

Before session:

- Email participants and ask them to sign up for a free Autodesk account
- Set up 3D printer with demo prints

Materials:

- Per participant:

# Acknowledgement of Country

We acknowledge Aboriginal and Torres Strait Islander peoples and their continuing connection to land and as custodians of stories for millennia. We respectfully acknowledge the land on which we all meet today, and pay our respects to elders past, present and emerging.

**Intros!**



**Why did you  
sign up?**

Why do you want to  
know about 3D Printing?

What do you hope to get  
out of these sessions?

## Session Overview

1. See The Edge's 3D printers at work.
2. Look at some software you can use to design a model
  - Fusion 360
  - Meshmixer
  - Tinkercad

## Session Overview

3. Look at the software we use to slice our models.
4. Have a go at designing something to print

# Why 3D printing?

Allows us to

- Rapid prototype
- Create elegant solutions to annoying problems... repair, invention, time or effort saving solutions
- Express our creative selves and beautify the places we spend our time.
- Also there are things you can do with a 3D printer (additive manufacturing ) you cant do with subtractive processes

# How does 3D printing work?



## That depends...

There's 3 main types at the consumer/prosumer level.

- UV Resin
- Laser cinter
- FDM

# UV Resin

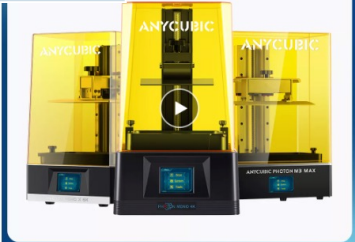
Layer by layer image exposes tank of UV activated resin UV light

Pros	Cons
<ul style="list-style-type: none"><li>👍 Cheap hardware</li><li>👍 Hi Res</li></ul>	<ul style="list-style-type: none"><li>👎 Nasty chemicals</li></ul>

AliExpress ANYCUBIC Online Store Top Brand 96.8% Positive Feedback 6294 Followers

Products Sale Items Top Selling Buy 2 Get 3 Feedback

Online Store



Mono X 6K/Mono 4K/M3 Max/Mono X

ANYCUBIC Photon Mono X Wash&Cure Machine SLA 1

★★★★★ 4.7 ~ 65 Re

**AU \$182.95** AU\$

color: Wash and Cure 2.0

Quantity: 1 50 Pieces available

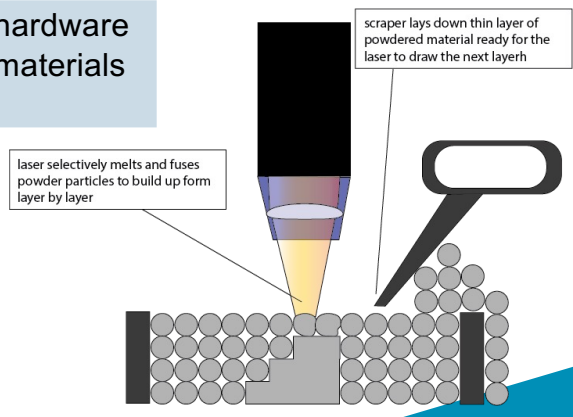
Ships to Woolloongabba, Q

**Free Shipping**

# Selective Laser Sinter

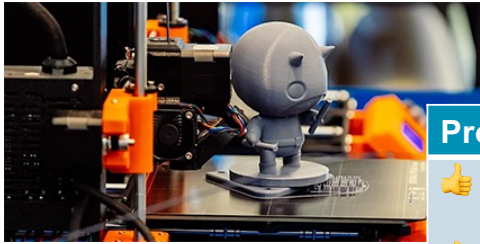
Laser draws an image layer by layer by selectively melting powdered material.

Pros	Cons
👍 Hi Res 👍 All sorts of great materials	👎 Expensive hardware 👎 Expensive materials



# Fused Deposition Modeling

A hot nozzle draws a bead of melted thermoplastic layer by layer to create a model.



## Pros

- 👍 Reasonably priced materials
- 👍 Reasonably priced hardware
- 👍 DIY kits and open source community

## Cons

- 👎 Limited to a few types of plastics
- 👎 Limited resolution
- 👎 More plastic being used and potentially ending up in our environment

**What can go wrong?**

## Safety

- Electricity
- Fire
- Respiratory
- Crush injury
- Brain explosions

Electricity – need to be aware that we are working with machines that are run off 240v

Fire- thermal run away can cause a fire this is why we do not leave printers running without general supervision

Respiratory- Fumes from the filament and particulate are harmful human health take ohs precautions

Crush injury- you can get fingers stuck in a machine

Brain explosions- if you start to get frustrated walk away.

Isopropyl used to clean printer bed also presents fire, inhalation and skin irritation risk please read and follow SOP located with equipment

## **Print failure modes**

### **Machine failure and possible damage to the machine**

- Birds nest - non adhesion/ print lift
- Z axis shift
- Delaminated layers
- Clogged nozzle or extrusion stepper errors
- GCode Encoding error
- Hot end runaway

# Lets see a machine and how to start a job

## **Move to printers.**

- Explain operation - feed stock passed into hot end driven by extruder stepper motor, movements controlled by the gcode instructions and actuated by x & y Stepper motors, draws out model on layer a a time and then Z axis stepper moves the layer and the machine then draws the next layer.
- Show components
- Prep build plate with Isopropyl
- Insert SD card and navigate to job.
- Start job
  
- Look at ½ done jobs on other printers:
  1. Add insert to paused job
  2. Look at internal infill
  3. Discuss support

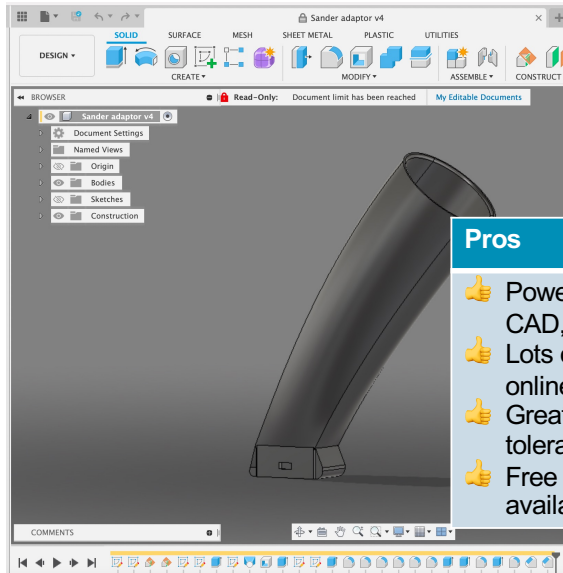
## **Move to back to computers.**



**Designing for 3D printing**

**CAD software**

# Fusion 360



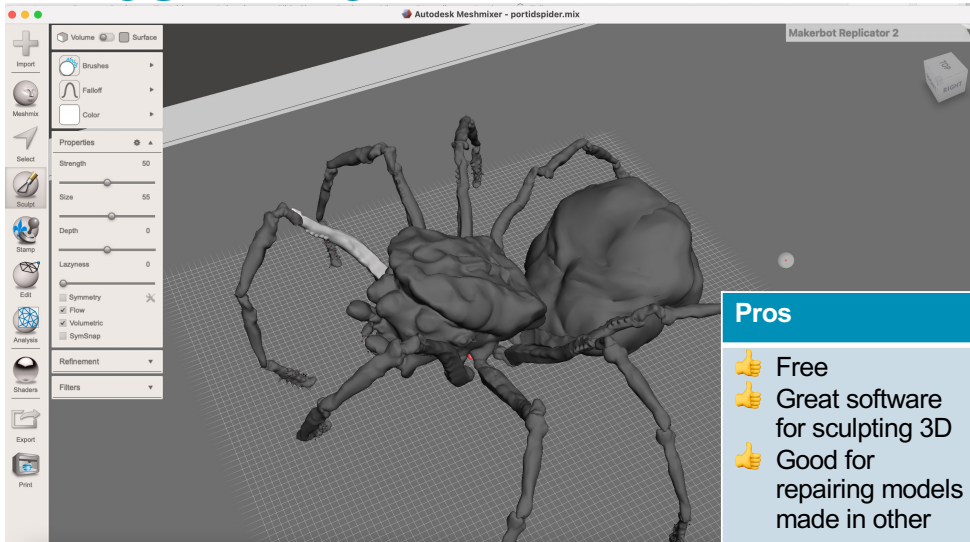
## Pros

- 👍 Powerful professional CAD, CAM, CAE software.
- 👍 Lots of good tutorials online
- 👍 Great for design hi tolerance mechanical parts
- 👍 Free hobbyist license available

## Cons

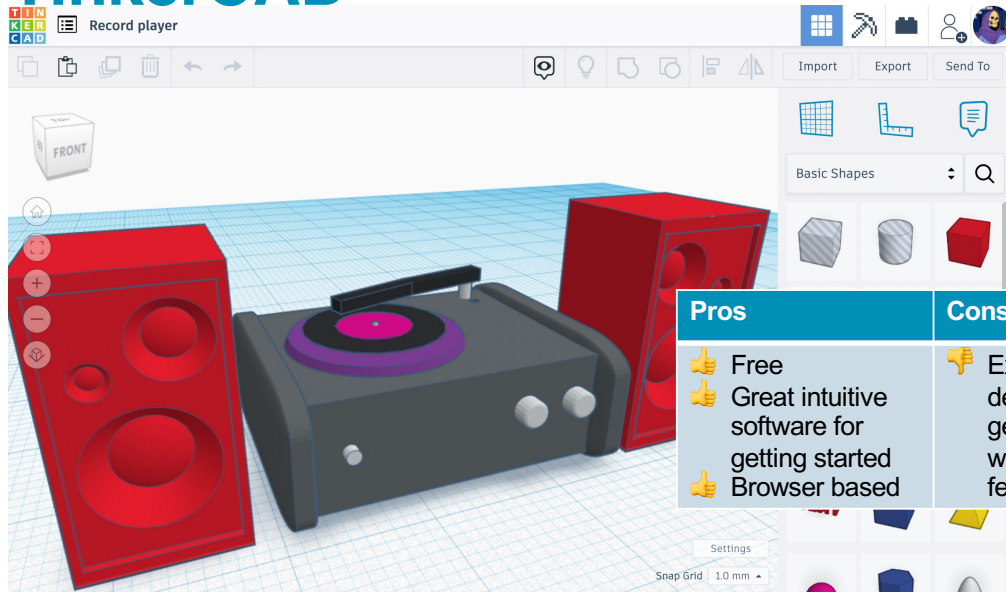
- 👎 A lot to get your head around when starting
- 👎 Full version relatively expensive (but not as expensive as others)

# Meshmixer



Pros	Cons
<ul style="list-style-type: none"><li>👍 Free</li><li>👍 Great software for sculpting 3D</li><li>👍 Good for repairing models made in other programs</li></ul>	<ul style="list-style-type: none"><li>👎 Probably want try something more intuitive first to get your head around the concepts</li></ul>

# TinkerCAD

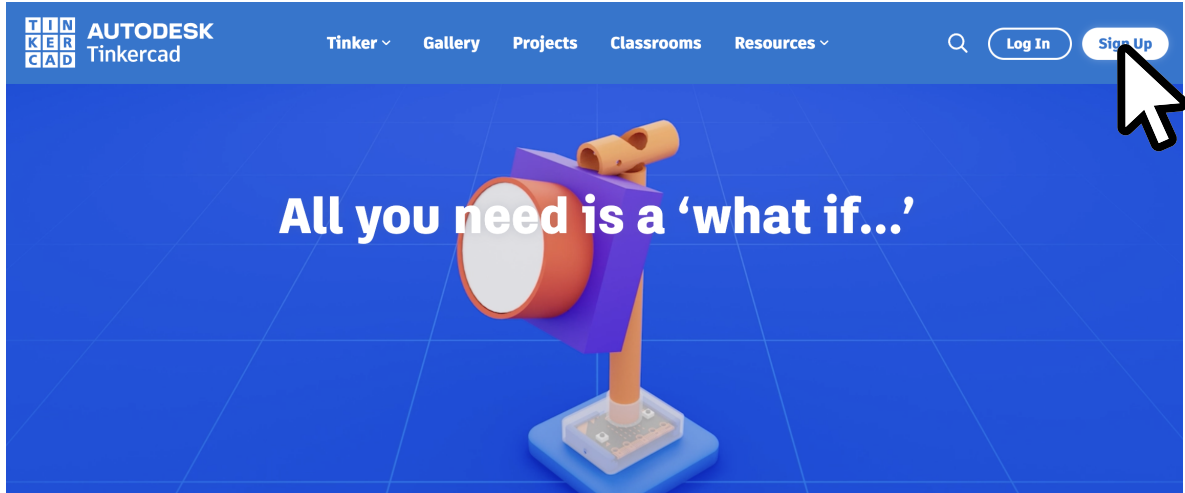


**Lets have a go!**

Go on the internet and navigate to

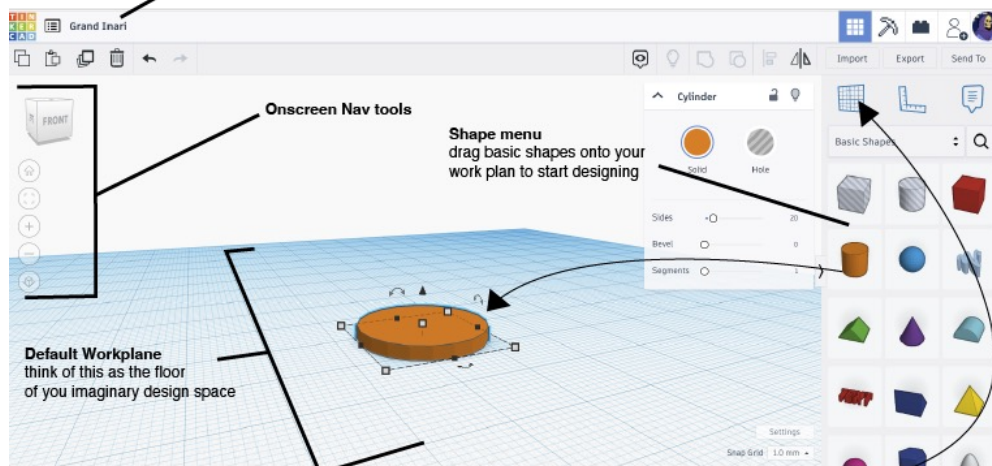
**TinkerCAD.com**

# Sign up for a free account



# The interface

Auto generated file name  
double click to type in  
something meaningful



Onscreen Nav tools

Shape menu  
drag basic shapes onto your  
work plan to start designing

Default Workplane  
think of this as the floor  
of you imaginary design space

but you can also use this tool  
to place a workplane on any face of an object

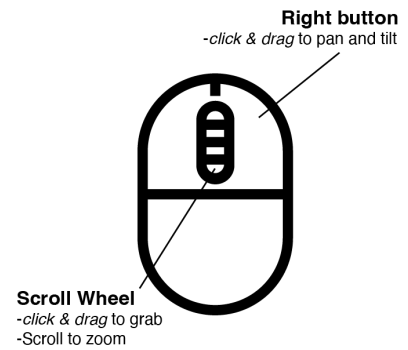
# Navigating the 3-dimensional space

## Moving around

- Zoom in and out using the scroll wheel

## Pan & Tilt

- Right click and drag to change the aspect of your view or
- Click and drag the Cube device to rotate your view angle
- If you get lost click the **home icon** and it will take you back to the default view





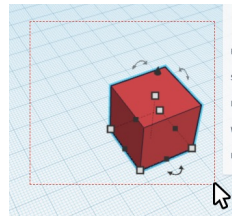
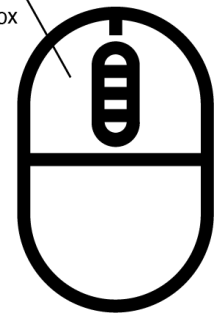
# Moving and manipulating shapes

## Select

- Using the left click (hold shift select multiple objects)
- Or left click and drag a selection box around multiple objects

### Left button

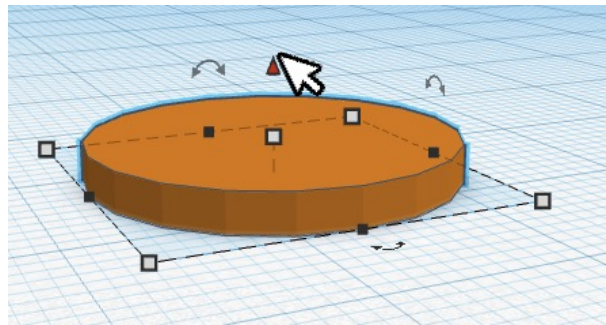
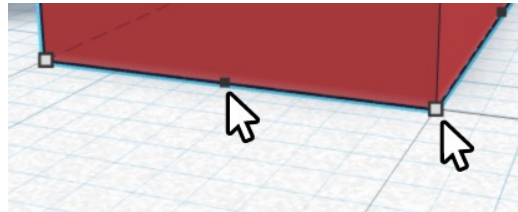
-click to select  
(hold SHIFT(to select multiple objects)  
or  
-click & drag a box select to select multiple



# Moving and manipulating shapes

## Resizing

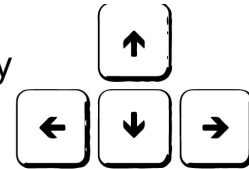
- left click and drag the black or white handles to resize the your shapes.
- Hold the SHIFT key to constrain proportions.
- Left click and drag the black cone to change the elevation of your in relation to the work plane



# Moving and manipulating shapes

## Moving

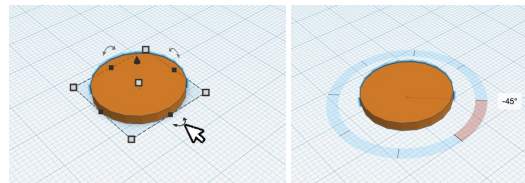
- You can nudge a selected object around the x & y axes with the arrow keys



## Rotate

Left click and drag the curly one of the 3 arrows to rotate an object. Once the angle highlighted you can type in an angle too.\*

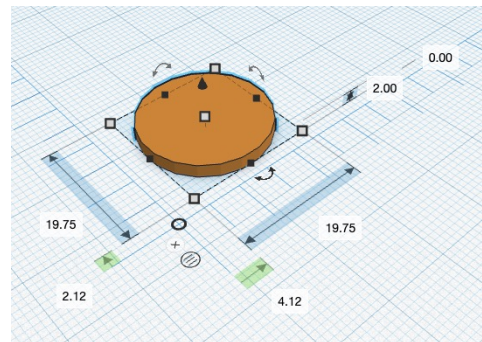
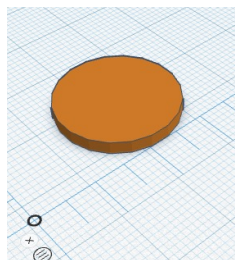
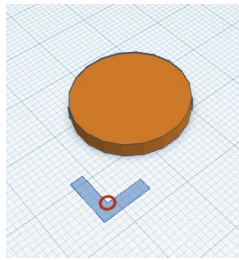
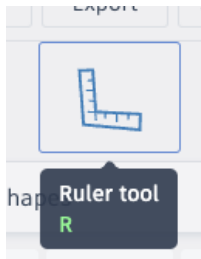
*\*it can be difficult to realign an object's angle once you've moved it so be deliberate with these changes*



# Moving and manipulating shapes

## Ruler

- Drag the ruler out onto the workplane to resize or arrange shapes using typed in dimensions.



# Make a complex shape

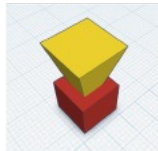
## Grouping solids and holes

- You can make complex shapes by combining and subtracting the primitive (basic) shapes using the group tool.
- Select the objects you want to combine
- And then hit the group button

# Make a complex shape

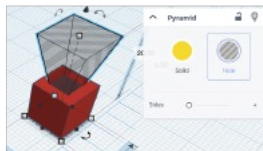
Make a complex 3D shape in 4 steps

1



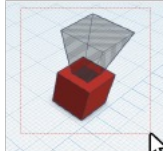
Start with 2 shapes

2



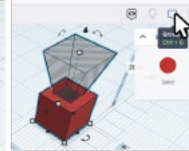
Select one shape and make it a hole

3



now select both  
by dragging a box  
around them

4

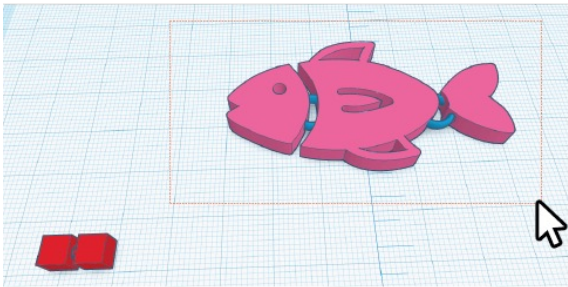


and hit the group button

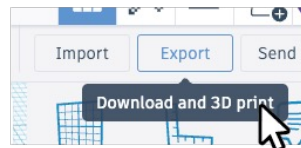


Da Na!

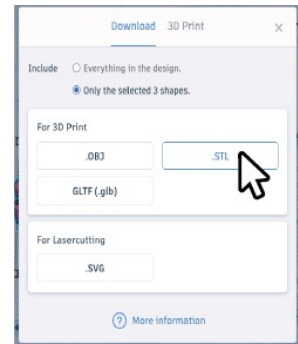
# Export your job for printing



select the parts of your design you want to print



hit the export button



and select STL

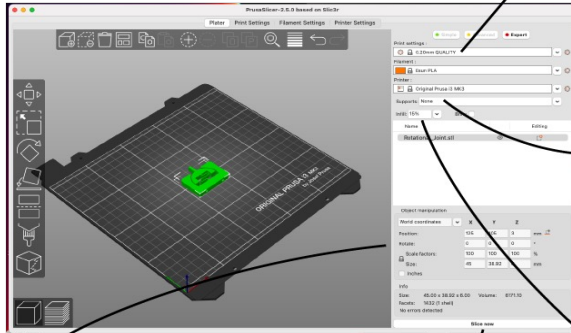
# Slicing with PrusaSlicer



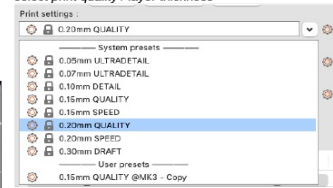
# Slicing

The image shows a screenshot of the PrusaSlicer software interface. On the left side, there is a vertical toolbar with several icons. Callout boxes with arrows point to these icons, each with a label: 'Move' (with 'Move [M]'), 'Scale' (with 'Scale [S]'), 'Rotate' (with 'Rotate [R]'), 'Place on Face', 'Cut', and 'Paint on Support'. Above the main window, four more callout boxes point to icons labeled 'Add', 'Delete', and 'Arrange'. The main window displays a 3D model of a green printed part on a grid. On the right side, there is a settings panel with sections for 'Print settings', 'Printer', 'Material', and 'Object information'. Below the main window, there are two smaller images showing a close-up of the 'Place on Face' tool being used on a green part, with the text 'select face to affect optimal printing orientation' above them.

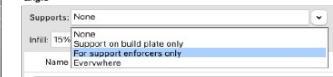
# Slicing



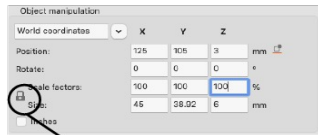
**Print Resolution**  
select print quality / layer thickness



**Support - select support mode**  
None - no support  
Support from build plate only - only generate support for overhangs directly over build plate.  
For support enforcers only - generate support structures corresponding with paint on support  
Everywhere - generate support where overhang exceeds threshold angle



**Manipulation**  
Position and rotate model using X, Y, & Z coordinates.  
Scale or resize using percentages or dimensions

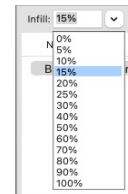


padlock icon - constrains proportion  
click to unlock

**Slice Now**  
Hit slice to preview how your settings will pan out



**Infill**  
select the volume of internal fill matrix added to the internal spaces of your model.



# Infill

Plater | Print Settings | Filament Settings | Printer Settings

Feature type	Time	Percentage	Used filament	
Perimeter	12m	19.5%	0.49 m	1.47 g
External perimeter	16m	25.4%	0.55 m	1.65 g
Overhang perimeter	12s	0.3%	0.01 m	0.03 g
Internal infill	10m	15.6%	0.33 m	0.99 g
Solid infill	6m	10.3%	0.25 m	0.74 g
Top solid infill	48s	1.3%	0.03 m	0.10 g
Bridge infill	1m	1.6%	0.04 m	0.12 g
Skirt/Brim	15s	0.4%	0.01 m	0.04 g
Support material	13m	21.5%	0.49 m	1.46 g
Support material interface	2m	3.6%	0.08 m	0.24 g
Custom	13s	0.4%	0.02 m	0.06 g

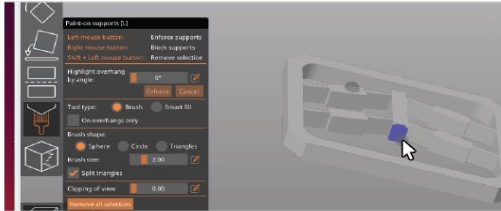
Estimated printing times (Normal mode):  
 First layer: 2m  
 Total: 1h1m  
 Show stealth mode

Print settings : Simple  
 0.20mm QUALITY  
 Filament : Esun PLA  
 Printer : Original Prusa i3 M  
 Supports: Everywhere  
 Infill: 15%  
 Name: Rotational\_Joint.stl

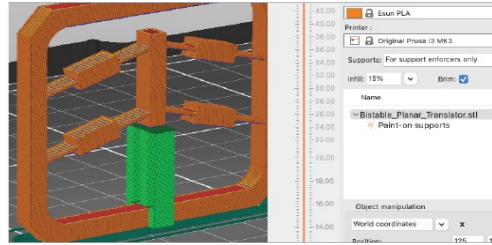
Object manipulation  
 World coordinates  
 Position:  
 Rotate:  
 Scale factors:  
 Size:

# Custom Support in PrusaSlicer

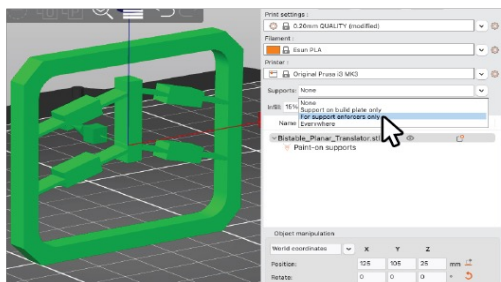
1 Use the Paint on Support tool



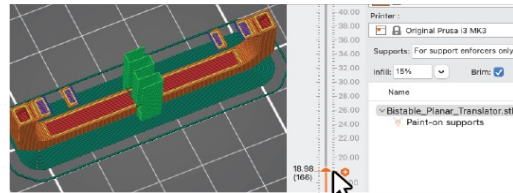
3 Da Da!



2 Select for Support enforcers only



4 Inspect and other print features using the layer /time ruler



# Export from PrusaSlicer

Whats it going to cost in terms of Filament and time?

If your happy with these costs when measured against the resolution, infill, support settings...?

Sliced Info	
Used Filament (g) (including spool)	5.87 (270.87)
Used Filament (m)	1.97
Used Filament (mm <sup>3</sup> )	4732.64
Cost	0.15
Estimated printing time:	
- normal mode	1h3m
- stealth mode	1h4m

[Export G-code](#)

Export your print job to an SD card

# Finishing your model

## Finishing FAQs

What's the best way to removing supports?



**What's the best way to removing supports?**

- Use a pair of plyers to work the support off. People also use (dental) picks and exacto blades.
- Be patient and try and get it off in one bit or bigger bits if you can't be patient... it will save you more time down the tract

## Finishing FAQs

What's the best way to get my model smoother



### What's the best way to get my model smoother?

- One good way to get it smoother is to sand it down with sand paper or some smooth files (cheap emery board from the \$2 shop work well) Make sure your using the appropriate PPE (breathing protection) if you are going to make any particulates microscale particulates (in a range of materials) have been associated with lung cancer.
- Before you start sanding you may want to consider starting by filling the gaps with a body filler. This way when you sand your model your starting with atleast some of the low points filled in and the sanding can take of the high points.
- Vapor Bath. We don't recommend this with PLA as the solvents associated with PLA are carcinogens. We can't allow isopropyl vapor baths on site cause trying to heat isopropyl is a good recipe for a bomb.



# Finishing FAQs

Can I paint PLA?



## Can I paint PLA?

1. If you are going to be painting a print consider whether you want the model to be fully assemble before painting. If so break the model down into parts ( this will help with finishing and keep support to a minimum
2. Consider if you need to prime your model before applying paint. This will ensure your top coat especially detail adheres evenly.
3. Top coat / detail use brushes sponges, air brushes to apply acrylic paint

Yeh but don't take my word for it do some experiments

**Design time!**

# Where to go from here?

## SLQwiki –

- There's a version of the tinkercad tutorial is on there.

## Hack the Evening

- Come back and print your own designs,
- Get signed off on the induction.
- Talk to people about their projects.

SLQ Wiki

You are here: Home > Fabrication Lab > Software > Designing for 3D printing using TinkerCad

### Designing for 3D printing using TinkerCad


About the Fabrication Lab  
Health and Safety  
Procedures and Policy  
Materials  
COTS Equipment  
Clean Lab  
About the Clean Lab  
Clean Lab Inductions  
Clean Lab Equipment  
Consumer Off the Shelf  
Custom  
Clean Lab Fittings  
Machine Shop  
About the Machine Shop  
Machine Shop Inductions  
Machine Shop Equipment

**Why**

TinkerCAD is a great way to start making 3D models for 3D printing, or to open out ideas that you wish to hand-cut or export for laser/CNC technologies. It's free for anyone to use, runs on any device with internet and it's arguably the most simple/easy 3D design software to start out with.

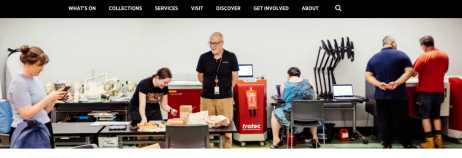
**What**

TinkerCAD is made by Autodesk and works essentially like children's building blocks: you stack shapes together or cut shapes from each other to build up your part.



STATE LIBRARY OF QUEENSLAND

WHAT'S ON COLLECTIONS SERVICES VISIT DISCOVER GET INVOLVED ABOUT



Home > Fabrication Lab > Hack the evening

### Hack the evening

Join a meetup for makers, designers, fabricators and anyone interested in learning new skills or getting hands on with digital and fabrication technologies. No induction or booking resources are necessary, just head to the new pop-up Fabrication Lab and turn up and play!

Available resources include:

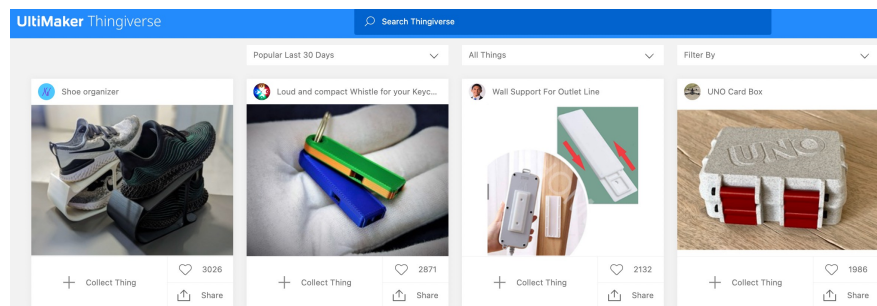
**When**  
This is a 5-6pm + 1 hour event  
See dates below

**Price**

# Where to go from here?

## Thingiverse –

- Checkout things other people have designed for 3D printing.
- Save yourself a lot of time designing something someone else has successfully made.
- Remix / customise other peoples designs



# Where to go from here?

## Functional Print

- Check out the functional solutions people print up on Reddit  
<https://www.reddit.com/r/functionalprint/>

