NAME: _____ DATE: _____

# 3D PRINTING BASICS


**3D printing** is a type of Additive Manufacturing (AM). Material is added layer by layer to create an object based on computer code. This is the opposite of Subtractive Manufacturing (SM) where material is removed to create an object, for example, woodworking. 3D printing is commonly used for prototyping and manufacturing and is becoming an increasingly common tool in the hobbyists' arsenal. There are many types of 3D printers and hundreds of different materials to print with and new advancements are happening every year. Researchers across the world are searching for novel uses for 3D printing technology, from improving manufacturing processes to creating new human organs for transplant. 3D is an exciting technology that will only become more common in the future.

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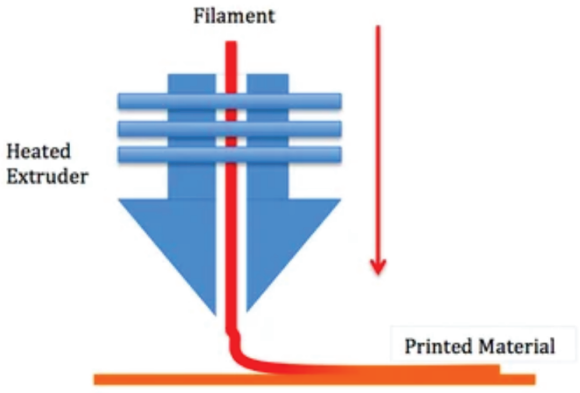
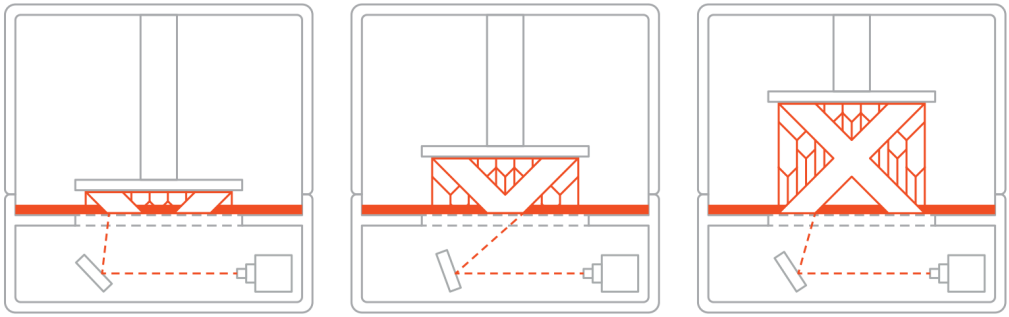
**Fused Deposition Modeling**, often abreviated as FDM is the most common type of 3D printing for hobbyists. FDM 3D printers are generally the cheapest to purchase and have the lowest material cost. FDM printers create objects by melting a plastic filament and depositing the melted filament in layers on a flat surface. The print surface is often heated to keep the object attached to the printer while it is being printed. FDM printers have a vast selection of filaments, ranging from simple plastics that can be flexible or rigid, to metallic, conductive, colour changing or even wood fiber infused.

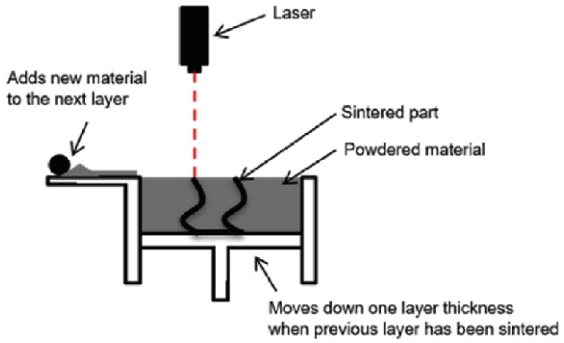


# 3D PRINTING BASICS Page 2

**Stereolithography Apparatus**, abbreviated as SLA , is the most precise type of 3D printing on the market. Instead of plastic filament, these printers use a light-sensitive resin. The printing accuracy depends on the light source that the printer uses to cure the resin. Some printers use an LCD screen, similar to the screen of a smartphone, to expose each layer at once. Other, more accurate printer use a focused laser to draw out each layer, line by line. These printers print the object upside down and the current layer being printed is exposed is in a bath of resin with the light source underneath. These prints often require some type of post processing to completely cure the hardened resin and cannot be hollow because they would be filled with liquid resin. SLA machines are generally more expensive than FDM machines and the resin is significantly more expensive than equivalent resin. These types of printers are commonly used by model makers, jewellers and dentists among others.



**Selective Laser Sintering**, or SLS is the most common type of 3D printing for industrial use. This method of 3D printing uses a laser to melt pellets of material into layers. While SLS does commonly use plastics, especially nylon, a major benefit of this method is the ability to print using a wider range of materials including metal and even glass. Another benefit of these machines is that they use material very efficiently as they do not require support material for overhangs. When the machine lays down a layer of pellets and the layer is fused, the un-fused pellets remain where they are and are able to support layers above them. The un-fused pellets can be re-used in the next print. Similar to SLA printers, these machines cannot print hollow objects without the unfused powder remaining inside the object. SLS machines have the highest purchase cost for the machine itself but materials are reasonably cost-effective for use in prototyping and small-scale manufacturing.




**Images sourced from:**
https://www.lulzbot.com/store/printers/lulzbot-taz-6
https://all3dp.com/2/fused-deposition-modeling-fdm-3d-printing-simply-explained/
https://www.3dhubs.com/knowledge-base/introduction-sla-3d-printing/
https://www.researchgate.net/figure/The-SLS-printing-process_fig1_328604028

# How To: Change Filaments On the Prusa Mini

Name: _____ Date: _____



2: Home Screen


3: Filament Screen

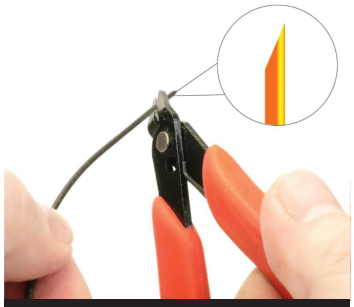

4: Printer Heating

## Part 1: Unloading the old filament

1. Turn on the printer using the switch on the lower righthand side of the machine
2. On the home screen of the printer, use the selection wheel to navigate to “Filament” and select it
3. Use the selection wheel to navigate to “Unload Filament” and select it
4. The machine will move into position and begin to heat up the nozzle
5. When the nozzle is up to temperature, the machine will automatically reverse the feeding mechanism and remove the filament

   **Note:** Be sure to pull the filament all the way out of the tube immediately. The end is still melted and can get stuck in the tube if left too long

6. Using a pair of wire cutters, cut the melted end off of the filament at a 45 degree angle and place the filament spool back in the appropriate sealed bag



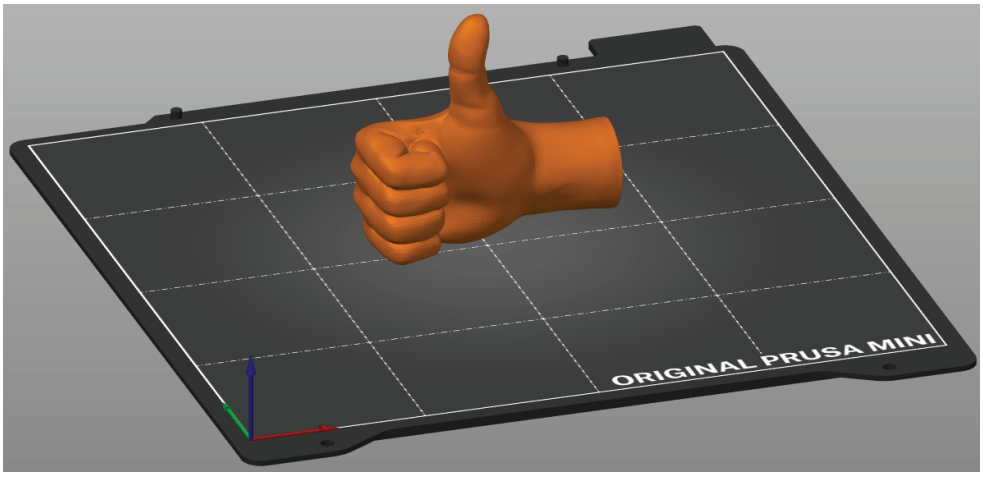
6: Cut Filament

# Changing Filaments Page 2

## Part 2: Loading the new filament

7. From the home screen, naviate to and select “Filament”
8. Navigate to and select “Load Filament”
9. Select the type of plastic from the list

   **Note:** If the material is not on the list, ask for help
10. Insert the filament into the tube until you can’t push it anymore
11. Press “Continue” with the selection wheel and slightly push the filament into the tube so that the machine can grab hold
12. After the machine has loaded the filament, it will purge the nozzle to remove the old filament
13. When purging is complete, if the extruded filament is the right colour select “Yes”
14. If the filament colours are still mixed, select “No” and the printer will purge again. Repeat until the colour is correct
15. You are now ready to load your G-code

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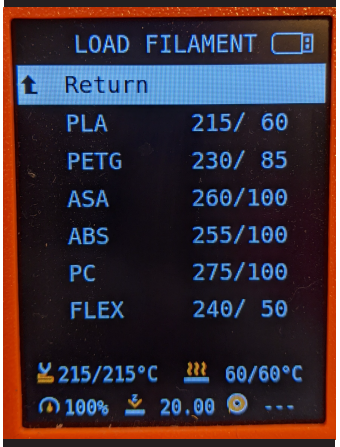
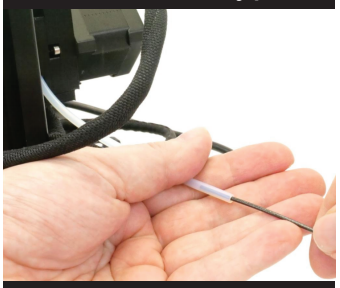
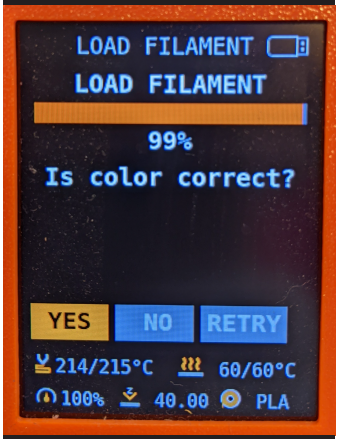
“3D PRINTING HANDBOOK” by Joseph Prusa

8: Filament Screen



9: Filament Types


10: Filament Tube



13: Is color correct?

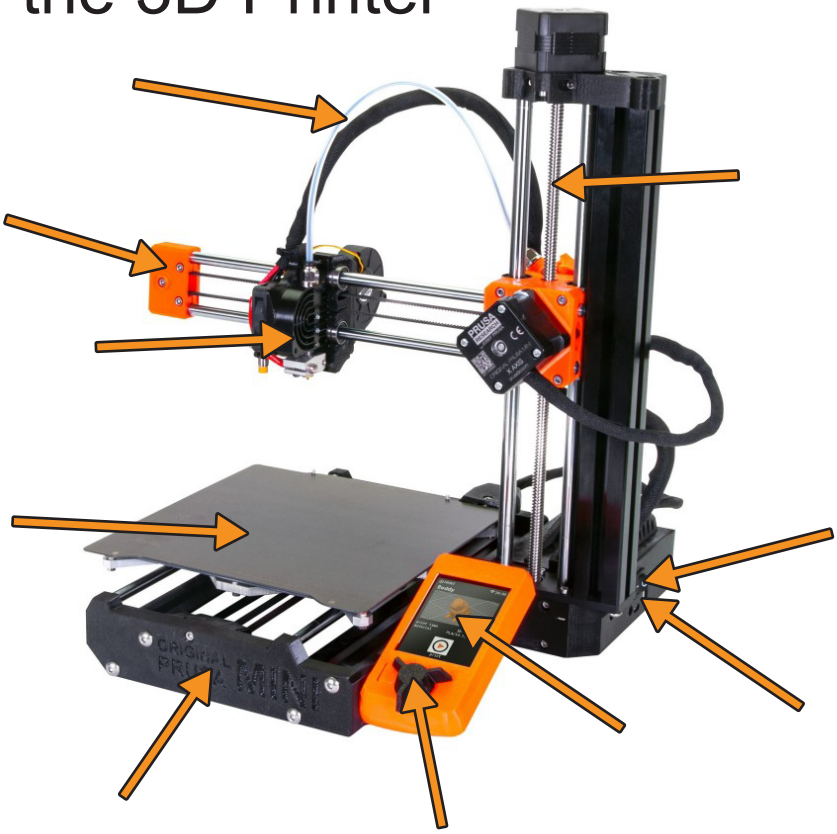
# 3D PRINTING

Due Date: _____

Name: _____

# TEST YOUR KNOWLEDGE

## Part 1: Label the 3D Printer



## Part 2: Match the plastic to its properties

A: Polylactic Acid (PLA)

B: Acrylonirile butadiene styrene (ABS)

C: Polyethylene terephthalate Glycol (PETG)

D: Thermoplastic Elastomers (TPE)

E: Nylon

F: Polycarbonate (PC)

_____ Industrial 3D printing material, felxible and durable

_____More durable than PLA, The most commonly used plastic around the world

_____High durability and ability to withstand high temperatures. Used to make LEGO

_____Low melting Temperature, odorless, wide variety

_____Strong, high heat tolerance, transparent

_____Rubber-like, extremely flexible

Name: _____ Date: _____

# 3D PRINTING PROJECT

**Problem:** 3D model and print and object with (at least) one removable or moving part

## Restrictions:

**-Time:** students must have a completed 3D model ready for printing in time for the printing timeslot they have selected

**-Size:** the maxiumum size of the final item is restricted to four inches cubed. This is to ensure everybody has time to print their objects

**-Materials:** Students may choose from the selection of filaments provided by the instructor. Students may provide their own specialized filament only with permission of the instructor.

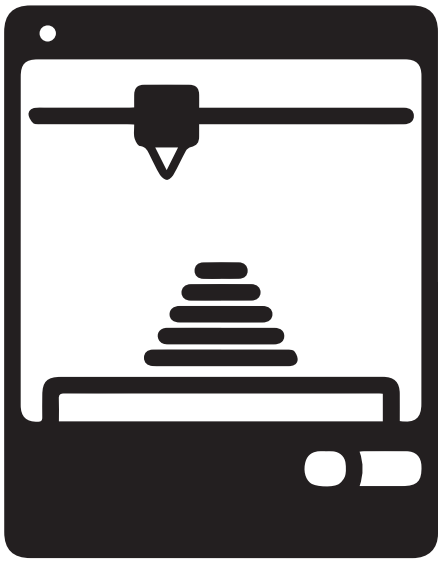
**-Skills:** the design must incorporate at least one of;

- Two separable pieces. These pieces can be printed separately or together. For example, a container with a screw on lid
- A movable part or function. This could be a flexible object or portion, or a moveable part incorporating print-in-place techniques

**-Originality:** the design does not need to be original but the 3D model must be entirely produced by the student. Downloading any 3D model is not permitted

## Outcomes and Checkpoints:

| | | |
|---|---|---|
| Idea | 2 Marks | Due: Week 1 |
| 3D printer components assignment | 8 Marks | Due: Week 1 |
| Filament types assignment | 8 Marks | Due: Week 2 |
| Design Sketches | 6 Marks | Due: Week 3 |
| 3D Model | 10 Marks | Due: Week 6 |
| Slicer Software Assignment | 8 Marks | Due: Week 6 |
| Printing Request Sheet | 3 Marks | Due: Week 7 |
| Test Prints** | 5 Marks | Due: Week 8 |
| The finished project | 50 Marks | Due: Week 9 |
| Self-evaluation | 5 Marks | Due: Week 10 |
| Total | 100 Marks | |



** Note: If a test print is not required, those five marks will be differed to the final project grade