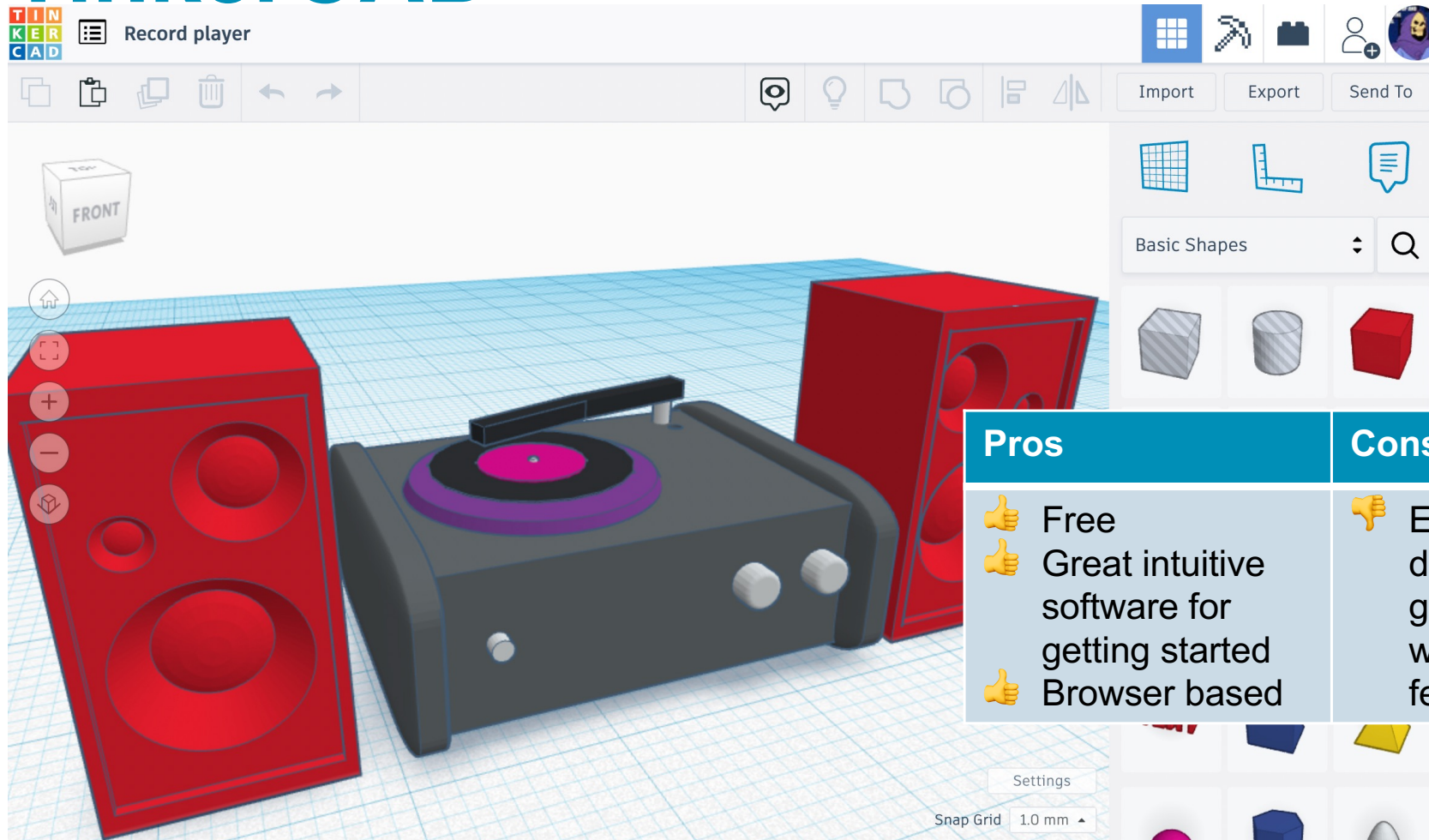


Designing for 3D printing

CAD software

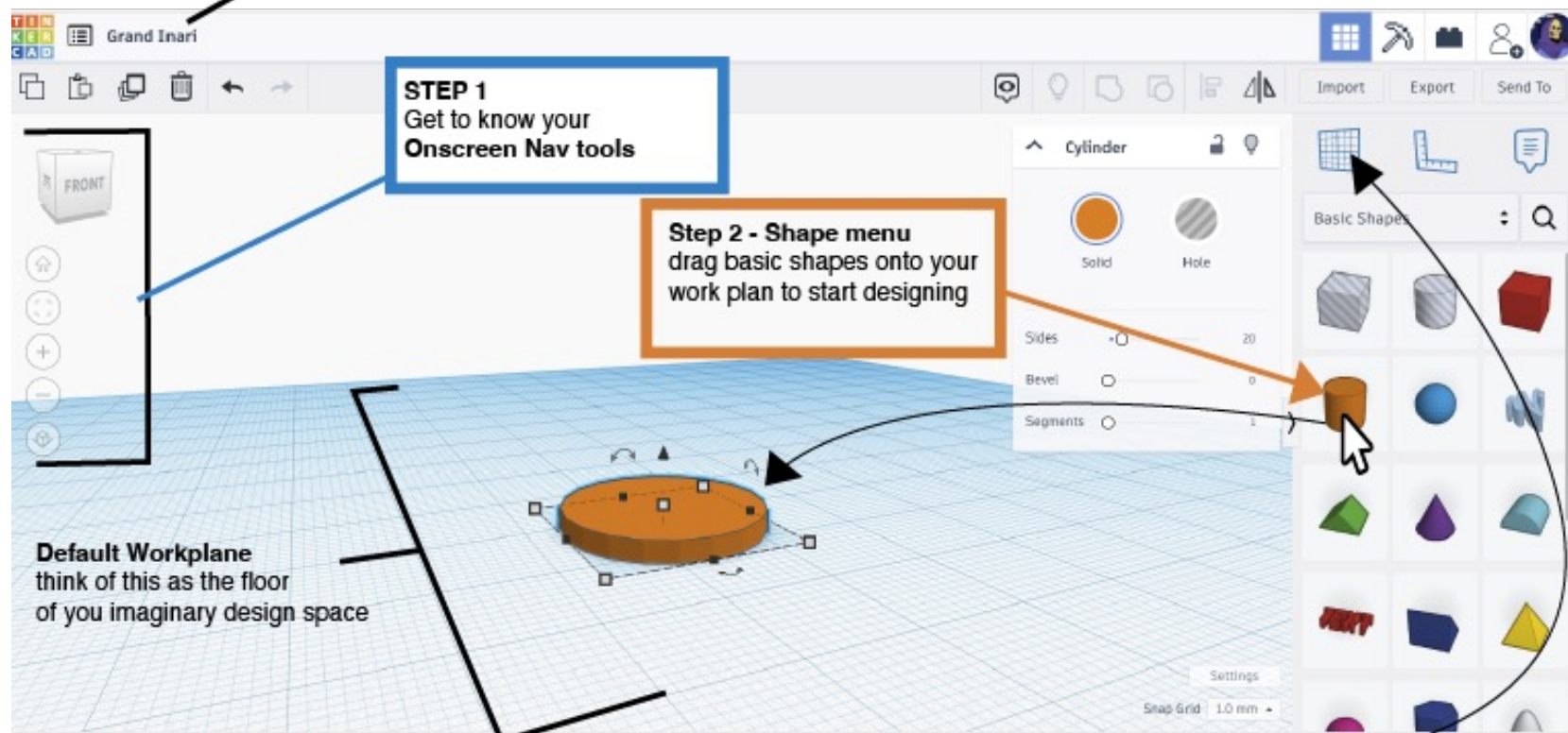
TinkerCAD



Pros	Cons
<ul style="list-style-type: none">👍 Free👍 Great intuitive software for getting started👍 Browser based	<ul style="list-style-type: none">👎 Experienced designers might get frustrated with the lack of features

The interface

Auto-generates a file name
double click to type in
something meaningful



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

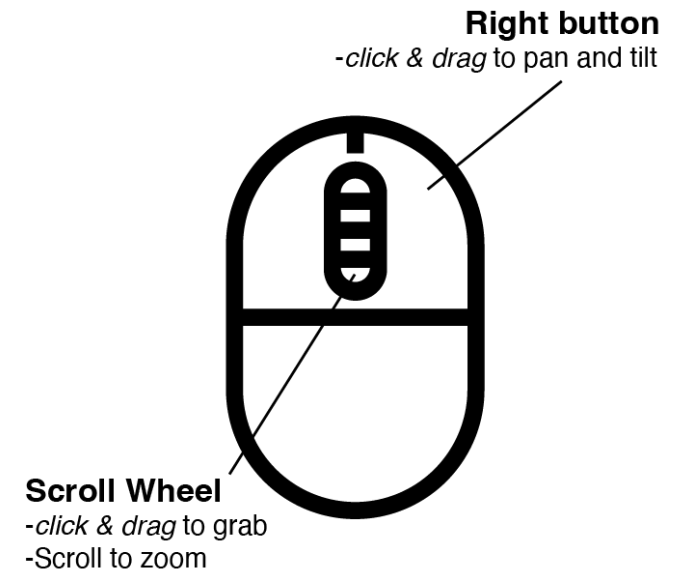
Navigating the 3-dimensional space

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 you view angle
- If you get lost click the **home icon** and it will take you back to the default view



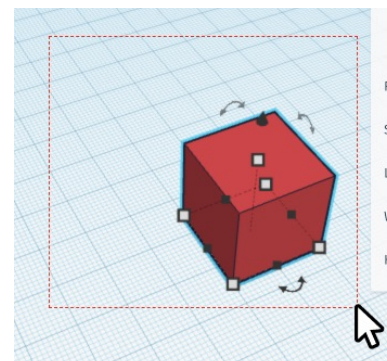
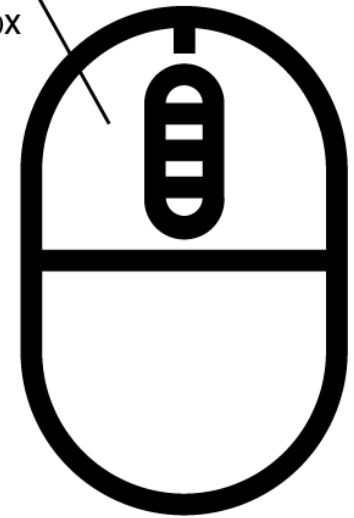
Moving and manipulating shapes

Select

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

Left button

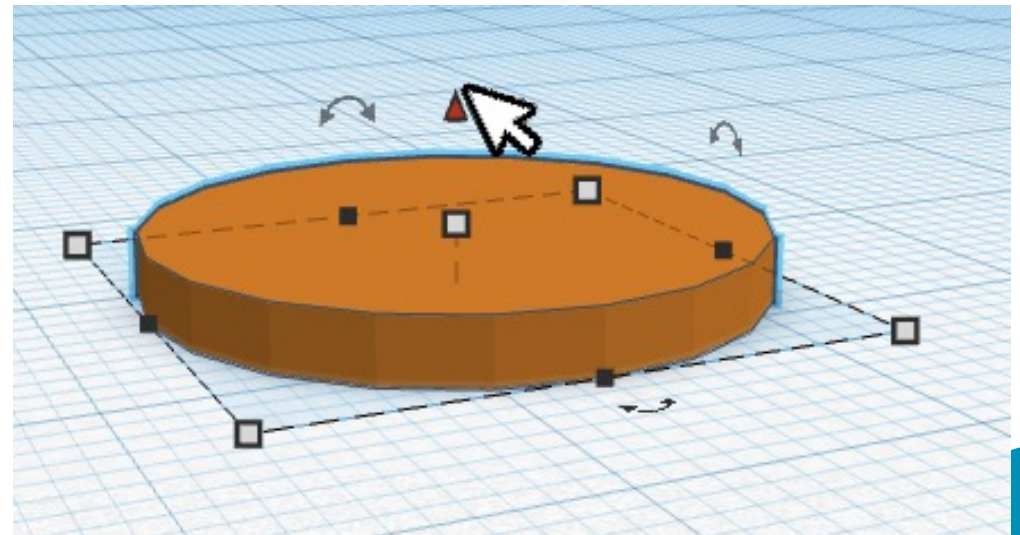
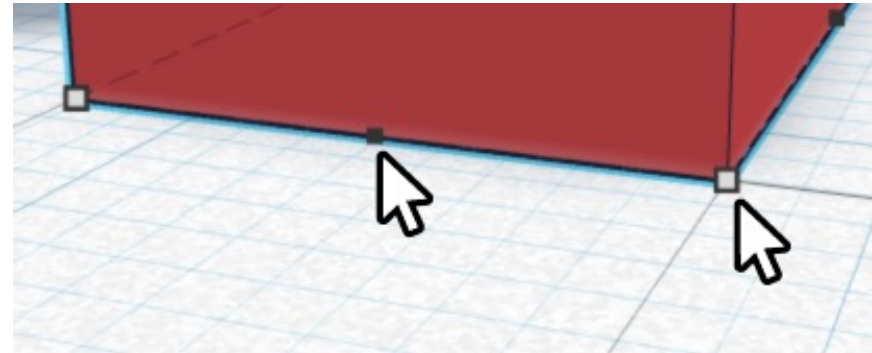
- click to select (hold SHIFT(to select multiple objects)
- or
- click & drag* a box select to select multiple multiple



Moving and manipulating shapes

Resizing

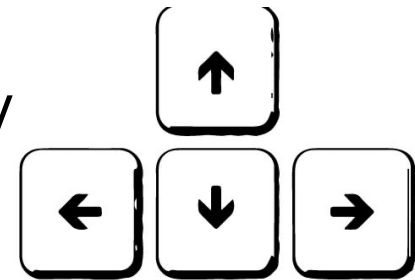
- left click and drag the black or white handles to resize the your shapes.
- Hold the SHIFT key to constrain proportions.
- Left click and drag the black cone to change the elevation of your in relation to the work plane



Moving and manipulating shapes

Moving

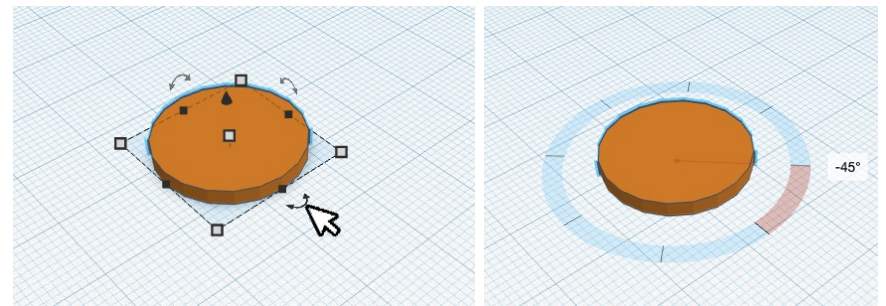
- You can nudge a selected object around the x & y axes with the arrow keys



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.*

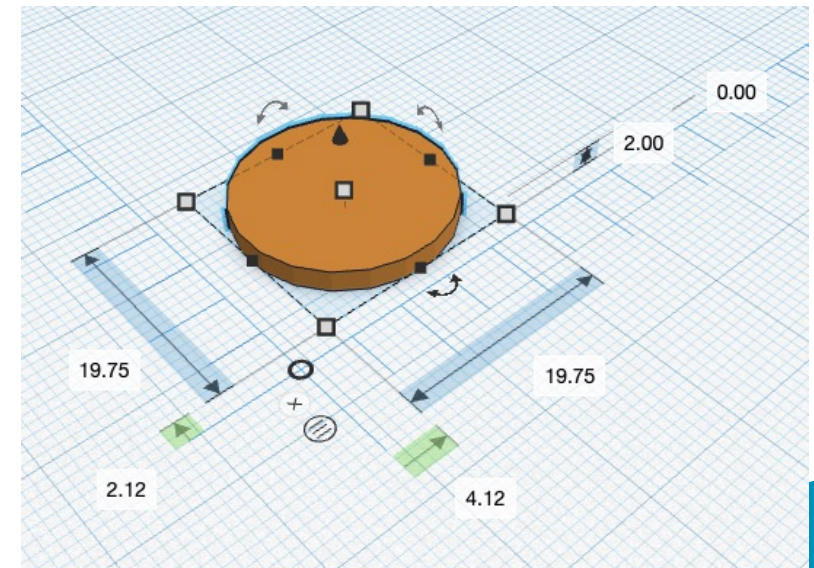
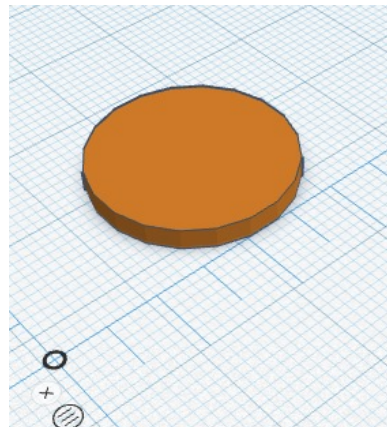
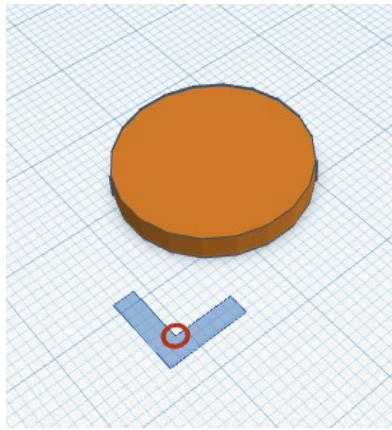
**it can be difficult to realign an object's angle once you've moved it so be deliberate with these changes*



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

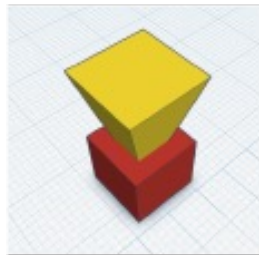
- You can make complex shapes by combining and subtracting the primitive (basic) shapes using the group tool.
- Select the objects you want to combine
- And then hit the group button



Make a complex shape

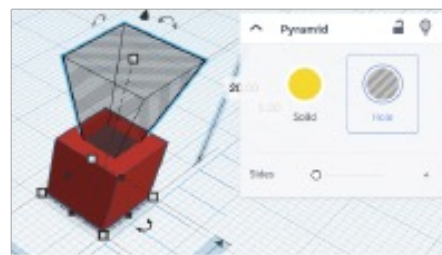
Make a complex 3D shape in 4 steps

1



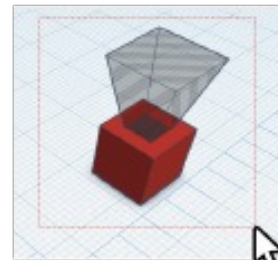
Start with 2 shapes

2



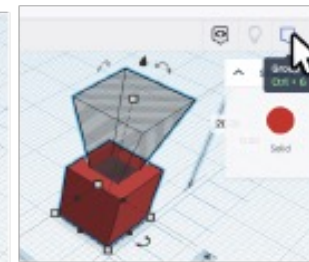
Select one shape and make it a hole

3

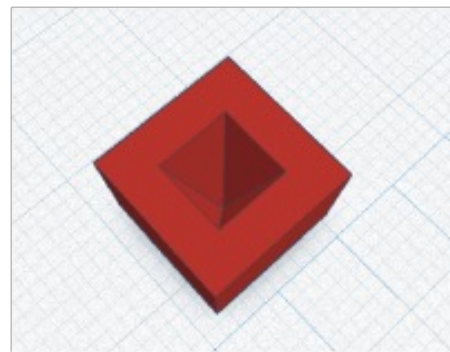


now select both
by dragging a box
around them

4



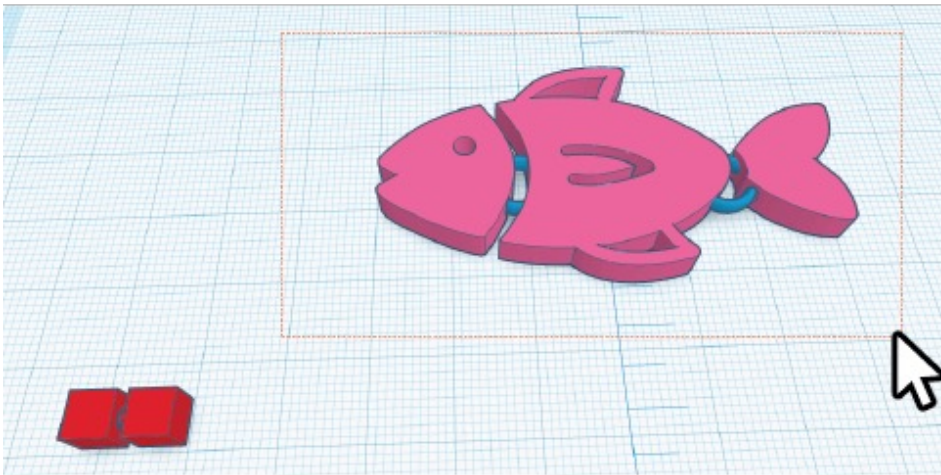
and hit the group button



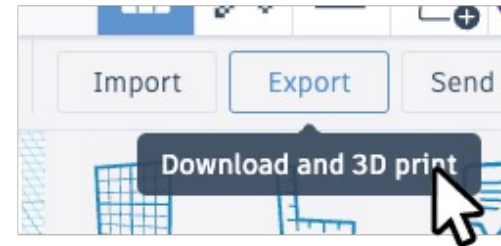
Da Na!



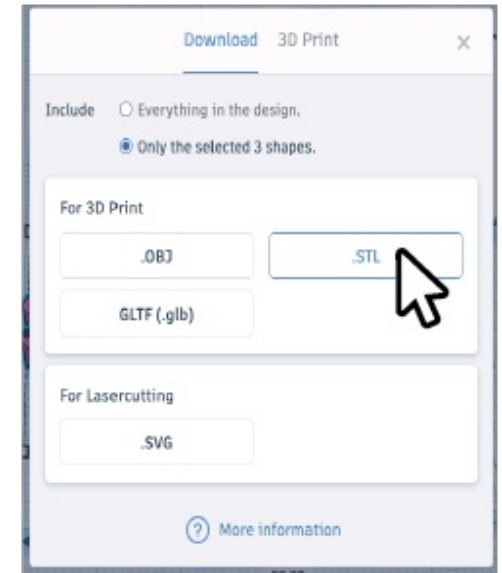
Export your job for printing



select the parts of your design you want to print



hit the export button



and select STL

Slicing with PrusaSlicer

Slicing

The image shows the PrusaSlicer 2.5.0 interface with a 3D model of a green object on a black build plate. A toolbar on the left contains various manipulation tools. Callouts on the left side of the image identify these tools:

- Move**: Move [M]
- Scale**: Scale [S]
- Rotate**: Rotate [R]
- Place on Face**
- Cut**
- Paint on Support**

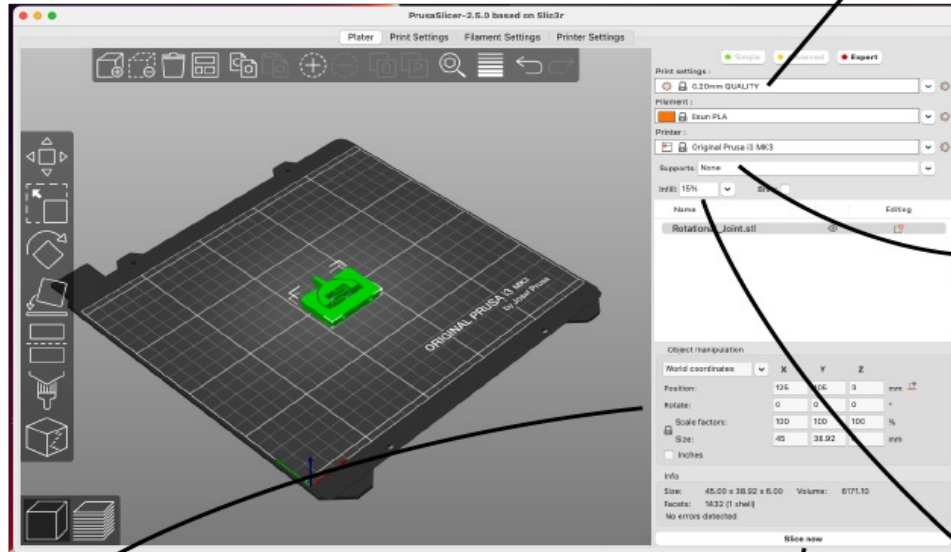
Additional callouts at the top identify icons in the main toolbar:

- Add**
- Delete**
- Arrange**

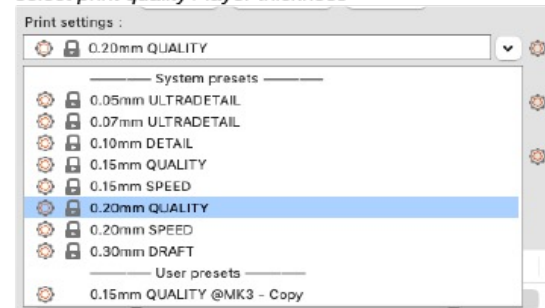
The main interface includes a top menu bar (Platform, Print Settings, Filament Settings, Printer Settings), a toolbar with icons for file operations and manipulation, and a right-hand panel with settings for print quality (0.20mm), filament (Esun PLA), printer (Original Prusa i3 MK3), and object manipulation (Position, Rotate, Scale factors, Size). The object info panel shows: Size: 45.00 x 38.92 x 6.00, Volume: 14.32 (1 shell), Facets: 14.32 (1 shell), No errors detected.

Below the main interface, two smaller images illustrate the 'Place on Face' tool. The first image shows a mouse cursor hovering over a face of the green object with the text "select face to affect optimal printing orientation". The second image shows the object with a semi-transparent green selection box on its top face.

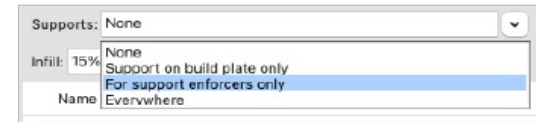
Slicing



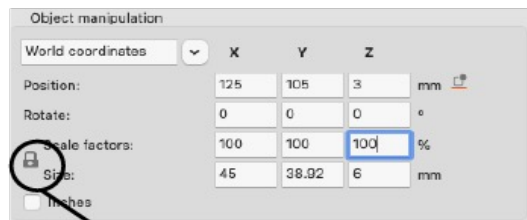
Print Resolution
select print quality / layer thickness



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 cooresponding 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

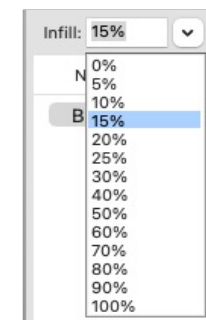


padlocck icon - constrains proportion
click to unlock

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](#)

23.40 (154)

Simple

Print settings :
0.20mm QUALITY

Filament :
Esun PLA

Printer :
Original Prusa i3 M

Supports: Everywhere

Infill: 15%

Name
Rotational_Joint.stl

Object manipulation
World coordinates

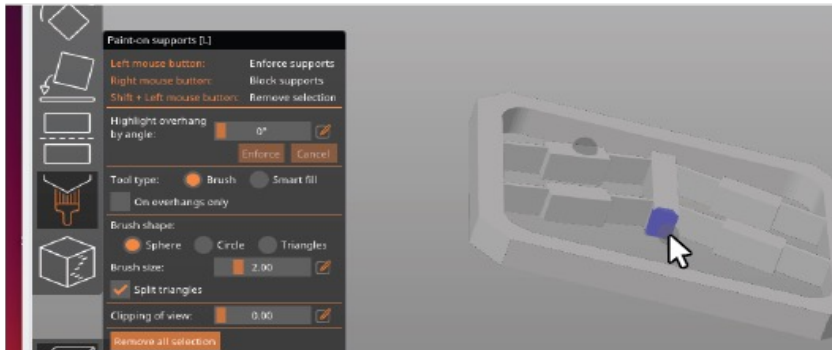
Position:

Rotate:

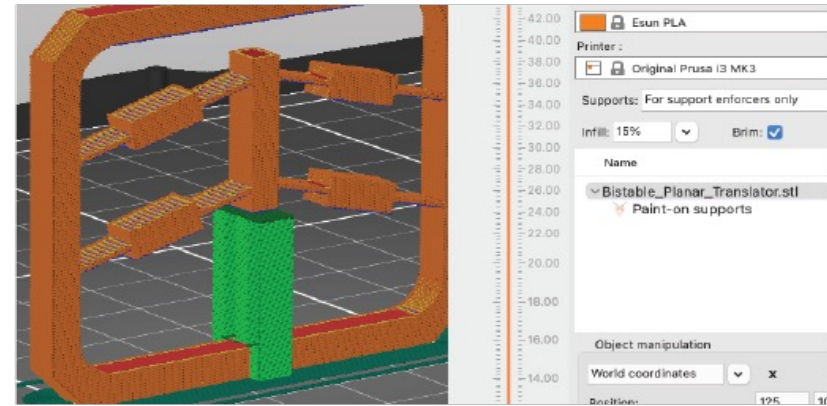
Scale factors:
Size:

Custom Support in PrusaSlicer

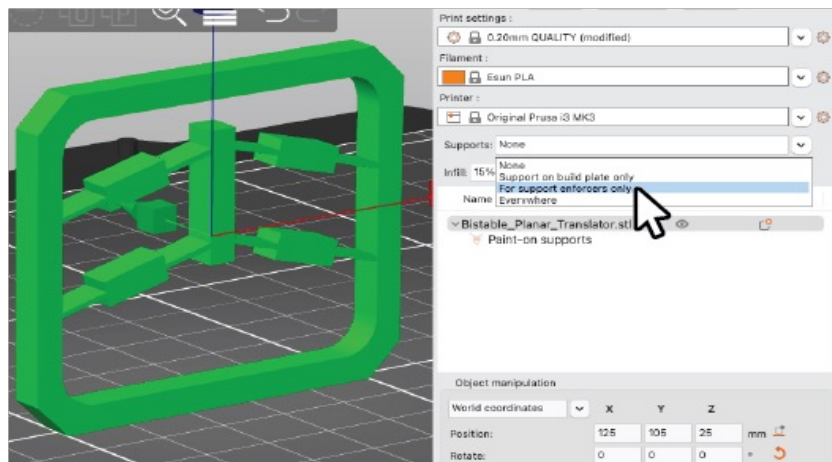
1 Use the **Paint on Support** tool



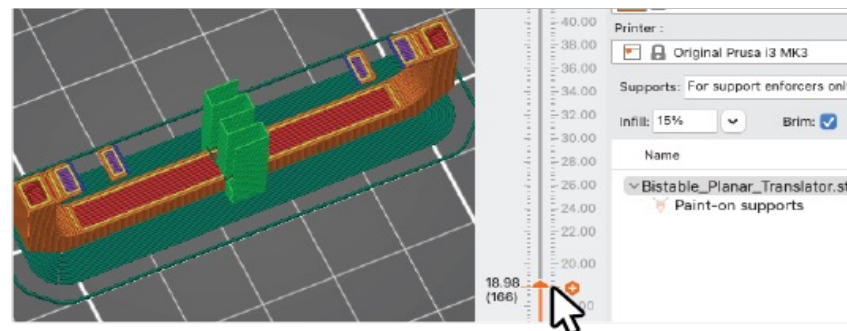
3 Da Da!



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 ³)	4732.64
Cost	0.15
Estimated printing time:	
- normal mode	1h3m
- stealth mode	1h4m

[Export G-code](#)

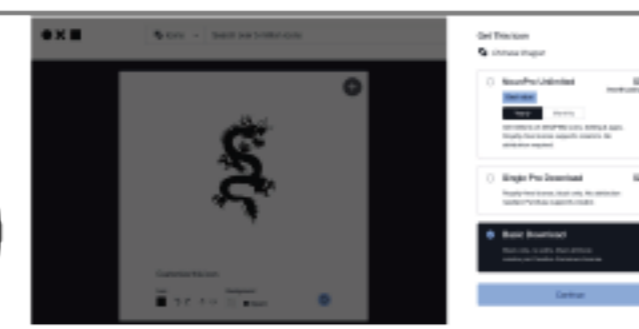
Export your print job to an SD card



Print-in-Place articulated model in 7* easy steps

**some patience required*

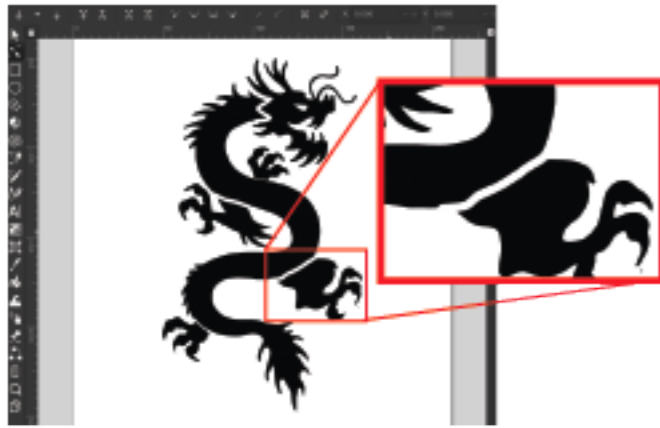
1



Find a vector artwork to extrude

I use <https://thenounproject.com> for creative commons icons

2

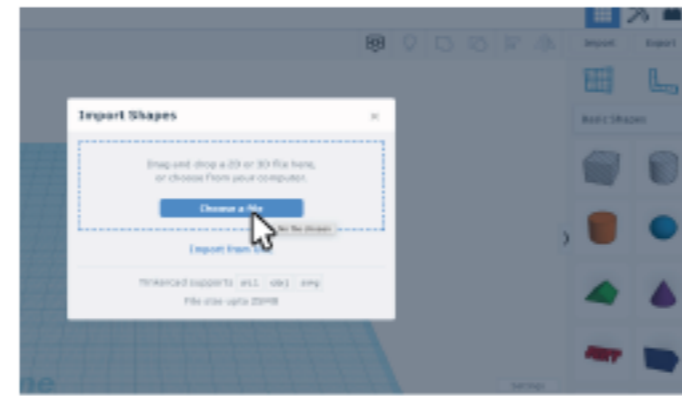


Separate the components in the vector file

use your favourite Vector editing program to separate the components and then save as an svg.

Inkscape is free and there's a tutorial on the SLQwiki.

3



Import your SVG into TinkerCAD

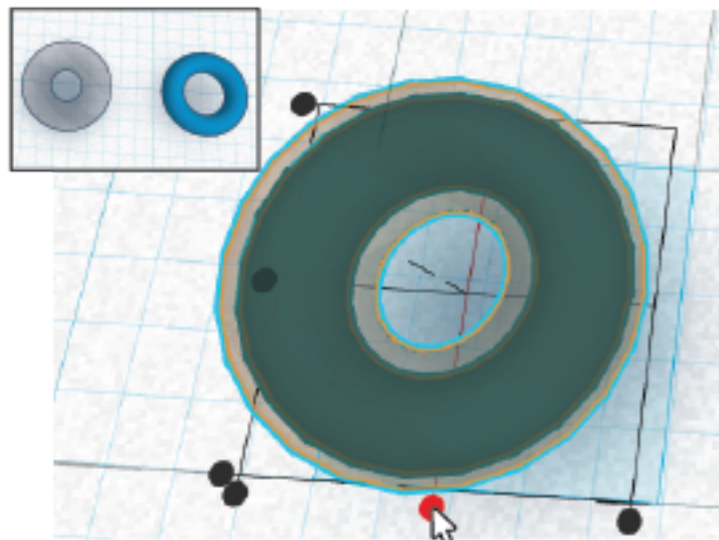
4



Separate each of the components in TinkerCAD

I make enough different coloured duplicates of my extruded artwork so that I have one for each component. And then go around and delete the other parts.

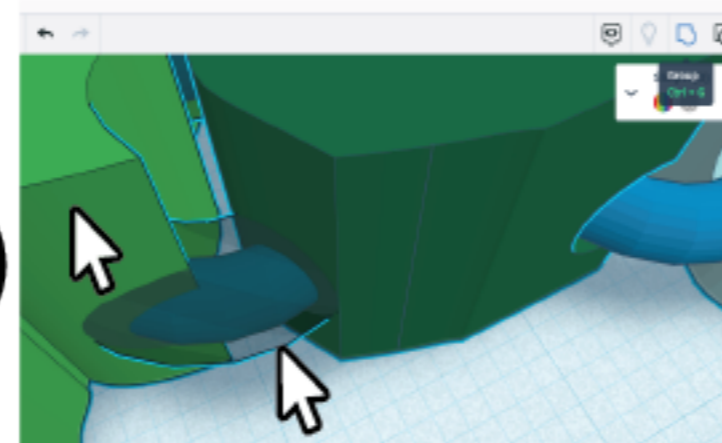
5



Design a connector /hinge component

You need a connector and a void (hole) for this to move in.

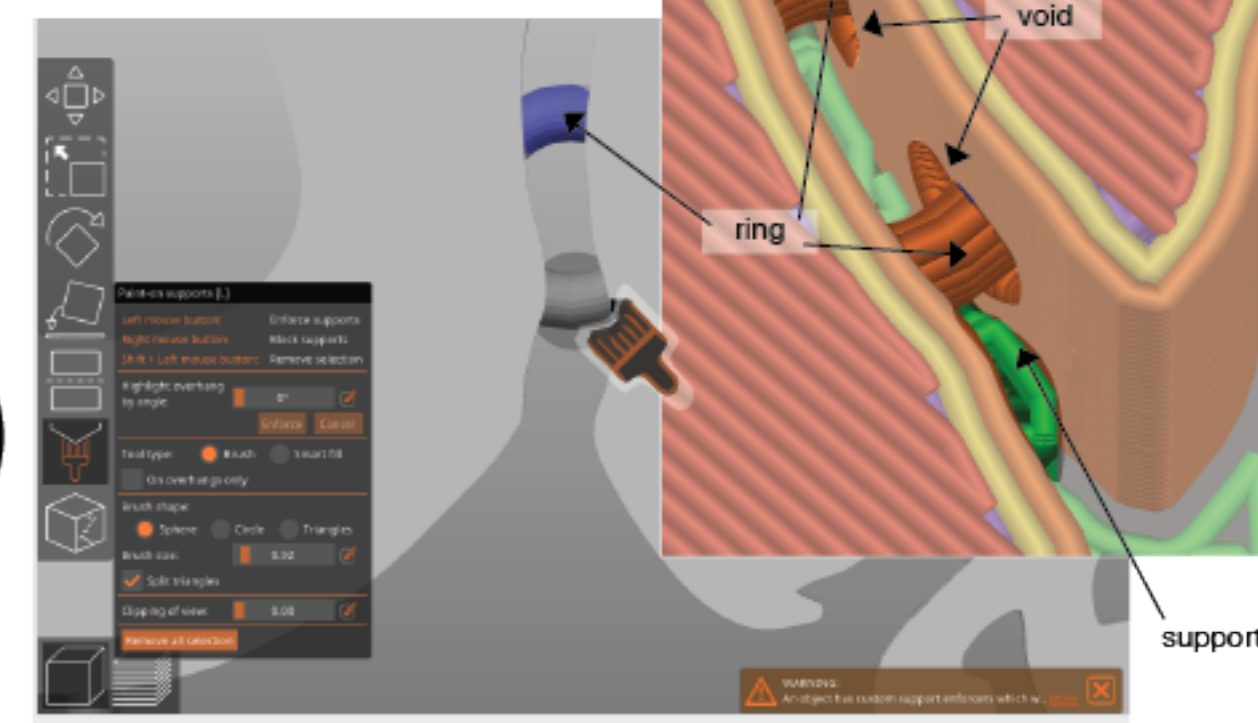
6



Add connectors & then group each of the voids with corresponding components

This way the connectors (rings in this case) are trapped but also free to move inside each of the link components

7



Export your model from TinkerCAD & open it in PrusaSlicer adding support around your connectors

Use the Paint-on-support tool to add support around the connectors. The support (shown in green) will hold the connector during printing