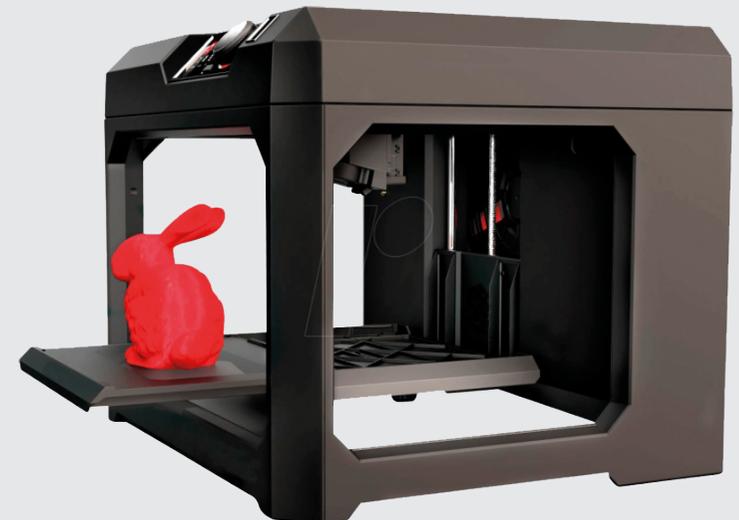# TIPS & TRICKS

FOR 3D PRINTING

Discover Manufacturing

Introduction

Welcome to these **Tips & Tricks For 3D Printing** suggestions.

There are many different types, styles and manufacturers of 3D printers on the market today. We have tried to keep these **Tips and Tricks** as generic as possible for all models - however, it's important to always follow the manufacturer's guidelines.

Given the wide variety of printers, specifications, styles and brands - this is not a comprehensive guide. These **Tips and Tricks** are not a guide to purchasing a printer (although we do recommend some tools, materials and software to make your prints easier). We will however presume you have some experience in 3D printing and already own a 3D printer and it is a low to mid-range printer - as high-end models tend to be quite specialised, have particular requirements - and often have dedicated technical support.

There are almost no standards among the hardware of printers (Except how they work). Things like nozzle screw thread size, heating of filament, printing bed type, gantry gears and more are different for almost all brands. (Always check with your school's Health and Safety Officer if you are unsure about the installation or use of any equipment). However, as most printers work in very similar ways, once you learn the intricacies of your particular machine, our **Tips and Tricks** will not only save you time, headaches and heartaches - but help to smooth the process as much as possible. We have included URL links for some products - these may change or disappear over time, so you may have to do a Google search.

Tips & Tricks

Isopropyl Alcohol

Our hands have lots of oils on them, especially if we touch our face before touching the print bed. Use this to clean the print bed - you will find that the first layer will adhere much better. It will also remove residues or oils from projects and if you are building multiple sections, gluing will be easier. (Note that some beds specifically say not to use this - a small drop of diluted washing up liquid or glass cleaner will be better. Always follow manufacturer's directions.)

Digital Calipers

These are an essential item to have when printing. Many times when designing a print, you need to scale it either up or down. This is especially true for wearables and items that need to fit together. Digital Calipers can give you exact measurements in the real world which can then be plugged in to your software.

Sometimes 3D prints fail (more often than we'd all like!). This can be a second reason for Digital Calipers. If you have a fairly flat surface on the failed section, you can measure this with the Calipers. Then simply drop your print down that amount in the software on the "z" axis and reprint... it should only print the remainder of your file (make sure this is the case as software varies). Then simply glue your two pieces together. It won't always work (due to layer shifts, etc.) but you can save lots of time and materials.

The last (and most obvious) use is to make sure your specifications are correct when measuring something for printing. A ruler just isn't precise enough - especially when measuring 3D objects that are not square.

Shop Towels

A good shop towel with a tighter weave is better for cleaning and soaking eg: when using Isopropyl Alcohol. (Note that cheap "blue towels" are often the opposite of this - a very loose weave which falls apart easily). You can also use microfibre cloth to clean surfaces.

LED Light Strips

These have become extremely cheap in recent years. Often the basic overhead ambient light is poor to see exactly what the 3D printer is doing. These lights are easy to use and install; can run over wifi; change colour, are very cheap and give good fill light. Install these around your printer to better see what the printer is doing.

Hot Glue Gun

A hot glue gun is invaluable for putting separate pieces of a design together. A dual-power/temperature model is a much better option than a single temperature model as often a lower heat setting can be better. If you can get a cordless model, this can be a great benefit in a classroom situation (try to avoid the "mini" style glue guns - generally they are not very good). Another great use for a glue gun is if you notice a print beginning to move or come loose on the bed, you can put some glue around the piece on the bed and save the print.

Tips & Tricks

Nozzles

Different 3D printers can take different nozzles. If your printer doesn't come with different sizes, you can order others from the company you purchased from or even cheaper on Amazon. Just ensure they will fit your printer. There are many different thread and nozzle sizes - from 0.2mm to 1.0mm and not every one fits every printer. Larger size nozzles will allow more filament through - making for a rougher (but faster) print. (Good for prototyping). Generally you need to increase the temperature and decrease the speed a little with larger nozzles.

Layer Lines

Currently, 3D printing works on building up layers to create a final print. Often these layers can cause many issues if something moves or shifts even half a millimetre. Many people presume the software settings are incorrect, or try to tweak it there to fix the problem. However, many times it can be a hardware issue. Common fixes are to check to ensure the print bed is level or the gantry isn't loose.

A note here regarding layer height and initial first layer... if printing a very detailed and fine print, your layer height may be 0.1mm. However, in many pieces of software you can also set the "initial layer" height - it's tempting to make this 0.1mm, but if you make it a small bit higher - 0.3mm for instance - then your first layer can be more forgiving and the rest of your layers will still be very detailed.

Test, Test, Test

Depending on complexity of your model, don't create it and hope it just prints perfectly the first time. Do tests. Print a small section first to see if it works - also, it can (sometimes) be quicker to print different sections and either glue or fasten them together in a different way... especially when prototyping.

Nozzle Cleaning Kit

Your print head nozzle will eventually become clogged. Keep a sharp eye on it as you really don't want this to happen in the middle of a print. A good cleaning kit can cure this in a short period of time. A kit that has different size cleaning needles, strong tweezers and sometimes a wrench/removal tool and a steel brush is a good start.

Filling and Sanding

Not all 3D prints can (or should) come out as finished items. Gluing, sanding, joining and filling are all part of any print - even simple ones. (Depending on the material you are using - PLA or ABS). ABS is easier to smooth, but PLA can be difficult. There are many ways to prepare your print for joining, filling, painting or gluing. For filling, some people will use wood filler on their print, but consider using autobody repair filler instead - it sticks a bit better and doesn't shrink as much. (Wood filler can shrink up to 10%.) For sanding, use different grades of sandpaper and try using wet sandpaper with a touch of washing liquid in the water (just a drop!). Always remember to work your way up in sanding grits - generally start at around 80 and work up to 220 for final products.

Tips & Tricks

Cracks and Breaks

If your print is large and you get breaks or cracks, you can fill them (see "Filling and Sanding" above) - but you can also consider using an epoxy on the print to give it extra durability - especially if it will be used a lot. Beware however that while epoxy gives a nice, shiny finish and can double the strength of a print - it is messy, hard to sand and generally creates a thick layer - so not to be used for precision parts. Plastic putty can also be used to repair a print - it dries quickly, adheres very well and is only a single part product (unlike epoxy which is dual part).

Another option here is to use a 3D Printing pen - these are very cheap and if you get one you can use the same filament with - this can be an easy way to fill in cracks before sanding and finishing a piece.

Miscellaneous Tools

When printing 3D elements - there are a few small tools that can be very useful... these include: good snips (for trimming filament, taking larger burrs off prints, etc. Note that they come in curved and flush types - both are useful); different size pliers (from standard to needle nose) for removing supports; leather or workman gloves for working with larger bits of plastic (they can be quite sharp sometimes)

Octoprint

While this isn't a necessity - it can make life much easier. The reality of 3D Printing is that it often takes quite a lot of time. It can be impossible (especially in Educational settings) to watch and monitor this all the time. Having the ability to leave it run and be alerted if there is an error can be an invaluable time saver. Octoprint is an operating system that runs on a Raspberry Pi and offers many features such as: monitoring and remote control of your print; check temperatures; control all axes of your printer; create time-lapse videos of your print; slice your .stl files and even shutdown your printer. Even better, it's 100% free. (You do have to purchase a Raspberry Pi and set it up however!) Have a look at "The Spaghetti Detective" and "Klipper" as well.

Filament

Sometimes filament can have a life cycle - it doesn't last forever. It can dry out and begin to snap - this can be extremely annoying when trying to feed it into the extruder. You think you have it right and then as it begins to feed, it just snaps off. Sometimes when this happens it's easy to blame the filament - thinking it's inferior or just wrong for the job. Experience tells me that it is usually me that is the issue. Almost (!) all filament is pretty much the same. Frequently the bed needs to be leveled, there's a wrong setting (temperature!) or I just made a mistake in my calculations.

There are really 2 main types of filament: PLA and ABS. PLA is very forgiving and easy to use for almost all prints. ABS is more difficult to work with, but has some better characteristics PLA does not. [Relatively] recently, PETG was introduced and falls in-between these - you can print hotter and it is also very forgiving. There are of course others out there - but for 80% of your projects PLA will be the correct type to choose.

Tips & Tricks

Size & Scale

During the design phase of your project - keep size and scale in mind. (Use your digital calipers!). On screen - objects look huge and you may sweat the small stuff trying to get it perfect. However - bear in mind your print nozzle size and the size of your filament. Will a 0.5mm bevel really matter if your nozzle is 0.2mm? (The answer is no, because the filament and nozzle won't print that small). Try to keep perspective on real-world prints vs. on-screen design.

Shoulders of Giants

The 3D Printing community is extremely generous. You will find tons of resources online and many people share their designs freely with others. While there may not be a design for exactly what you are making - you may be able to adapt something that is very close - this can be a real time saver in the design phase.

Print Bed Adhesion

When printing, your filament is layered on to your print bed. Regardless of the size of print you are doing - it is almost always a good idea to ensure your print adheres to the print bed in some way. There are a variety of different methods to do this.

Skirt. This is simply laying down a few lines of filament outside your actual print - without attaching to the print. This will give you a guide to the actual print to see if the print shifts at all during printing and to gauge how the print will look.

Brim. The Brim method will add multiple lines attached directly to the outside of your print to give it a larger surface area to hold on to the print bed. This can be especially useful if your print is narrow at the bottom but tall. (Think of a tall handle).

Raft. This method will give the largest surface area and acts like a binding layer between the print and the bed. Using this method is especially good if your bed isn't centred, level or even in some places. While this method can be the best and most stable - it will add more work to your final print. By its nature, a raft adhesion will be attached to your print. This means you will have to remove it by breaking or cutting it off - and then you will have to sand and clean it down afterwards.

Tree Supports

Depending on the type of object you are printing, Tree Supports can be an excellent way of making sure prints don't fail. Tree Supports can be built in to prints to ensure sections of the print remain attached and solid until the filament sets. What is nice about these supports is that they tend to have minimal points of contact with your print - giving you less to clean up and fix. It's worth noting that they can be implemented from the bed up or just inside the print. The downside is that you have to be careful - sometimes they don't work as well as other supports in your slicing software.

Tips & Tricks

Sectional Analysis

Most software will include a "sectional analysis" function. This is where you can drag your model up and down - effectively seeing how it will print before printing. Use this tool before moving to your Slicer software to add needed supports that are just built into the print. Some Slicer software is better than others and can sometimes miss areas that need supports when printing.

3D Builder

Sometimes when designing, you may take objects from other 3D sources. When you copy these files, they are not always suitable for printing and need to be repaired. "3D Builder" (a free Windows 10 download) can repair these files with a single click. (Of course, you may still need to do a bit more repair work).
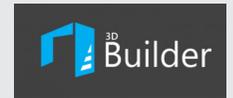
File Types

Certainly most modeling/slicing software will use the standard .stl file format. However, if possible and available - use the .3mf file format instead. File sizes are dramatically smaller and these files contain more data such as geometry, material, properties and even colour data. Many pieces of software are moving towards this format.

Good References

https://www.engineersireland.ie/Covid-19-information-base/ultimate-guide-to-3d-printing

https://www.nervecentre.org/news/story/download-nerve-centres-new-3d-printing-handbook-schools

https://www.engineersireland.ie/Covid-19-information-base/first-resident-of-3d-printed-concrete-house-receives-key

https://blog.tinkercad.com/2019/01/18/teenpreneurs-use-tinkercad-to-design-medical-devices-for-children

Links

Epoxy Resin	https://www.grs.ie/product-category/products/epoxy-resin/laminating-epoxy/
OctoPrint	https://octoprint.org/
Hot Glue Gun	https://www.amazon.co.uk/dp/B07PM8PY2P/
Plastic Putty	https://www.amazon.co.uk//dp/B0076LAVFK/
Nozzle Cleaning Kit	https://www.amazon.co.uk/dp/B07PR41QSG/
Autobody Filler	https://www.halfords.ie/motoring/paints-body-repair/fillers-preparation/davids-isopon-p38-600ml-194738.html
Wet/Dry Sanding Paper	https://www.halfords.ie/motoring/paints-body-repair/fillers-preparation/halfords-wet-and-dry-sanding-paper-4-assorted-sheets-384818.html
Isopropyl Alcohol	https://rpmsupplies.com/product/i-p-a-isopropyl-alchohol/
Digital Caliper	https://www.amazon.co.uk/dp/B07GJMH9BP/
Shop Towels	https://www.halfords.ie/motoring/car-cleaning/sponges-brushes-buckets/scott-garage-shop-towels-692970.html
Snips	https://www.amazon.co.uk/dp/B08L5CX1XD/
Plier Set	https://www.amazon.co.uk/dp/B08TQXS2HT/
Filament Dehumidifier Bag	https://www.amazon.co.uk/dp/B08QHMSYY3
3D Printing Pen	https://www.amazon.co.uk/dp/B08FHX7GMS/

Links

The Spaghetti Detective   https://www.thespaghettidetective.com/

Klipper   https://www.klipper3d.org/

LED Light Strips   https://www.amazon.co.uk/dp/B07QBMJW6W/

Extra Nozzle Set   https://www.amazon.co.uk/dp/B07DL24HDY/

Diamond File Set   https://www.amazon.co.uk/dp/B08TZVB3YS/

Carving Set   https://www.amazon.co.uk/dp/B08MCBVMY6/

Note that URLs can change frequently as products come and go. If the links are no longer working, do a search for the item.