
Filament
Generic PLA Silk
AMS filament
Generic PLA
Generic PLA
Generic PLA
Generic PLA Silk
Bambu PLA Basic
User presets
Matterhackers Multicolor PLA-SILK
Matterhackers PLA-Green
Matterhackers Pink
Matterhackers Yellow PLA
System presets
Bambu PLA Basic
Bambu PLA Matte
Bambu ABS
Sparse infill
0.45
Internal solid infill
0.42
Support
0.42
Seam
Seam position
Aligned
Smart scarf seam application
Scarf application angle threshold
155
Scarf around entire wall
Scarf steps
10
Scarf joint for inner walls
Role-based wipe speed
Click this icon to Resync Filaments
These four are the filaments we are currently using
Bambu Cool Plate
01

Let's look at the steps we need to take to print a model in our 3D printer



Steps needed to print a 3D model

1. Lift and remove build plate **only by edges** and check things to remove
2. Replace build plate aligning it with the magnetized print bed with no side overhang, or the printer will not function. Be sure printer is on and ready
3. Select which of the 4 AMS filaments to use, check it is loaded in the AMS
4. Select & download a model to Bambu Studio slicer typically in 3MF format
5. Review the settings and adjust/refine settings as desired
6. Press “Slice Plate” and then “Print Plate” at the right of the navigation bar
7. The printer should wake up and begin the printing process
8. Monitor the first layer carefully for any errors, then occasionally monitor the printing process to look for anything that might go wrong
9. When the print is finished the nozzle returns home and the bed will lower
10. Then remove the plate by its edges and allow it to cool down
11. Remove printed model by flexing the plate both X & Y, use scraper if needed

Multi-Material or Multi-Color Printing

One of the great features of the Bambu X1 Carbon is multi-color printing. We load up to four different colors of PLA and use Bambu Studio to "paint" which colors go where on the model.

This is a very nice feature, especially for those who do not wish to paint their parts but still would like some color contrast.

Multi-Material Printing can produce *quite a bit* more wasted filament and take much longer to print than single filament printing. However, the extra waste can be minimized through careful design and some fine tuning. (Though It cannot be eliminated, nor can the longer print time)

We will cover Multi- Color printing in our Level 2 classes.

Finished Print

- When the print is finished, the nozzle moves away from the model and returns to home and the bed platform should lower
- Gently lift the bed platform up to disconnect the magnetic connection and carefully slide out of the machine
- Please remember, **The Bed Platform may be Hot!** Let the model and plate cool
- Next, hold the corner of the build plate and then flex the build plate in both the X and Y directions and try to remove the model if it does not come off caretully **slide a corner of the spatula** under the raft to gently pry it from the bed.
  - (**DO NOT APPLY HEAVY FORCE**, this can damage the bed sticker or cause injury)
- Remove supports by hand and then with needle nose pliers if necessary.

At SCPD we can print objects about 9”wide x 6”deep x 9”tall in our desk top printer with PLA

The space inside the printer is larger but the printer uses some of the Y or depth direction to print administrative needs like purge towers and flow calibration strips and needs some of the height (Z) for clearance of the print head in certain situations.

There are other types and sizes of printers

Some can print a two-story house out of concrete or maybe print custom edible chocolate shapes or even orthotics or prosthetics

Here are some examples of what other 3D printers can print

FDM Printing Time Lapse – 2 Story House

https://www.youtube.com/watch?v=69HrqNnrfh4&t=4s

Chocolate 3D Printing

[Cocoa Press 3D Chocolate Printer - YouTube]

- Similar to FDM printing, an extruder head moves around the bed and lays down the molten chocolate in the desired shape in layers, which eventually cools into the final solid product.
- More difficult to print since chocolate has a lower melting temperature and takes longer to cool.
- $2,000 - $4,000

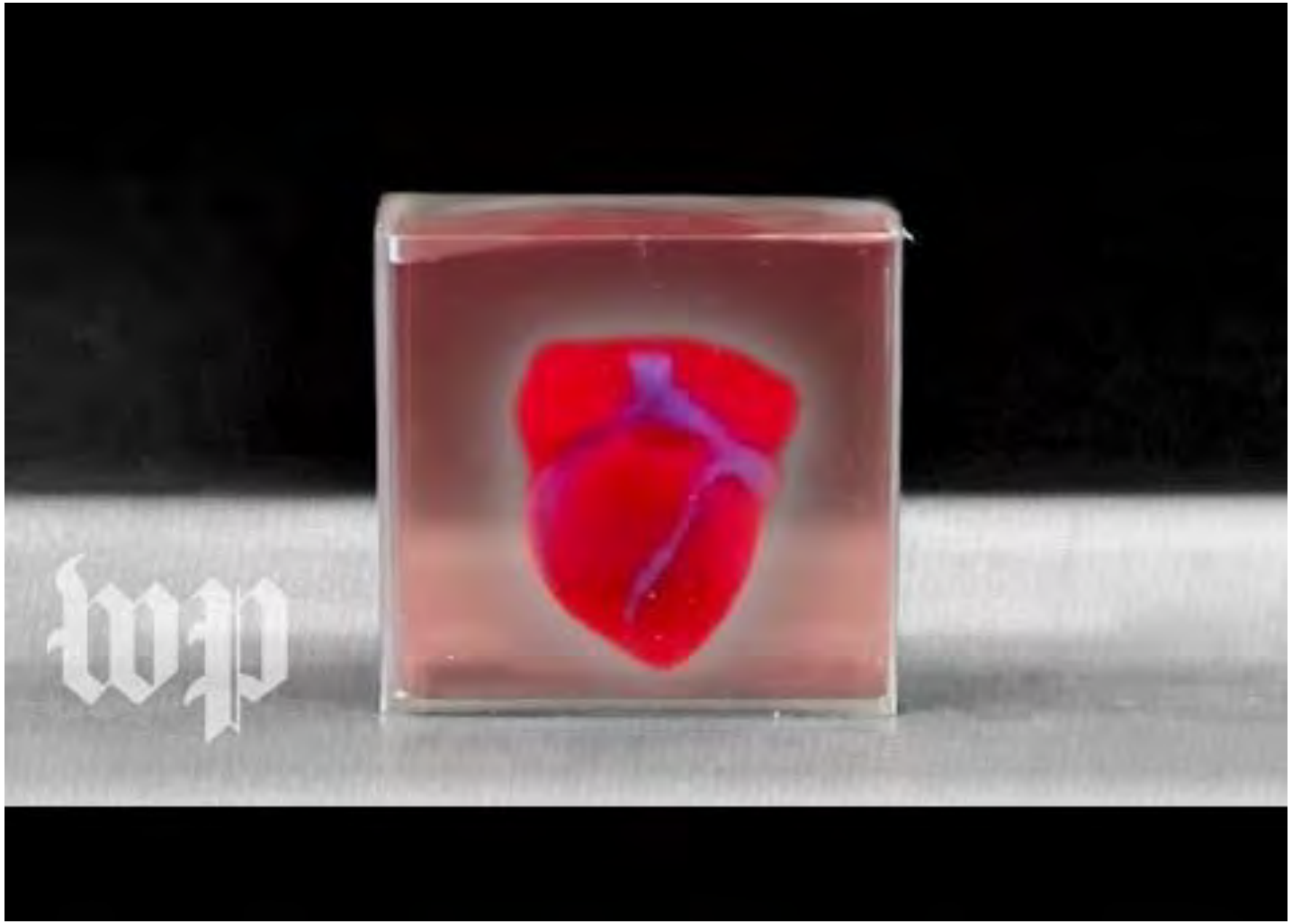
Metal X 3D Printing

- FDM Printing combined with sintering
  - Uses different metal powders bound in plastic and printed like an FDM parts (Parts are scaled up due to shrinkage in next stage)
    - Stainless Steel, Tool Steel, Inconel, Titanium
  - Printed parts go through a washing stage to remove the plastic binder and then are sintered in a special furnace to fuse the powder into a solid metal
  - Final part is pure metal
  - Machine Cost: Just under $100,000

https://www.youtube.com/watch?v=8AkSLUmky8g

3D Printed Heart

- Tel Aviv University of Molecular Cell Biology and Biotechnology, Israel
- Using a patient's cells
  - Printed with cells, blood vessels, ventricles and chambers
  - Biopsy of fatty tissue surrounding abdominal organs
  - Hydrogel acts as printing "ink"
  - Size of a rabbit's heart
  - Biocompatabilty eliminates organ rejections
  - Working on training cells to form a pumping ability
  - Expect that in 10 years Organ printers will be used in hospitals
- Coming Soon -> LulzbotBIO
  - $7,500.00 https



https://www.youtube.com/watch?v=CeOOMNtCFI0

3D Printed Dresses

- Nervous System's Petal Kinematics Dress (2016)
- $3,000 to print
- More than 2100 petals custom-fit interlocking flower petals
- Selective Lase Sintering (SLS)

https://player.vimeo.com/video/177127173

3D Printed Shoes –Addidas FutureCraft 4D

$180 - $300 a pair

https://www.youtube.com/watch?v=ufhh6vRfE6Q

Dash ® PancakeBot Pancake Printer

- World's first pancake printer, printing pancakes by automatically dispensing batter directly onto a griddle.
- $299.99

https://www.youtube.com/watch?v=sj-sKoBBJ5I

Foodini by Natural Mechanics

- Using cooked and mashed foods, create intricate and edible 3D food art
- $4000.00

https://www.youtube.com/watch?v=XxepFtNTh74

How do you like your steak? Rare, Medium or 3D Printed?

https://www.youtube.com/watch?v=fLpeeUYtW94&t=17s

3D Printed Prosthetics – Hero Arm by Open Bionics

https://www.youtube.com/watch?v=IyzrKB2WVtQ

Using 3D Printers at the Tech Center

Filament Use - You must use only the PLA filament supplied by the Technology Club. Exceptions may be requested to very large prints or other special circumstances. All filament must be in 1kg Plastic spools.

Print Quality - These are not $100,000 machines and have limitations, but for most applications, they work incredibly well. Printed models will not be totally smooth due to the technology. To produce smoother models, it may require many iterations of parameter changes and possibly some CAD changes. Also post processing using very fine grit sand paper or other means can be helpful.

Reservations - You must reserve time on the machine to ensure the Technology Center is available for 3D printing, and the printer is not being used by other Technology Club members, or for classes, and that there is enough time to print your model.

After this class, Technology Club members are approved to use our 3D printer with 1.75mm PLA filament only

DISCLAIMER:

PLEASE BE AWARE THAT ANY INFORMATION YOU MAY FIND IN THIS CREATION STATION DOCUMENT MAY BE INACCURATE, MISLEADING, DANGEROUS, ADDICTIVE, UNETHICAL OR ILLEGAL!

Some information here may create an unreasonable risk for readers who choose to apply or use the information in their own activities or to promote the information for use by third parties.

None of the authors, contributors, sponsors, administrators, students or anyone else connected with the Technology Center, in any way whatsoever, can be responsible for your use of the information contained in or linked from these documents or links.

Please take all steps necessary to ascertain that information you receive from the Technology Center is correct and has been verified. Check and double check the information with other independent sources.

If an article contains suggestions regarding dangerous, illegal or unethical activities, it is up to you to determine that! The authors may not be qualified to provide you with complete information or to inform you about adequate safety precautions and other measures to prevent injury, or other damage to your person, property or reputation. If you need specific advice, please seek a professional licensed or knowledgeable in that area.

The Technology Center is not uniformly peer reviewed; while readers may correct errors or remove erroneous suggestions, they have no legal duty to do so.

All information found on these documents or links are without any implied warranty of fitness for any purpose or use whatsoever.

DO NOT RELY UPON ANY INFORMATION FOUND IN TECHNOLOGY CENTER DOCUMENTS WITHOUT INDEPENDENT VERIFICATION!

ASK FOR HELP, USE COMMON SENSE, AND USE AT YOUR OWN RISK!

Any Questions?

3D Printing | Beginning & Advanced Classes on: Computer Programs | iPhones & Androids | Apple Watches | One on One Tech Help| and Much More

Sun City Palm Desert
Technology Club