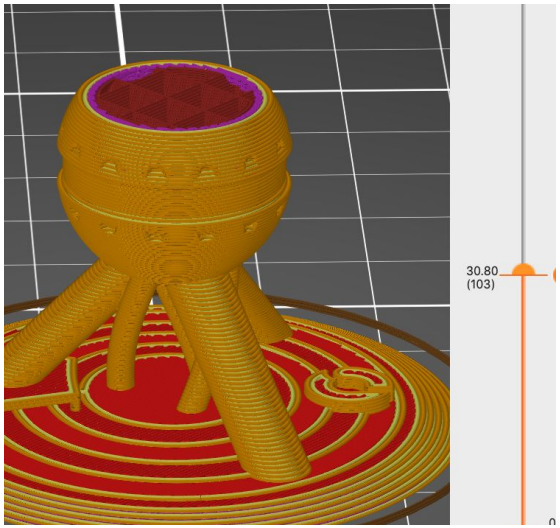
3D PRINTING

Introduction to 3D Printing

1. Principles & Hardware

3D PRINTING MAIN STEPS

3D Modeling → Export to STL → Slicing → Export to Gcode → Print



MOST COMMON 3D PRINTING TECHNOLOGIES

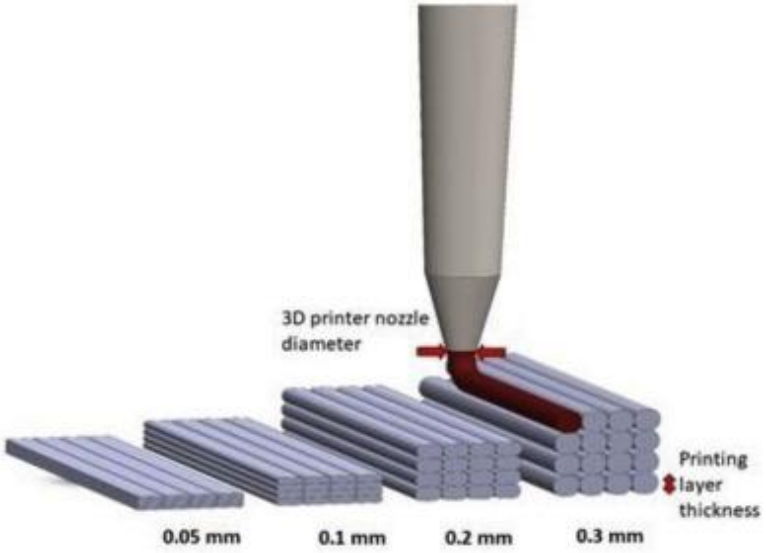
FDM or FFF
Fused **D**eposition **M**odeling

SLA
Stereo**L**ithogr**A**phy

SLS
Selective **L**aser **S**intering

https://formlabs.com/blog/fdm-vs-sla-vs-sls-how-to-choose-the-right-3d-printing-technology/

FDM (FUSED DEPOSITION MODELLING)



- ➔ A heated nozzle extrudes melted plastic,
- ➔ Each layer is added on top of the previous layer until the object is complete
- ➔ Thinner layers give higher “resolution” (model detail)
- ➔ Thicker layers reduce resolution, but also reduce time!

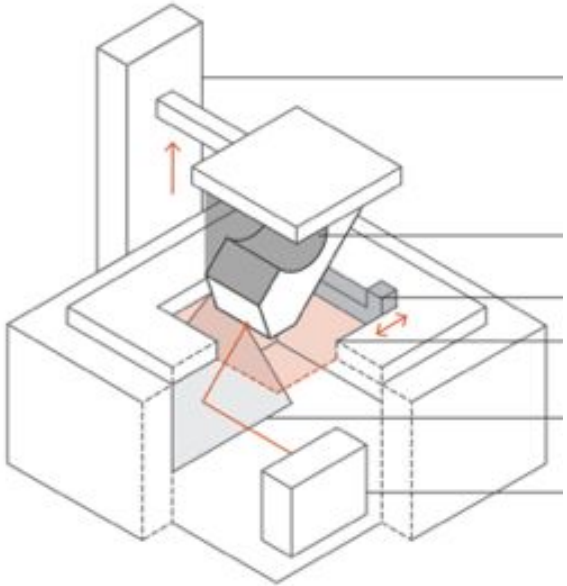
PRINTING MATERIAL

Material for 3D printing

Types of filament:

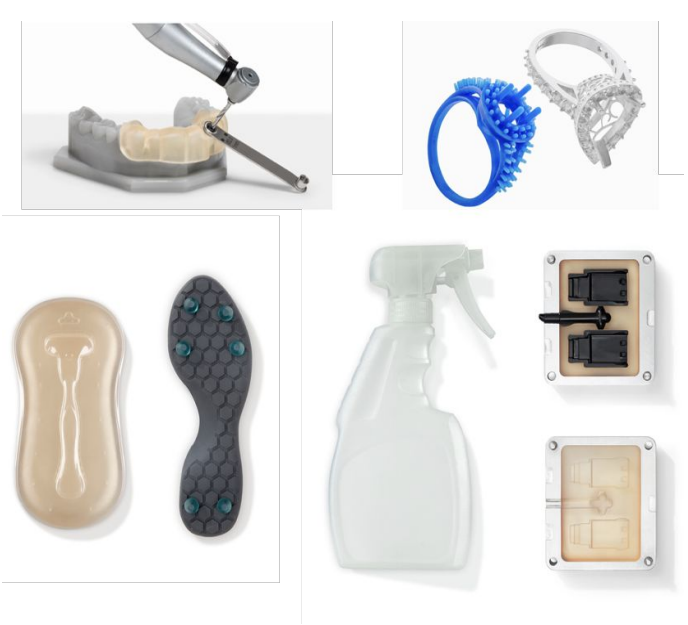
- ABS
- PLA
- PLA mixed with
  - Wood
  - Metal
  - Brick
- Flexible PLA
- Conductive PLA
- ...

SLA PRINTING



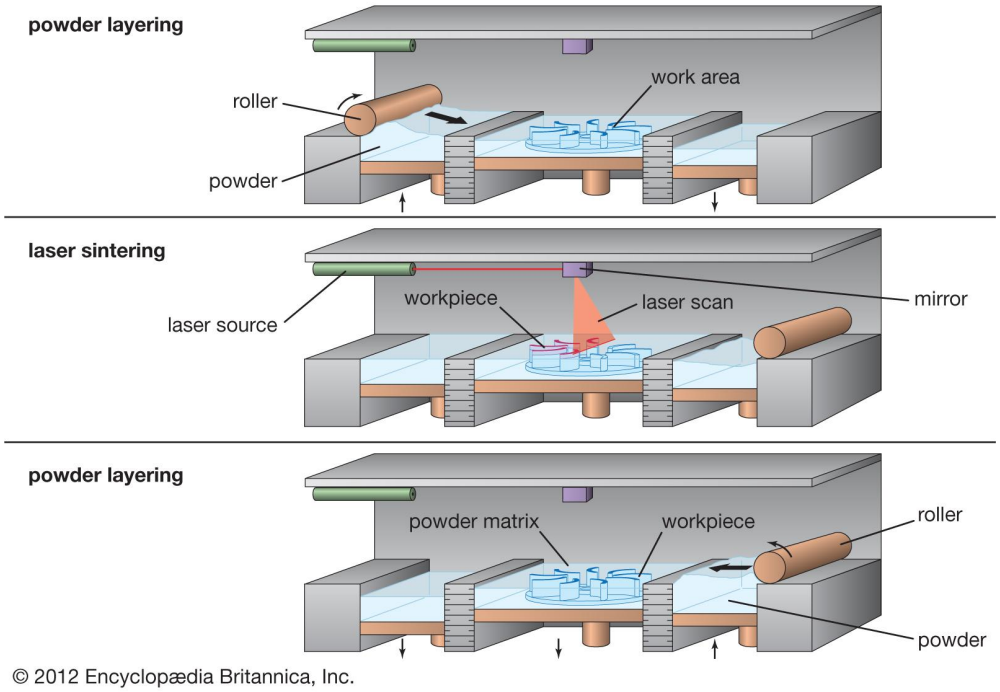
- SLA printing involves *curing* resin with a Laser, one layer after the other.
- Mirrors guide the path of the laser, and trace the paths to complete the layer
- Resin solidifies on the bed or previous layers, is given some time to aerate.
- Process continues to the next layer

DIFFERENT KIND OF RESINS FOR SLA



See Formlabs-Form-2-materials.jpg

SLS PRINTING



laser-sintering-process-layer-powder-work-area.jpg

SLS functions similarly to SLA, but the laser fuses powder into a solid layers instead of curing liquid resin.

WHICH PRINTER TO CHOOSE FOR YOUR PROJECT ?

	FDM	SLA	SLS
Feed Stock	Plastic filament	Polymer (light sensitive) resin	Metal and polymer powder
Materials and Costs	ABS, PLA, nylon, PC, PVA, woodlike...	Similar to PP to low end ABS	Alumide, stainless steel, ABS, titanium
Precision	25-75 microns	25 microns	150 microns
Part strength	Medium	Low	High
Material Availability	Easily available and cheap	Easily Available but is expensive	Not easily available and is expensive
Price	USD 4000 onwards	USD 4000 onwards	USD 500,000 onwards

3d-printerselectronics-materials-and-high-quality-prints-7-638.jpg

According to your project and the role of the part you are printing :

- Mechanical
- Artistic
- Aesthetic

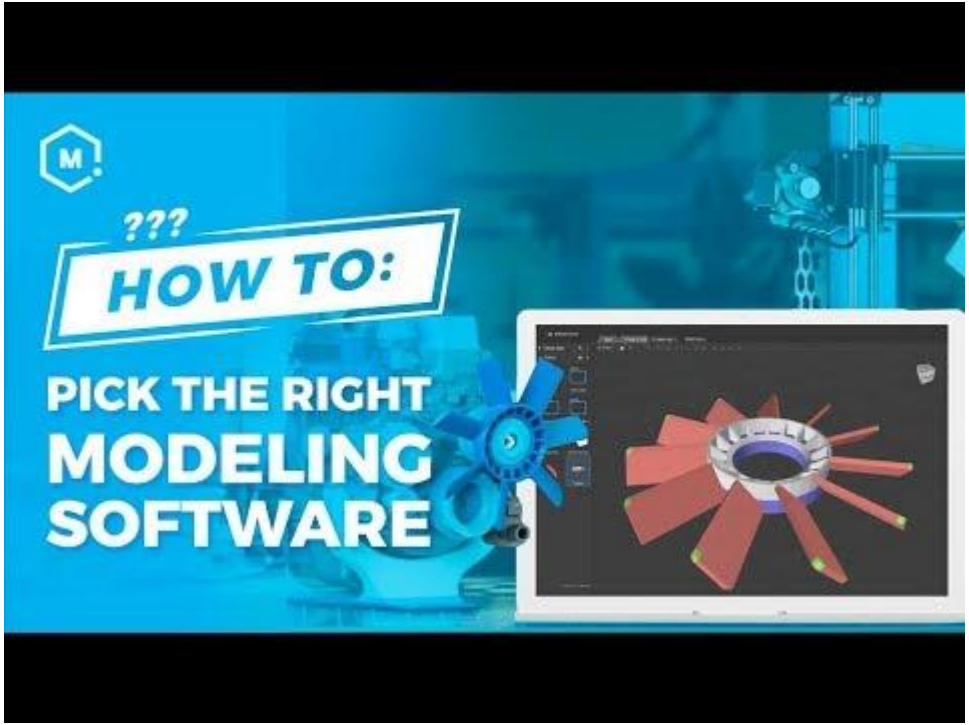
You may choose a different printing method.

Cost is also a deciding factor as much as the the state of development you are at :

Are you still prototyping? are you producing the final piece? etc.

2. Modeling & Hardware

CHOOSING THE RIGHT SOFTWARE FOR YOUR PROJECT

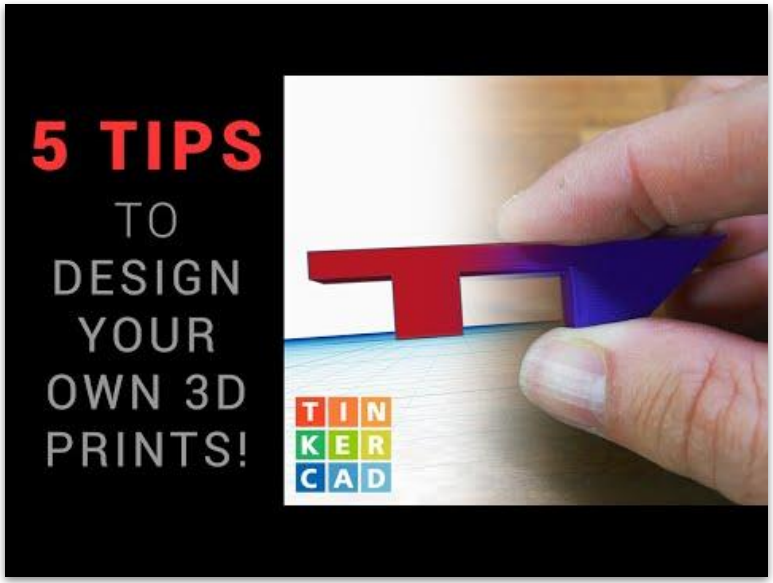


What software is used for 3D modeling? And what are the specific applications.

https://youtu.be/JzNdvZLoKAI

From Matter-Hackers Youtube Channel.

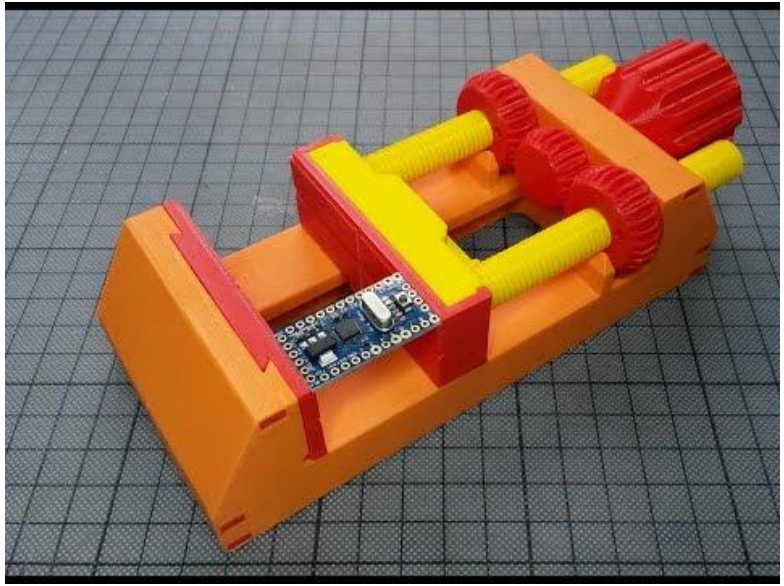
VIDEO - FDM DESIGN TIPS - GETTING STARTED



Tips to help you design and print your own parts from Teaching Tech's Youtube Channel.

https://youtu.be/QdvSzXByi_g

VIDEO - FDM DESIGN TIPS FOR MECHANICAL PARTS

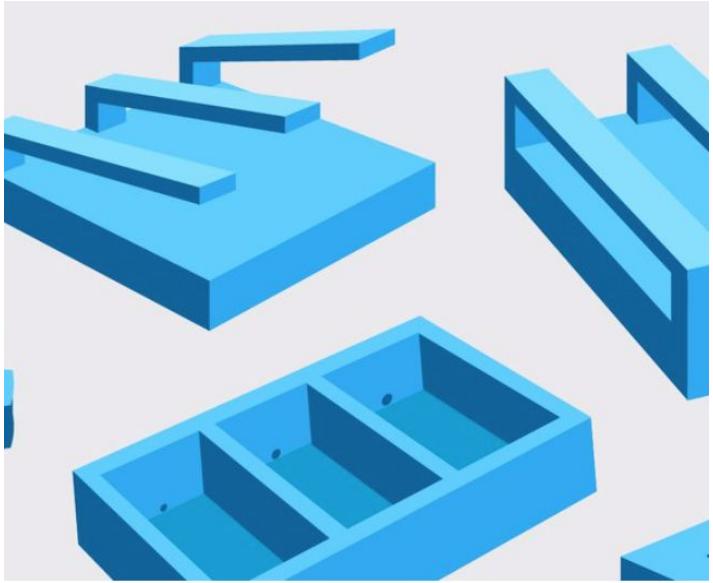


Prevent warping and mis-prints, orientate your model so the layers best suit its structural requirement

https://youtu.be/mziT7KV-fRI

From Christoph Laimer Youtube Channel.

SLA DESIGN TIPS



A successful 3D print starts from its modeling. According to the technique and intention, it may be better to pay attention to certain details.

Here are some tips from Form Lab, regarding design for SLA printing:

Plenty of tips on Formlabs website

Formlabs designing guide - PDF

EXPORT YOUR MODEL AS AN '*STL*' OR AN '*OBJ*'

'*.STL*' is a file format, containing meshes or shapes for describing the surfaces of 3D objects

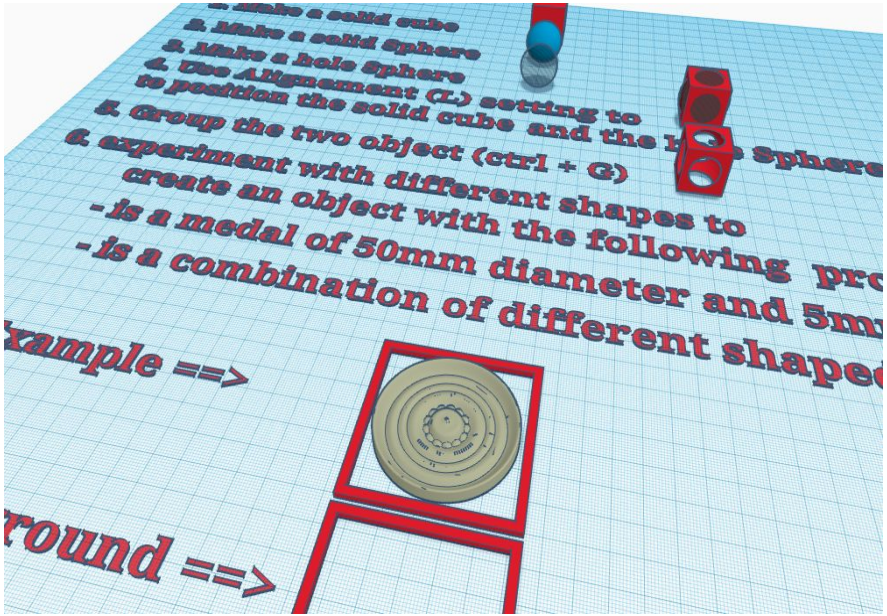
In 3D printing, an '.STL' file (or similar) is required for our next step : Slicing

Most of the time, you do not directly edit the STL, but you might export it from another program.

Let's say an .STL is like a .JPG. When you work on your picture with Photoshop you are working with a .PSD, if you work with Gimp you work on a .XCF, but when you want to publish, share, of look at your picture you export a .JPG.

3. Exercise: Exploring 3D modeling

EXERCICE - DESIGN A 3D PART



1 - Sign up to TinkerCad

2 - Copy and edit this project

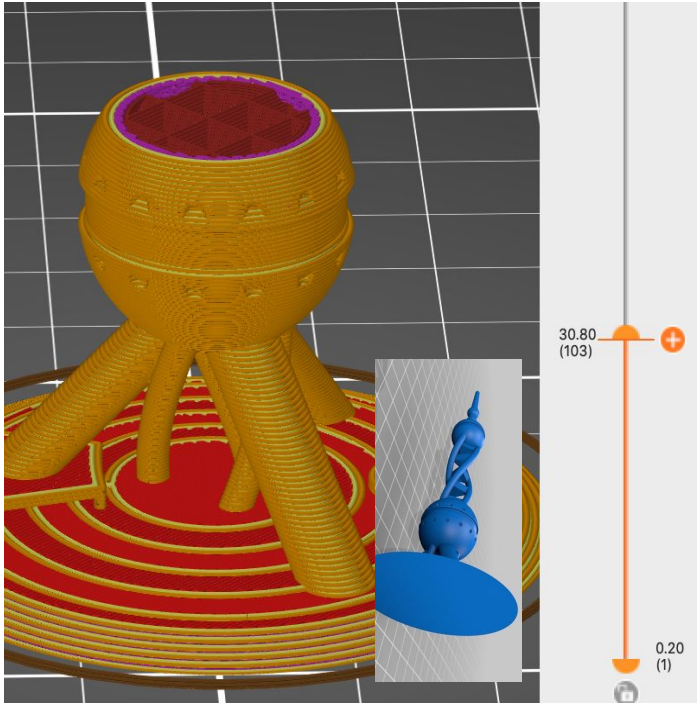
3 - Play around and follow instruction

4 - Export your object, and your object only (grouping all the part of your object and selecting it) as an .stl

https://www.tinkercad.com/things/6TODtWdarj3

4. Slicing your 3D model

WHAT IS THE “SLICING” STEP ?



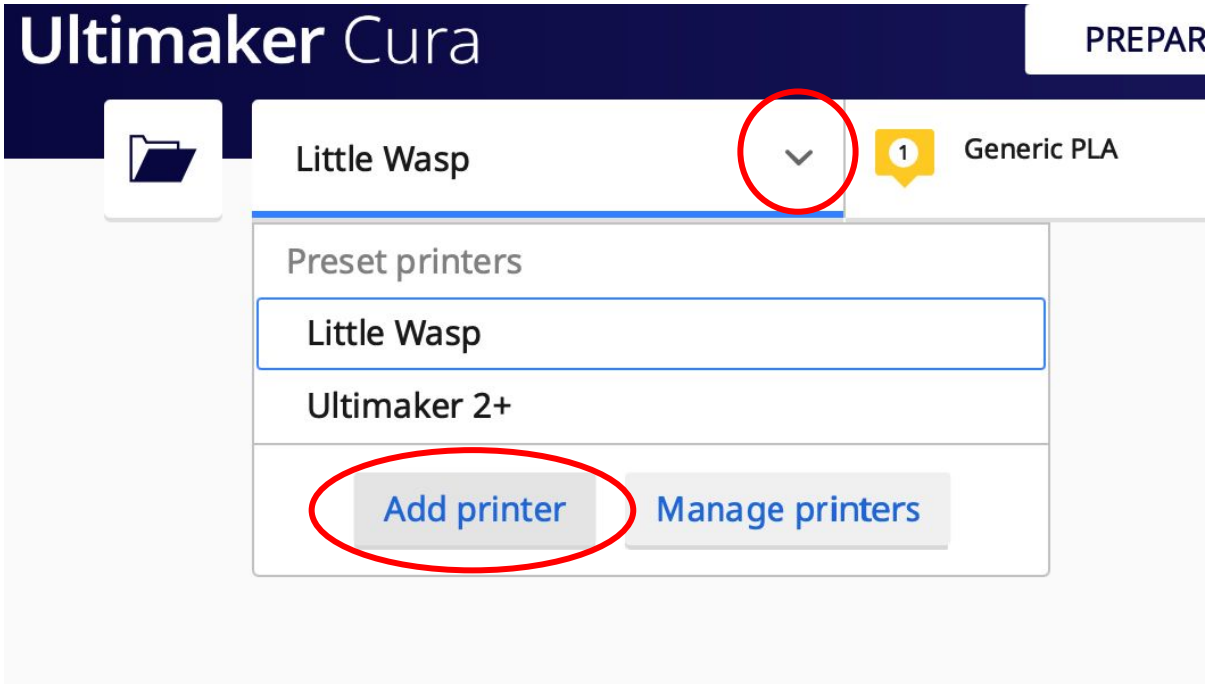
- ➔ To get from a 3D model to a 3D printed object you need to slice it.
- ➔ Slice = Cut the object in thin layer stacked on top of each other
- ➔ This step will generate a list of precise instruction the 3D printer can read and execute
- ➔ This is called *G-Code*
- ➔ The G-Code is what you need to upload to the 3D printer in order to get the job done

SOFTWARE, 3D PRINTERS AT FAB LAB LIMERICK

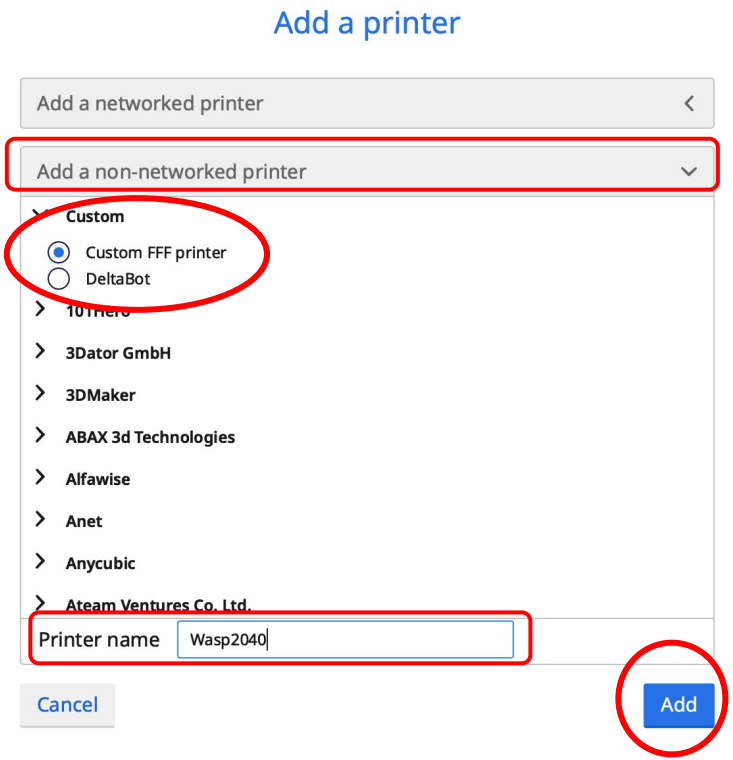
Different printers uses different software: please download and install the following software.

3D printer	Wasp 2040, 4070	Prusa i3 mk3	Form2
Software	Ultimaker Cura Needs configuration	PrusaSlicer Ready to use	PreForm Ready to use

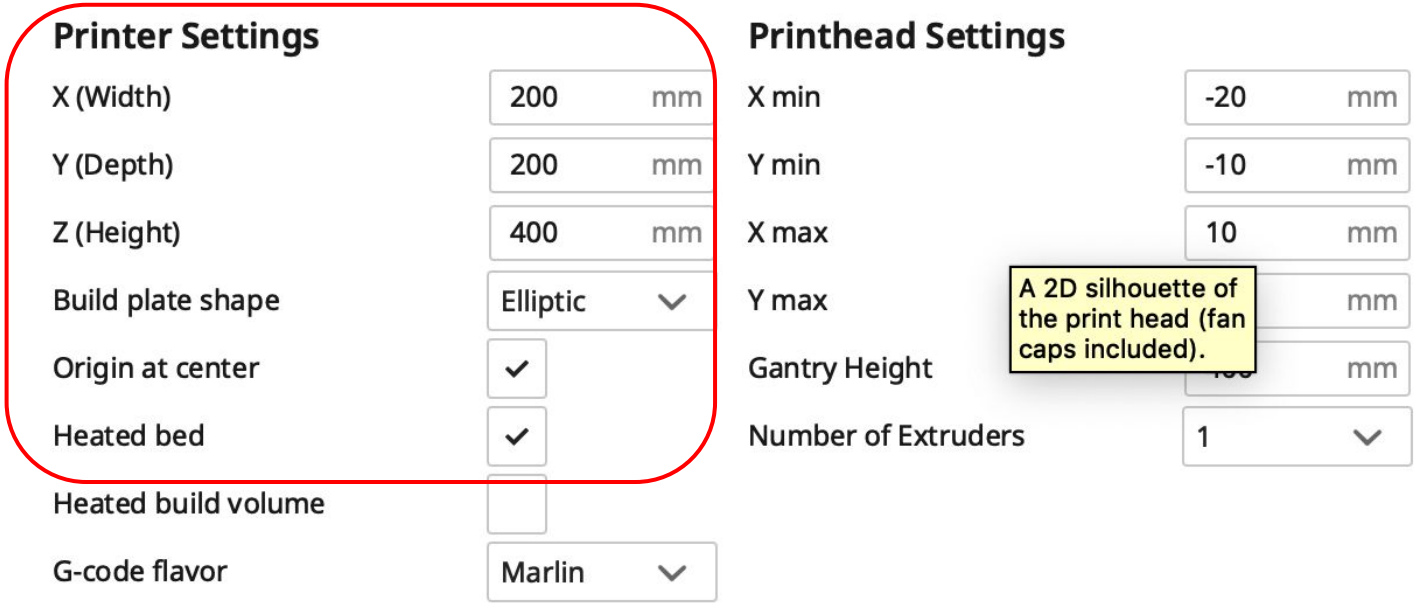
HOW TO SET UP CURA FOR THE WASP 2040



HOW TO SET UP CURA FOR THE WASP 2040

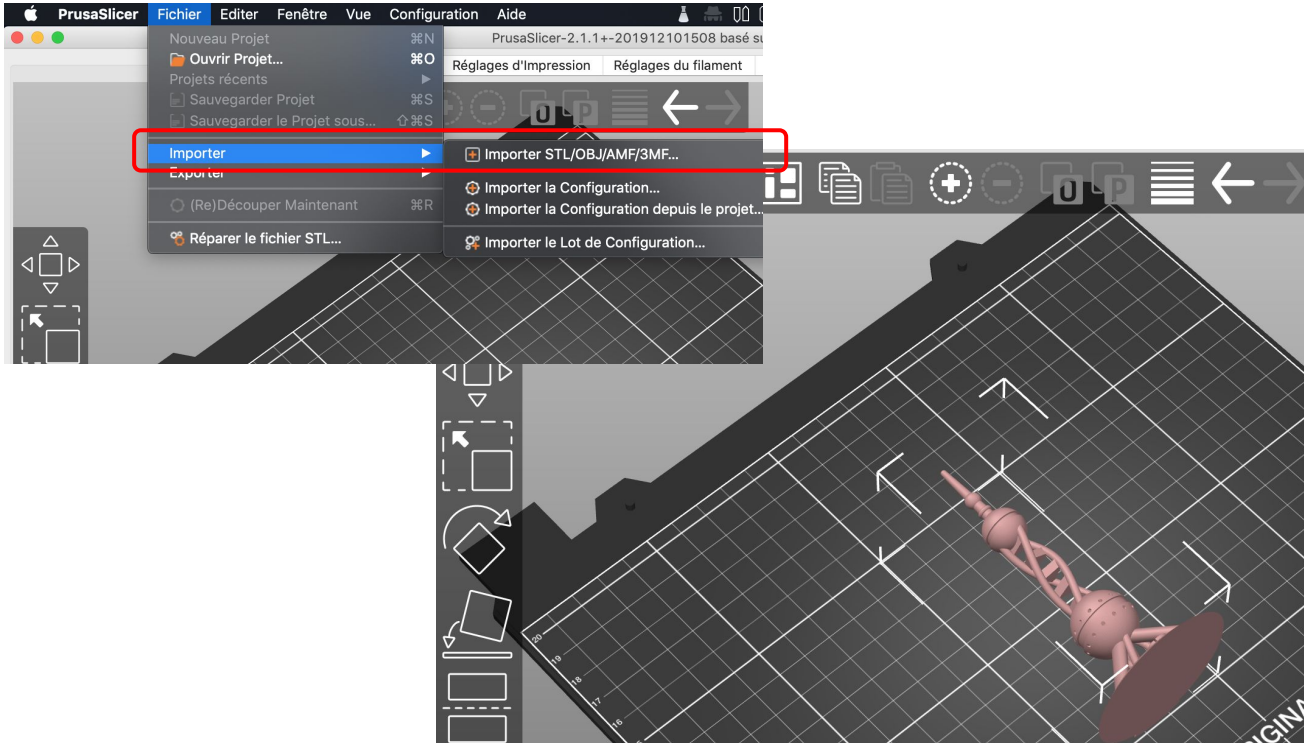


HOW TO SET UP CURA FOR THE WASP 2040

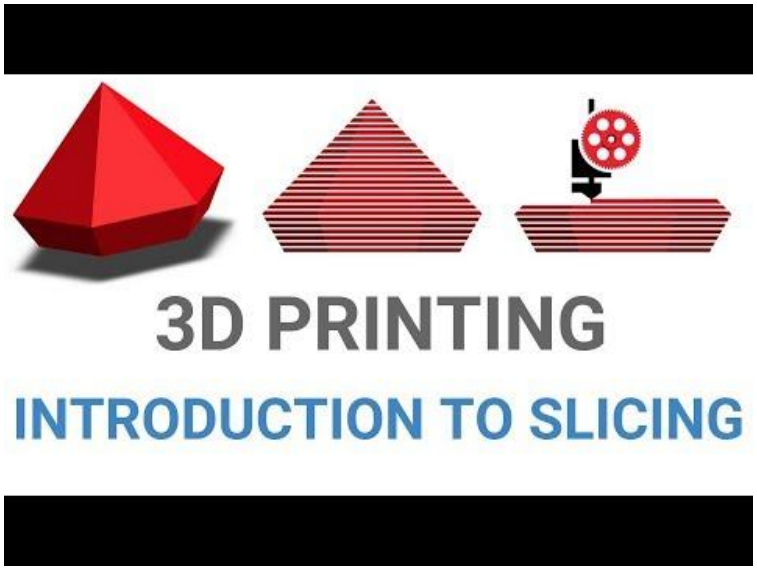


HOW TO SET UP CURA FOR THE WASP 2040

IMPORT YOUR MODEL INTO THE RELEVANT SLICER



VIDEO - INTRODUCTION TO FDM SLICING



This is how slicing works for FDM

Features are pretty similar in Cura and PrusaSlicer

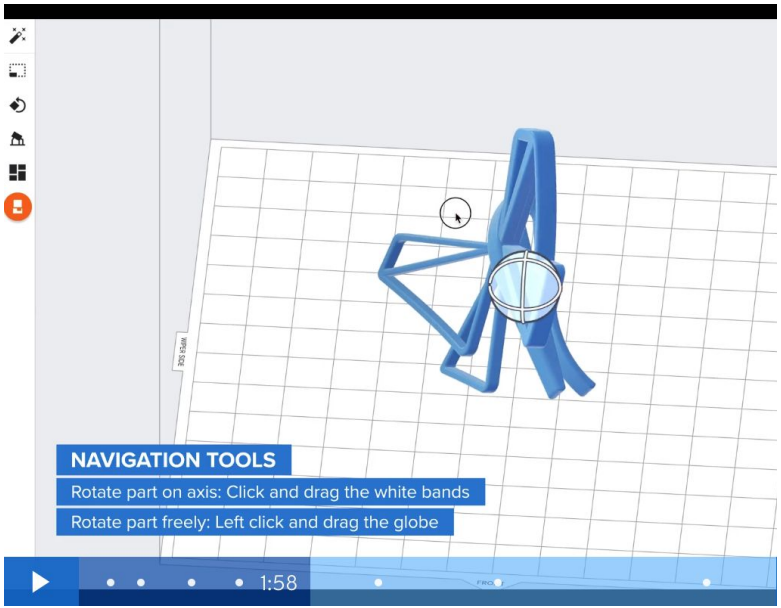
Take time to get familiar with the interface

We will slice object together on training day

https://youtu.be/8sxlyuN6xso

From Advanced engineering technologies Youtube Channel.

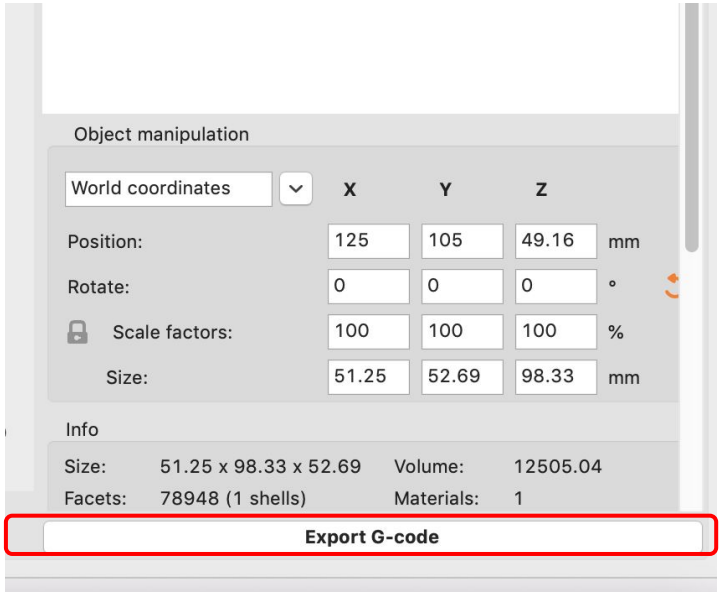
VIDEO - SLICING FOR THE FORMLAB/FORM2



Video available on Formlab website:

- ➔ Starting a print
- ➔ From Design to 3D Print: The Form 3 Workflow in Five Minutes

AFTER SLICING, EXPORT A G-CODE FILE

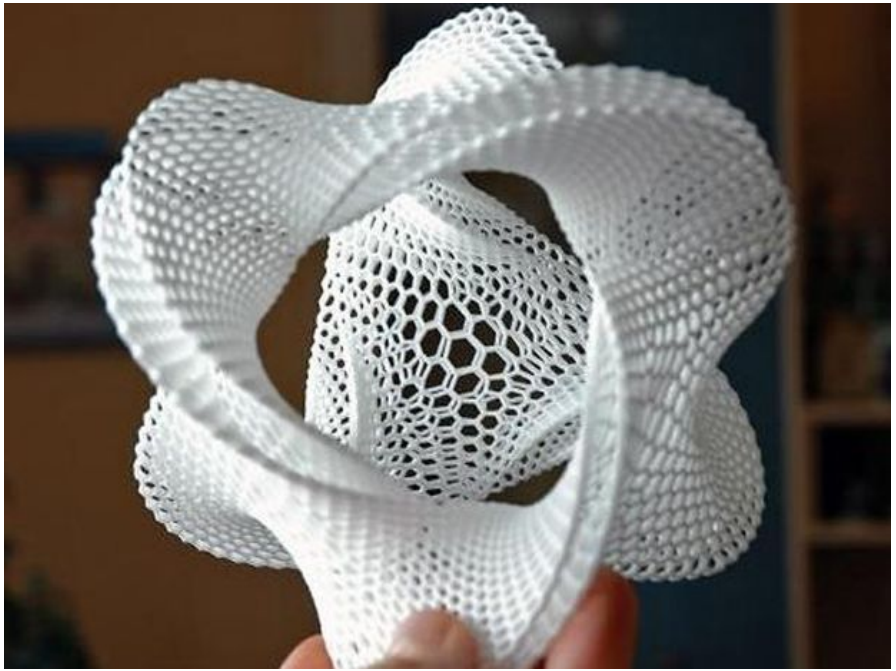


The result is a G-code file the printer will read and execute.

You need to “export G-code” as indicated

5. Exercise
Slicing your .STL model

EXERCISE



Slice the object you made on the previous exercise (back in section 3), with the slicer of your choice

Play with the different parameters (Scale, Layer height, Infill %), and see the expected print time, and material requirements.

Export your G-code

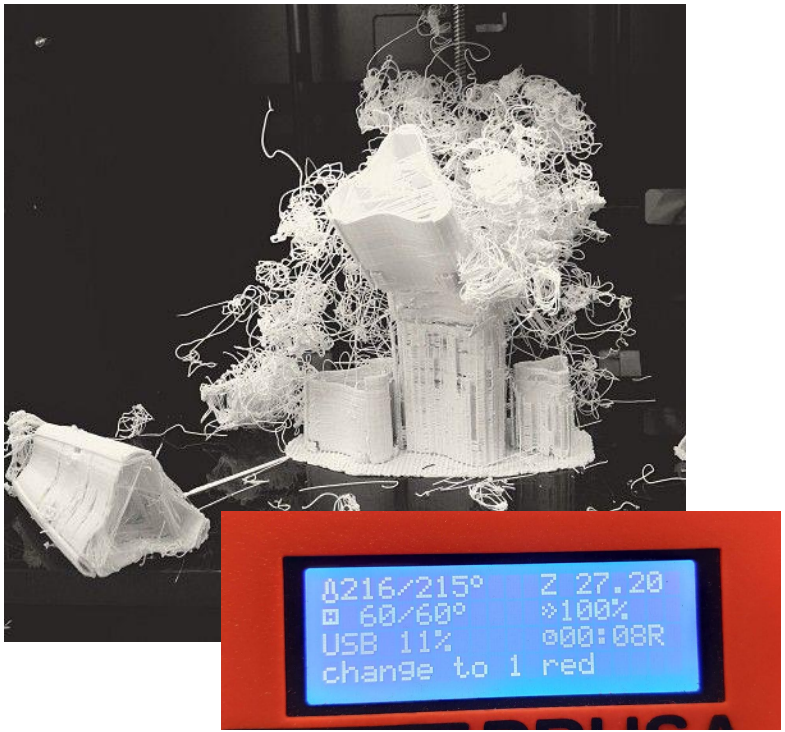
Here is a short article explaining the main 3D printing parameters

6. Printing

SELECT YOUR FILE

- ➔ Send the Gcode file to the printer sending it through WIFI or using a SD card
- ➔ Select the File you want to print
- ➔ Press OK

FDM : WHAT TO CHECK BEFORE YOU START

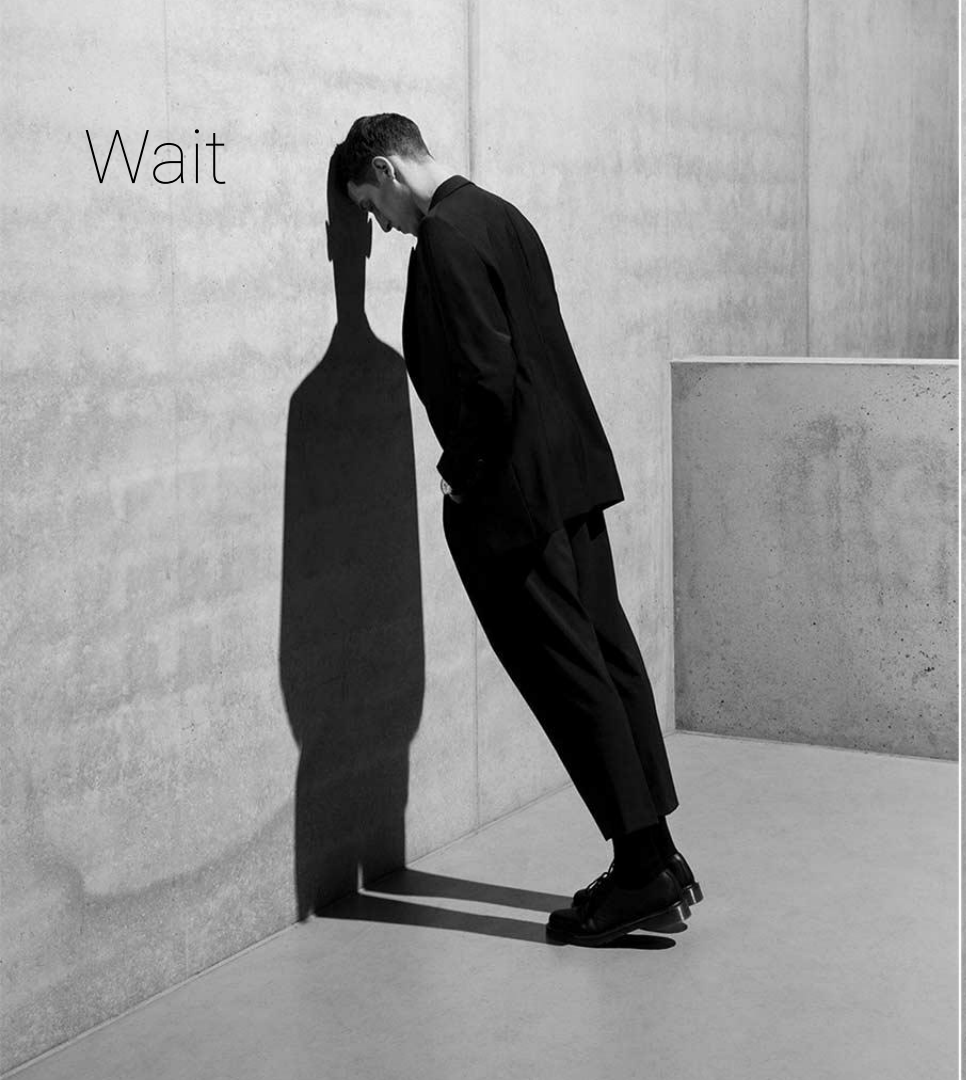


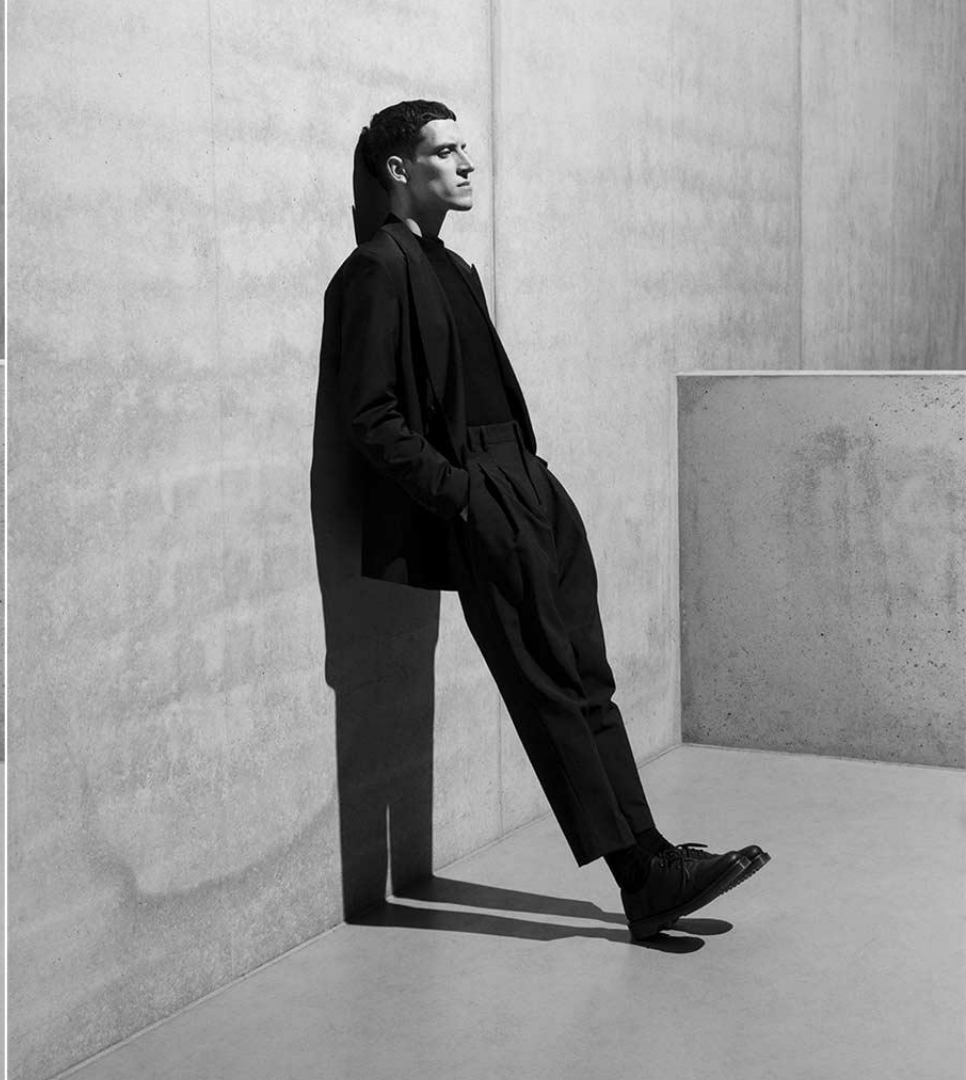
Temperature of the nozzle - Is it the right temperature for your filament?

Temperature of the bed - If the part sticks to the bed adequately.

Watch over the first layer or so to check nothing is going wrong

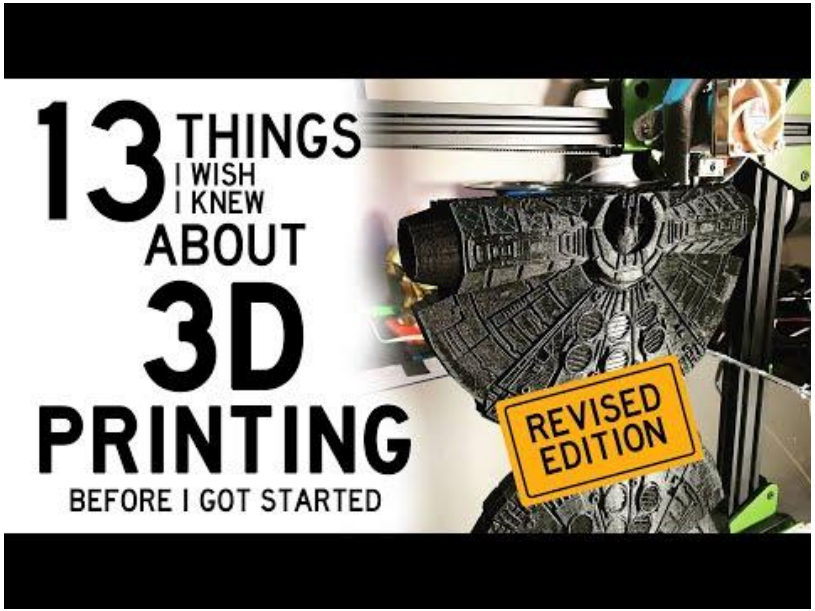
Wait






DONE !

VIDEO - BONUS 3D PRINTING TIPS



https://youtu.be/LvGKfevdf_Q

From The 3D Printing Zone Youtube Channel.

7. Resources

Software

Online

https://www.tinkercad.com/

https://www.onshape.com

Offline

https://www.blender.org

https://www.autodesk.com/products/fusion-360/students-teachers-educators

https://www.rhino3d.com

https://www.sketchup.com

Downloads - Models, parts & scans from other designers:

https://www.myminifactory.com

https://www.thingiverse.com

https://cults3d.com/en

See you at the Fab Lab, for the hands-on training!

If you have any other questions try http://fablab.saul.ie/how - for various tutorials and other information