3D Printing 101

Are you completely new to 3D printing? Don't worry, we'll help you get started. Whether you are in education, business, or interested for personal use, here is some background to help you print with confidence.

THE BASICS

3D printing is the process of taking a digital 3D model and building it layer-by-layer into a physical reality. There are several different kinds of printer technologies available, however, the most commonly available and affordable is a technology called fused filament fabrication (FFF), also known as fused deposition modeling (FDM). These printers use a continuous feed of filament made from thermoplastic materials, typically delivered in a spool, to build your model. We will provide an overview of common materials later in this guide.
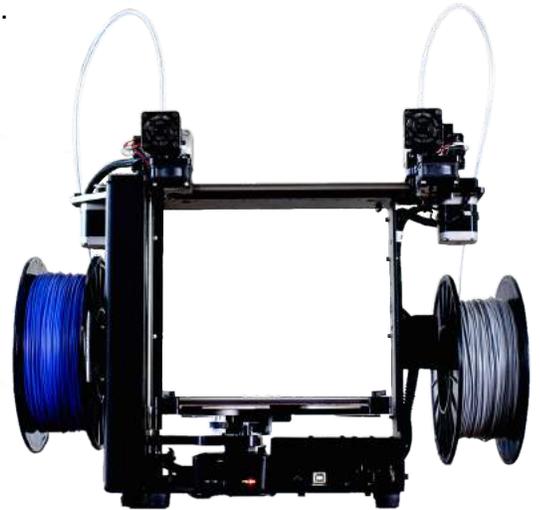
3D printing is called "additive manufacturing" because printing your model is an additive process. Unlike a sculptor who will remove material until their creation is revealed, FFF printers build a model layer-by-layer. Your printer uses thermoplastic filament on a spool and draws the filament through a heated nozzle (hot-end) onto the build surface where each layer is fused to the previous layer.

FDM Printer Photo: MakerGear M3 - Independent Dual

Now, a quick note on 3D printing. This is not like 2D printing (on paper), where you create a document and send it to your printer and it quickly spits out an accurate representation of the document or image you have sent. 3D printing requires managing several different variables and print times will differ, but with a basic understanding you will be able to print easily.

BASICS OF THE PRINTER

3D printers typically move along three axes; X,Y, and Z. The X axis moves right and left, as you look at the printer. The Y axis moves in and out, and the Z axis moves up and down.

Your extruder is the motor that feeds the filament (described below) into your hot-end. It can extrude and retract your filament. Your hot-end has a heater block and a nozzle. Inside the heater block, there is both a heater cartridge and a thermistor. The heater cartridge is what heats up your heater block. The thermistor is what communicates the temperature settings and readings between the hot-end and your control board. As the extruder motor feeds the filament into the hot-end, the filament melts and is extruded out of the nozzle onto the heated build plate.
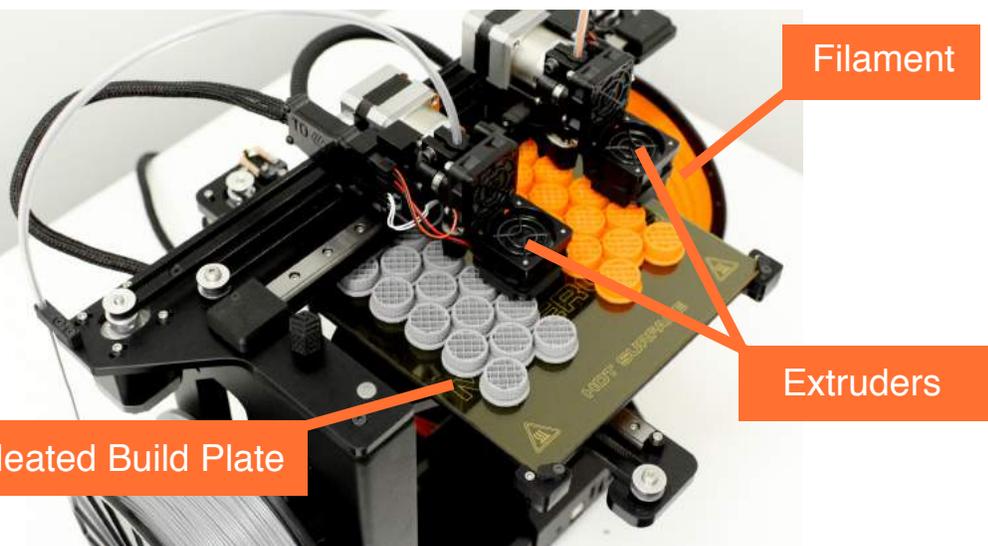
MAKERGEAR

3D Printer Basics

Right: Two objects printing simultaneously using Mimeo Mode by MakerGear.

This is only possible with "Independent Dual Extruders" seen here on the MakerGear M3-ID.

Filament

Extruders

Heated Build Plate

Before you start printing, you want to make sure that your print bed (build surface / glass plate) is level. MakerGear provides easy-to-use setup software to guide you through this process. This software can be used at any point during the life of your printer and also helps you set the starting height of the hot-end (nozzle).
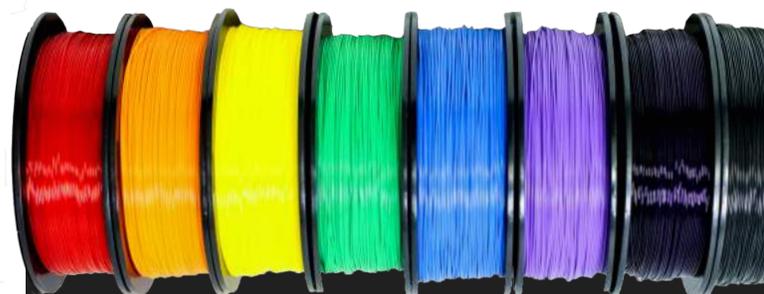
FILAMENT

Think of filament as the "ink" or "toner" for your printer. Filament can be extruded from different materials. Let's take a look at two of the most commonly used thermoplastic polymer materials used as filament in desktop 3D printing.

PLA (Polylactic Acid) is very forgiving and is a great material to get started with in 3D printing. PLA is non-toxic, biodegradable and commonly made from sugar or cornstarch. It is ideal for prototyping due to its low cost, high availability, and ease of use. We usually print with our hot-end at 220 °C and the heated build plate at 70 °C.

"Your printer uses filament. Think of it as the ink or toner for your printer."

**ABS (Acrylonitrile butadiene styrene)** is a petroleum-based plastic that is not biodegradable. ABS is commonly used in 3D printing and is ideal for functional prototypes and discrete, end-use parts. Similar to PLA, it is very affordable, but tougher in performance. It has very good durability, tensile strength and flexibility. We print ABS at 265 °C for the hot-end and 110 °C for the heated build plate.

THE CODE OF PRINTING

The 3D object you wish to print initially needs to be saved as an .STL file (stereolithography file format). There are two common sources of .STL files, the most accessible of which is to download shared .STL files from websites like Thingiverse and GrabCAD. If you are a beginner, these are great places to start.
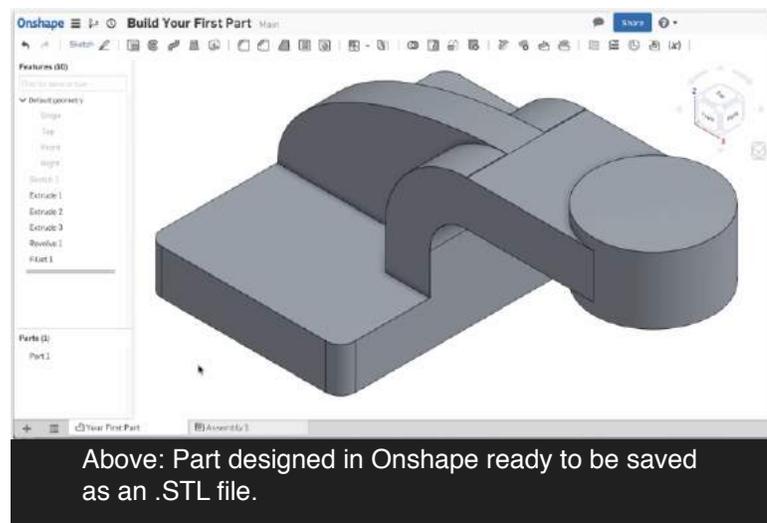
Above: Part designed in Onshape ready to be saved as an .STL file.

You can also design your own model in a program like Tinkercad, Onshape, Autodesk, or Solidworks. These software packages provide a way for you to export your file in the .STL format.

Once you have the .STL file of your object ready, you will need to prepare it for printing by converting it into a language your 3D printer can understand.

3D printers read a language called G-code. G-code literally tells your printer which axis to move, how far to go, and at what speed. It tells your fans when to turn on, how much filament to extrude, and how fast to extrude it. G-code is like the DNA of your print.

Instead of learning how to write G-code and then programming every single line, there is a process called "slicing" which automates these steps. Slicer programs take your .STL file and automatically convert your file into G-code according to specific parameters.

"SLICING"

When preparing to slice your project, there are several things to consider.

One important consideration when designing and slicing a model is to assess whether or not it will need supports to reinforce the object during printing (to be removed after completion). To understand supports, imagine a bridge over a river. It can only span so far without something to support it or it will collapse.

Above: Model in Simplify 3D ready for slicing.

As each layer builds on the previous one, your hot-end is getting farther from the build plate. So just like that bridge, your printer can only span so far without support.

If a model does not have any sharp angles or overhangs (specifically overhangs less than 45 degrees), then no supports are needed. If it does, however, you will need to utilize the support feature in your slicing software.

Above: Models printed on rafts and using MakerGear's Mimeo Mode feature to create multiple prints at once.

Rafts and brims are other slicing options that are valuable to use if your project is tall and thin. Using one of these options can keep it from losing adherence with the bed. A brim is a layer of material that extends from the perimeter of your project to help it stay in place. A raft is a base layer of material on top of which you print your project. Both rafts and brims are removed after the print is completed.

These are the most commonly used slicing options. For more slicing options, please visit the links at the end of this document.

There are several programs that can do the slicing for you, and Simplify 3D is one that organizes all the intricacies of slicing very well. Programs like Simplify 3D contain profiles that match the characteristics of your printer, and include specifications such as its build dimensions. These profiles can also store information specific to your preferred filament and layer height, and make regular use much simpler.

Once you have imported your .STL file and set your slicing preferences, you can click the slice button to create a sliced G-code file, and you are ready to print!

Above: Finished part printed on MakerGear M3-ID 3D Printer

CONCLUSION

Getting started in 3D printing is very exciting! MakerGear provides phone and email support to its customers and will work to trouble-shoot any issues that might arise. Please visit the resources at the end of this document for more ways you can advance your 3D printing skills.

MAKERGEAR

3D Printing Resources

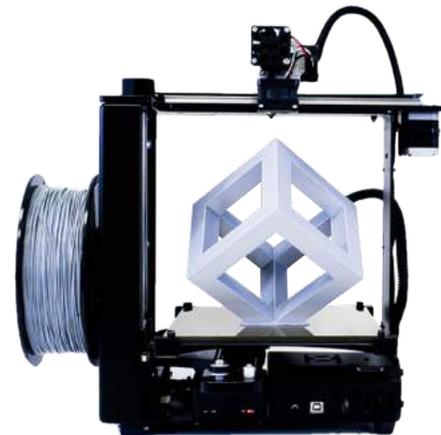For more information on the differences between PLA and ABS visit:
https://all3dp.com/pla-abs-3d-printer-filaments-compared/

To access MakerGear's library of 3D printing resources visit:
https://makergear.zendesk.com/hc/en-us

For Simplify 3D's Print Quality Troubleshooting Guide visit:
https://www.simplify3d.com/support/print-quality-troubleshooting/

MakerGear M3-SE 3D Printer

About MakerGear

Founded in 2009 in Beachwood, Ohio, MakerGear empowers thousands of users in all 50 states and more than 75 countries, ranging from Fortune 500 companies to small businesses, medical researchers, government agencies and educators. The company recently opened a new R&D facility in Northeast Ohio and is committed to expanding the use of technology and manufacturing in the region.

CONTACT US

Technical Support
www.makergear.com/support
(216) 508 - 4025

Sales
sales@makergear.com
216-765-0030

23632 Mercantile Rd. - Unit G
Beachwood, OH 44122 USA

www.makergear.com