

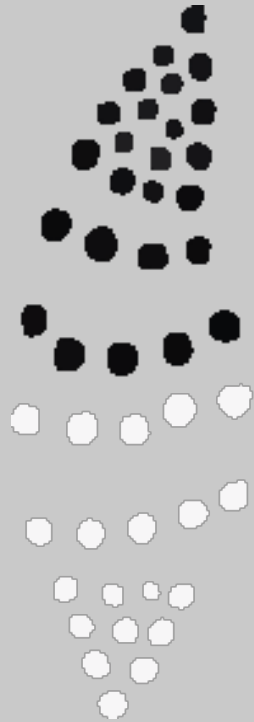
3D PRINTER INDUCTION - THE EDGE



State Library
of Queensland

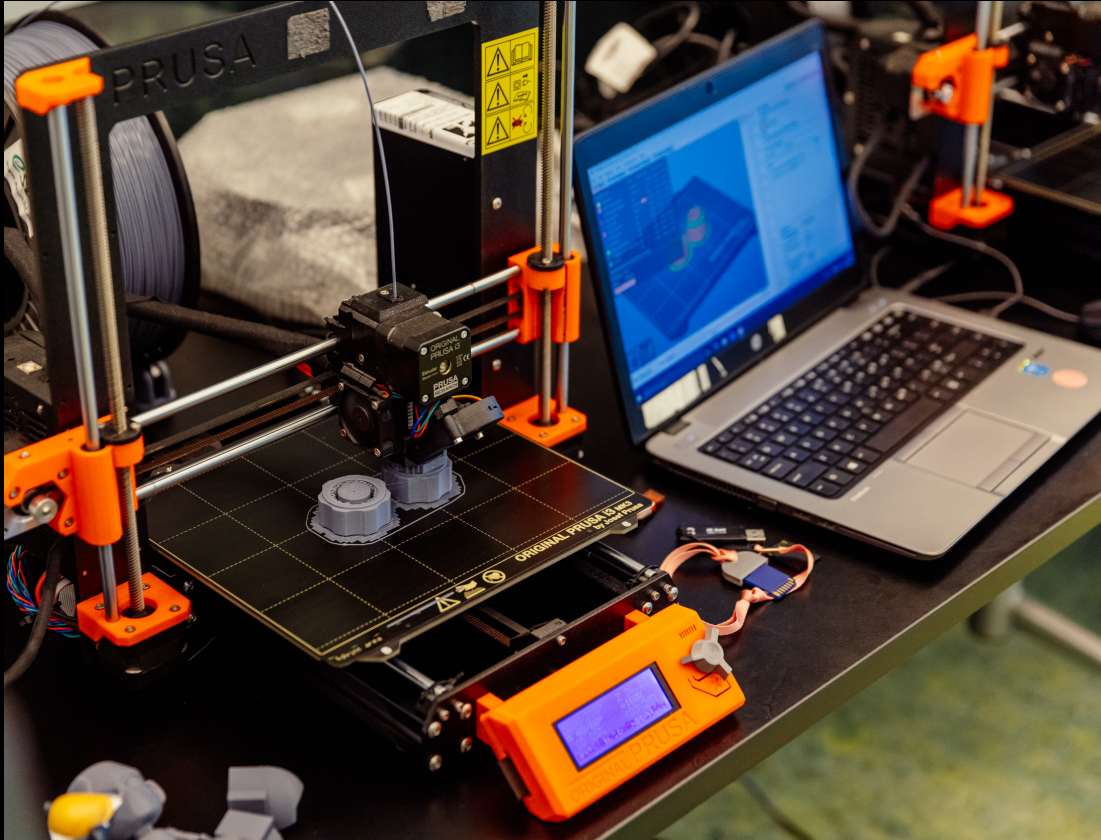


Queensland
Government



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.



INDUCTION SUMMARY

Using the State Library 3D printers, you can turn a digital 3D model into a solid plastic object.

In this induction you will learn the basics of 3D design with Tinkercad and how to print your own model, including how to load it into the printer and cleaning up the product.

Once you've completed the induction you can book and use the State Library of Queensland's 3D Printers at The Edge during Open lab.

Open Lab sessions are a chance to meet up with like-minded makers and tinkerers at The Edge with facilitators to support your creative needs in the space.

Bookings are required to use the equipment and you will be able to book with your SLQ account once you have completed the relevant induction.

Wednesday 1.30pm – 8pm

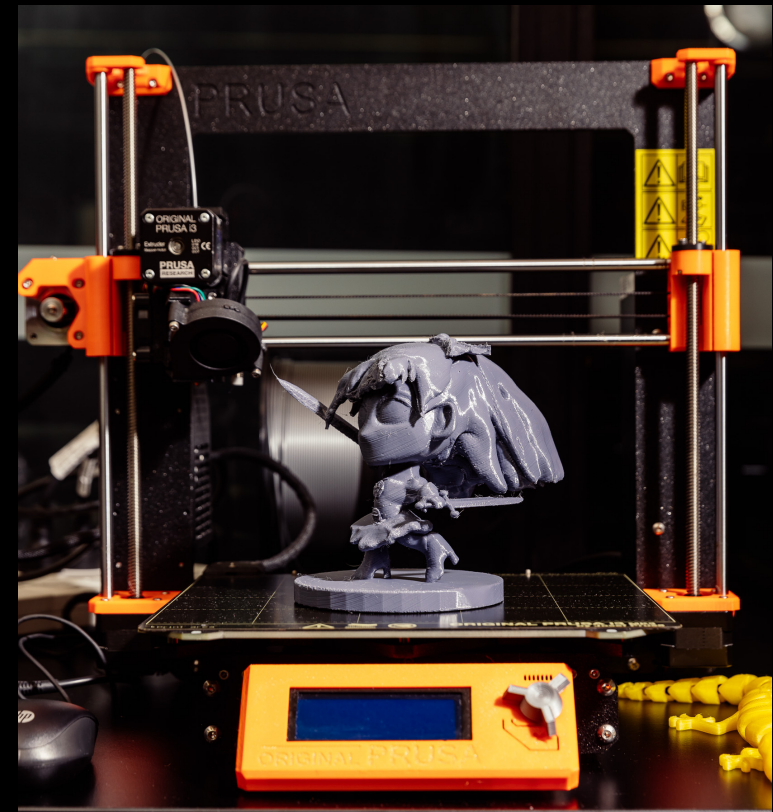
Thursday 1.30pm – 8pm

Saturday 12pm – 6pm

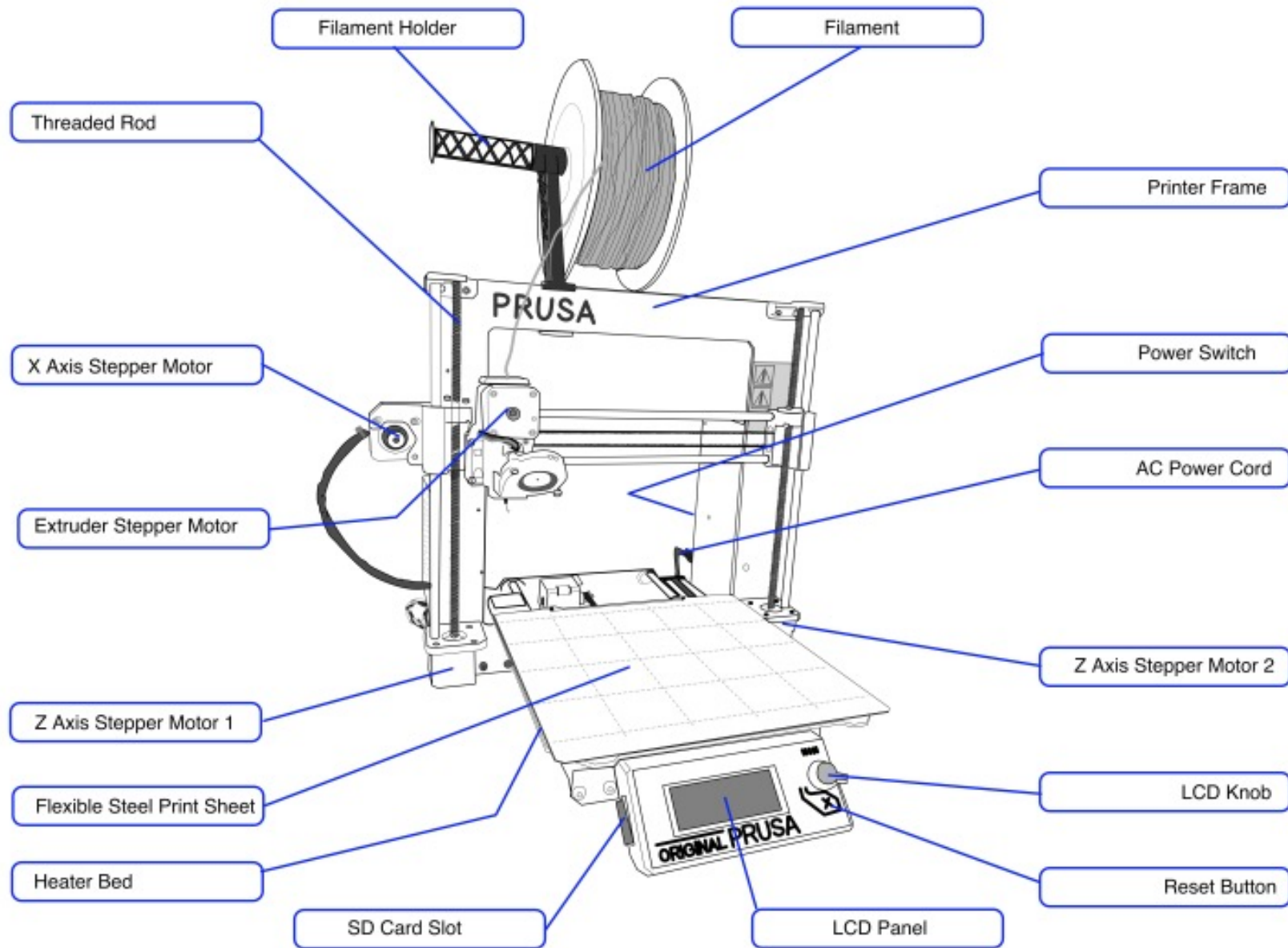
For more info and to book, head to <https://www.slq.qld.gov.au/visit/spaces/edge>

What is a 3D PRINTER?

- Allows for 3d printing which is the construction of a three-dimensional object. It does this through material being deposited, joined or solidified under computer control.
- The Prusa i3 MK3s+ is a successor to Original Prusa i3 MK3 with hardware and software upgrades which lead to improved reliability and ease of use and assembly. The Edge currently has 5 printers available for use.



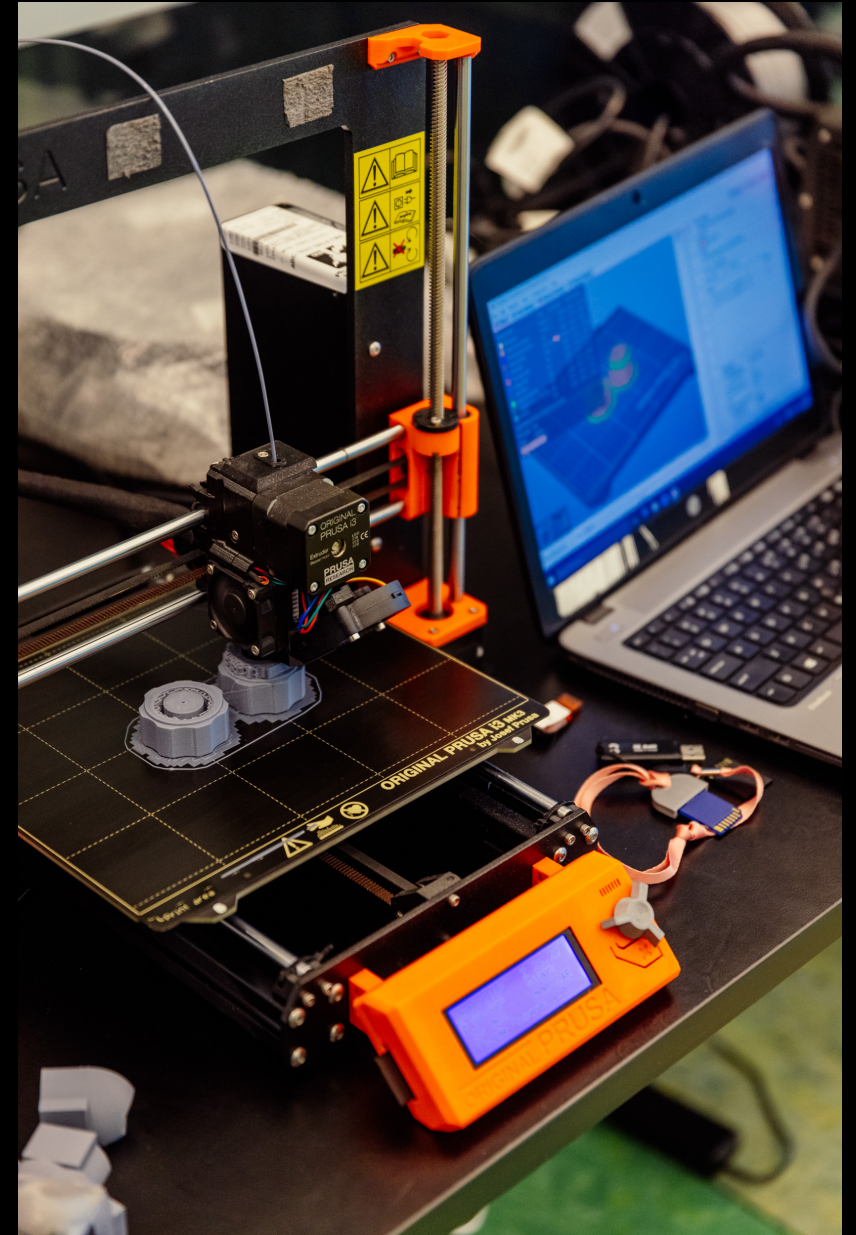
EQUIPMENT OVERVIEW



MACHINE OVERVIEW

Getting Started

- Let a staff member know that you have a 3D printer booking.
- Set up design file or if already done get slicing.
- Staff members can help with both designing and slicing.
- When ready to print grab a 3D printer form and ask a staff member to approve your job!



Safety

- Electricity
- Fire
- Respiratory
- Crush injury

Check the safe operating procedures and ask a staff member for help if you have any problems or concerns.

SL **SAFE OPERATING PROCEDURE**
Prusa i3 MK3S+ 3D printer

DO NOT use this machine unless you have completed an induction and the Supervisor has given permission

Protective eyewear must be worn when removing support structure from 3D prints.

Cut-resistant gloves must be worn when removing support structure from 3D prints.

Fume filter serving printer enclosure must be operating when print job is underway.

Printer hot end is a potential source of combustion. Keep isopropyl alcohol at least 2 metres away.

PRE-OPERATIONAL SAFETY CHECKS

1. Only filament approved by the Fab Lab is permitted for use on the Prusa printers.
2. Print job G-code files must be prepared using PrusaSlicer software installed on Fab Lab computers
3. ONLY to ensure correct printer and filament settings. The default file name, only edit text G-code includes critical information required by the Supervisor. If editing the file name, only edit text appearing prior to the 1st underscore.
4. Sliced models must be assessed by Supervisor prior to saving print job G-code.
5. Remove the steel heatbed sheet to the cleaning station for wiping with isopropyl alcohol prior to starting a print job; DO NOT take the isopropanol or wetted towels to the printer.
6. Smooth steel heatbed sheets are to be used for printing with PLA filament, and textured sheets for use with PETG. Smooth sheets MUST NOT be used when printing PETG filament.
7. All printers include sheet profiles for PLA and PETG. Ensure the correct profile is selected in the settings for the sheet being used.
8. The ultrafine particles and VOCs generated when melting plastic filament pose a health hazard. The fume filter must be switched on, both extraction and return air gates opened, and the print enclosure door shut before preheating the printer or commencing a print job.
9. Faulty equipment must not be used. Immediately report any equipment concerns to the Supervisor.

OPERATIONAL SAFETY CHECKS

1. Upon inserting an SD card into the printer slot and selecting a file to print, the nozzle and print bed will commence heating. Once operational temperatures are reached, the print head and bed will begin moving. This movement presents potential pinch points. Keep fingers clear during operation.
2. Monitor the first printed layer to verify the filament has attached to the steel sheet properly.
3. In the event of a print failure press the Reset button. This will abort the job and force a full reset of the printer.
4. Remove the heatbed sheet from printer before attempting to remove a printed part from sheet. Wait for the sheet to cool, then flex the sheet. The print should pop off. DO NOT use metal tools to prise a print from the sheet.
5. Always wear safety glasses and protective gloves when removing support materials

HOUSEKEEPING

1. Ensure all printed material is removed from the heatbed sheet.
2. Switch off fume extractor when print job is complete.
3. Dispose of all support structure and other print waste in the appropriate bin.

POTENTIAL HAZARDS

- Hot surfaces and materials
- Sharp edges
- Hazardous emissions
- Molten plastics
- Eye injury
- Control errors
- Pinch points
- 240v electrical components
- Failure or malfunction

The Edge Fabrication Lab Safe Operating Procedure
Authorised by Daniel Flood
Uncontrolled when printed

State Library of Queensland
Issue Date: 14/07/2020
Revision Date: 01/09/2023
Records File #: 520_315_227
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Print failure

- Birds nest (filament non-adhesion)
- X and/or Y-axis shift (belt or stepper motor errors)
- Print wholly or partially detaches from build plate
- Blocked nozzle
- G-code encoding error
- Thermal anomaly or runaway (hot end or bed)
- Head impact

Troubleshooting

Something is weird or going wrong?

- First reaction should always be *pause the job*
- Remember you can always help a staff member for help!

The filament spool doesn't unwind?

- Check spool mounting and rotation
- Inspect filament for knots or tangles
- Adjust spool holder tension

The machine announces an error?

- Refer to [the manual](#) for error code explanations
- Check for temperature, connection, or SD card issues

Troubleshooting

The print wholly or partially detaches from the build plate?

- Ensure a clean and level build plate
- Use adhesion methods like tape or glue
- Adjust first layer height and nozzle temperature

The printer shifts in the x and/or Y axis?

- Tighten belts and pulleys
- Ensure a stable, clear printing environment
- Verify correct print file generation

Filament birds nest forms

- Clean clogged nozzle
- Ensure smooth filament path
- Calibrate extruder and temperature settings

The spool runs out of filament or the filament breaks?

- Monitor spool and replace before empty
- Keep filament path clear
- Use guides or lubrication for filament integrity

Designing for 3D Printer

Fusion 360

Pros

- Powerful professional CAD, CAM, CAE software
- Lots of good tutorials online
- Great for designing hi tolerance mechanical parts
- Free hobbyist licence available

Cons

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

Designing for 3D Printer

Meshmixer

Pros

- Free
- Great software for sculpting 3D
- Good for repairing models made in other programs

Cons

- Probably want to try something more intuitive first to get your head around the concepts

Designing for 3D Printer

TinkerCAD

Pros

- Free
- Great intuitive software for getting started
- Browser based

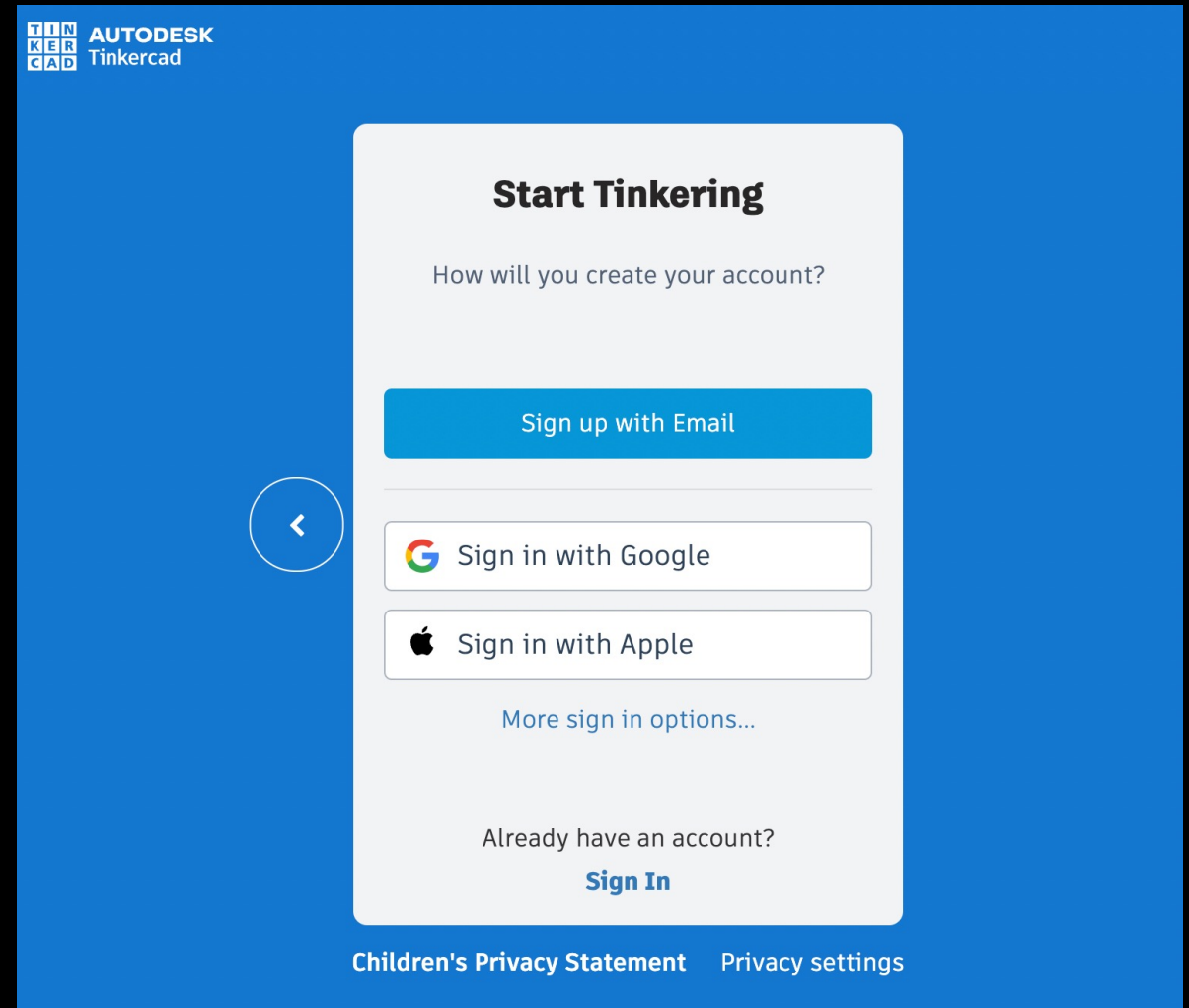
Cons

- Experienced designers might get frustrated with the lack of features

Designing for 3D Printer

Lets have a go!

- Head to the internet and navigate to TinkerCAD.com
- Create a free account using an email address



The Interface

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

STEP 1
Get to know your
Onscreen Nav tools

Step 2 - 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

The image shows a screenshot of a 3D CAD software interface. At the top, a window title bar displays 'Grand Inari'. Below it is a toolbar with icons for file operations (save, copy, paste, delete, undo, redo) and other functions like 'Import', 'Export', and 'Send To'. On the left side, there is a 'FRONT' view indicator and a vertical navigation toolbar with icons for home, zoom, pan, and rotate. The main workspace features a blue grid floor representing the 'Default Workplane'. In the center of the grid, a brown cylinder is being created, with its base on the workplane. To the right, a 'Basic Shapes' menu is open, showing various 3D shapes. A mouse cursor is hovering over a cylinder icon in this menu. A 'Cylinder' properties panel is also visible, showing options for 'Solid' or 'Hole', 'Sides' (set to 20), 'Bevel' (set to 0), and 'Segments' (set to 1). Annotations with arrows point to various parts of the interface: one points to the window title bar, another to the navigation toolbar, a third to the cylinder in the shape menu, and a fourth to a tool on the right side of the interface.

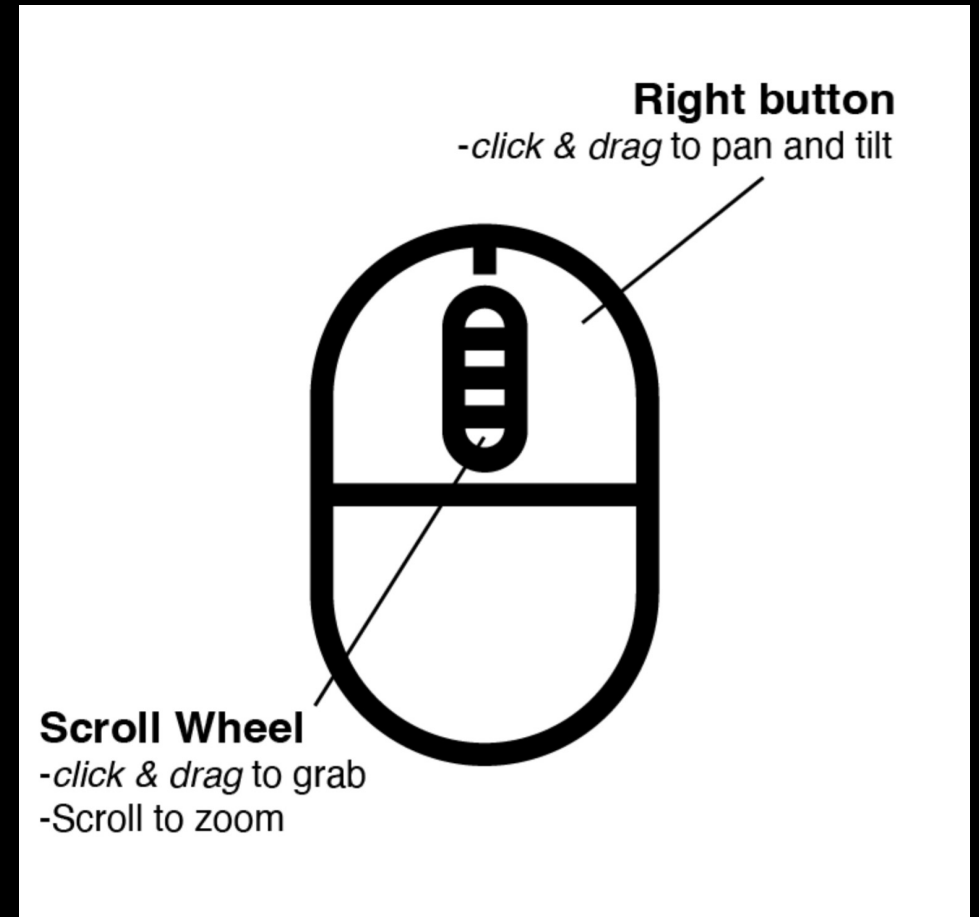
Navigating the 3-dimensional space

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

Resizing

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

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, you can also type in an angle once it is highlighted.

Ruler

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

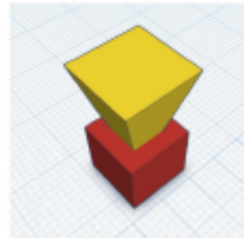
Make a complex shape

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

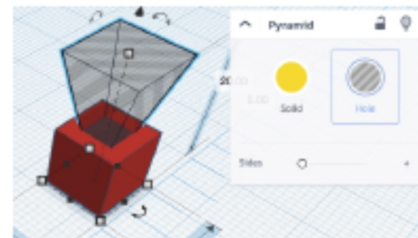
Make a complex 3D shape in 4 steps

1



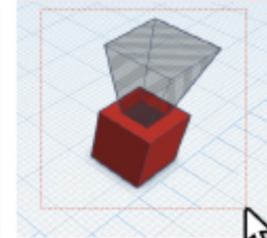
Start with 2 shapes

2



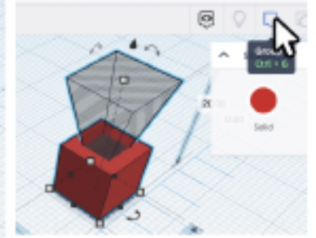
Select one shape and make it a hole

3

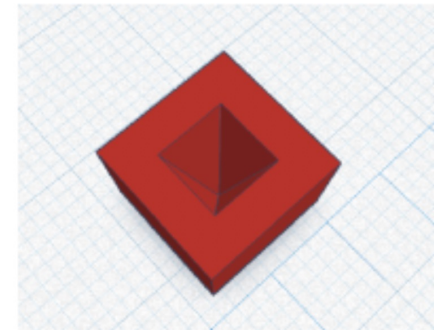


now select both
by dragging a box
around them

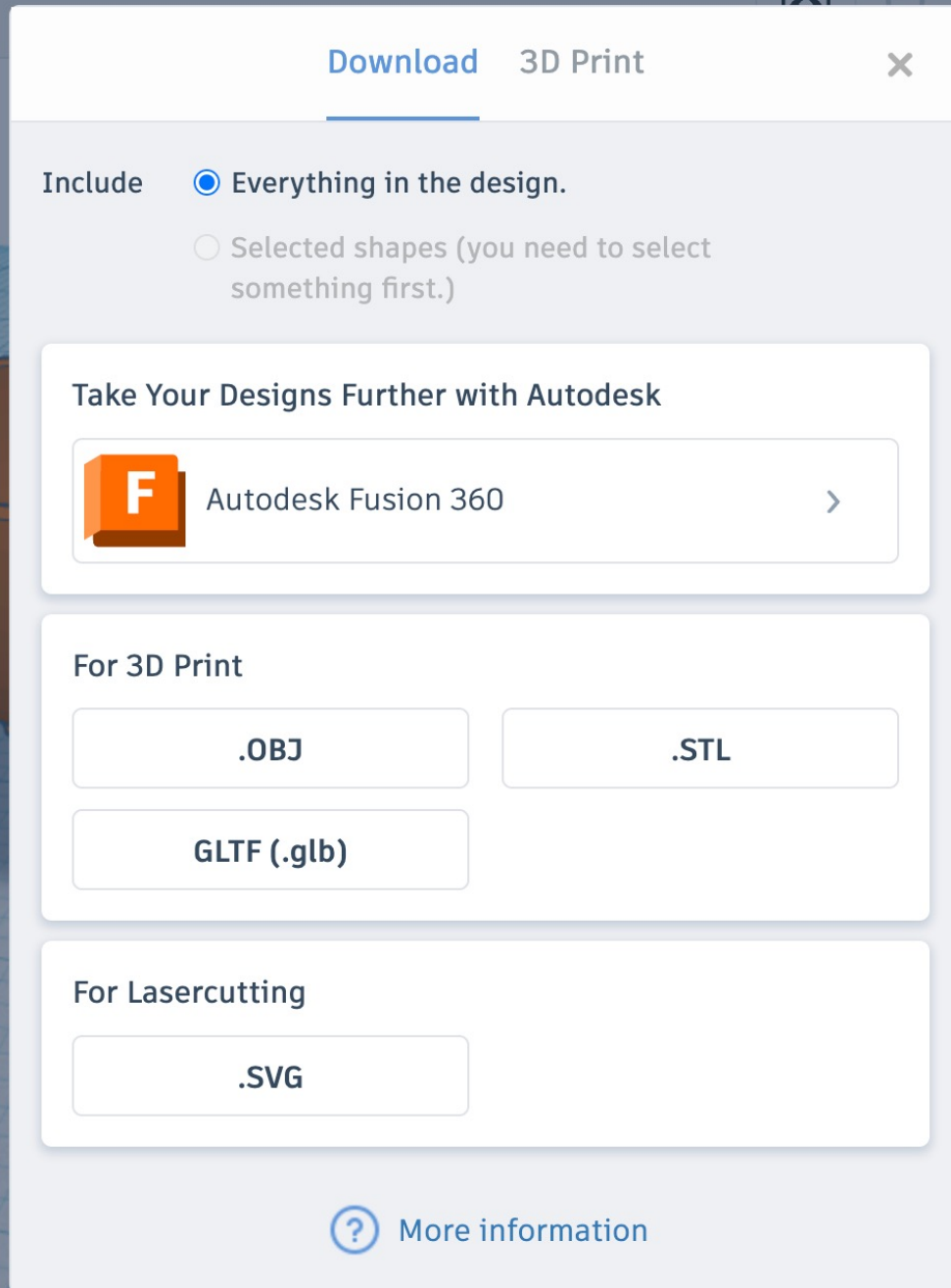
4



and hit the group button



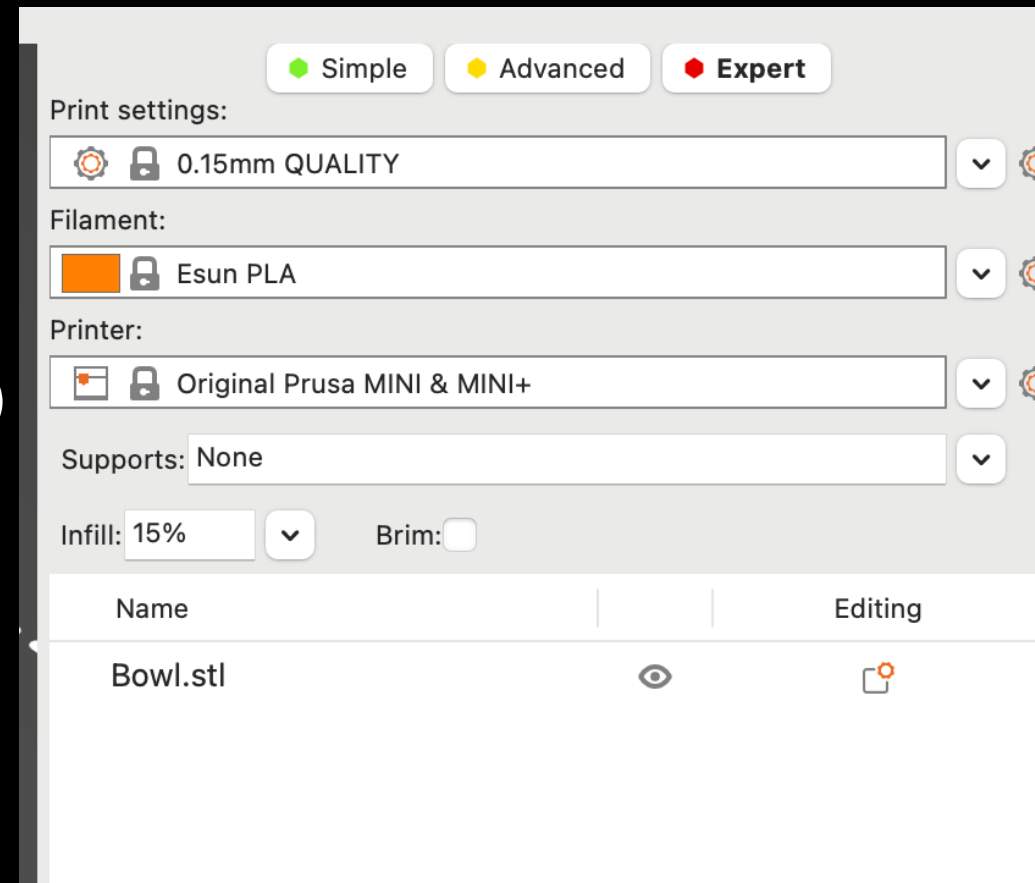
Exporting



- Hit the export button and select STL
- Save to your desired folder
- Open file up in PrusaSlicer, we recommend doing this from one of our workshop computer

Slicing with PrusaSlicer

- Open the **PrusaSlicer** application. If you are prompted that a Configuration Update is available, click to install the update before proceeding further.
- Use the **Add** button to load models into PrusaSlicer
- **Delete /Delete All** buttons remove the model(s) from PrusaSlicer opens the detailed settings of print , filament and printer
- Use **Move, scale, rotate , Place on Face** and **cut tools** to prepare the model to printing in the most efficient/ effective orientation,
- Select a **Quality / Speed** setting for your print
- Material selection



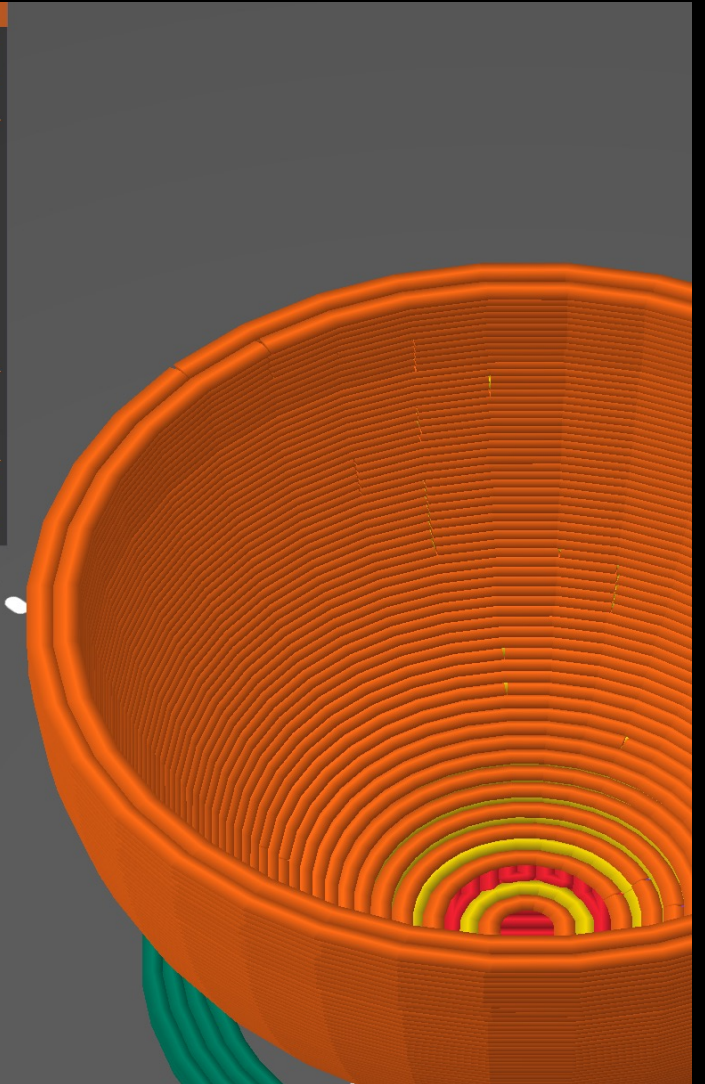
Slicing with PrusaSlicer

- Select a **Supports** setting
- Select an **Infill** percentage
- Click **Slice** to *slice* the model into layers in the Z axis and select **layers preview** to view infill land
- Check the **Sliced Info** for the cost and how long its going to take to print before exporting your gcode
- Generate and export *gcode* to the SD Card by clicking the **Export G-Code** button

- Ask a staff member to check over and fill out form!

Feature type	Time	Percentage	Used filament
Perimeter	4m	29.1%	0.09 m 0.26 g
External perimeter	7m	54.5%	0.16 m 0.48 g
Solid infill	50s	6.8%	0.02 m 0.06 g
Top solid infill	8s	1.1%	0.00 m 0.01 g
Skirt/Brim	26s	3.5%	0.01 m 0.04 g
Custom	10s	1.4%	0.02 m 0.05 g

Estimated printing times:
First layer: 32s
Total: 12m



THANKS FOR
ATTENDING

Please complete our survey that
will be sent out via Eventbrite.

Contact us on
appliedcreativity@slq.qld.gov.au



Extra resources

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
- <https://www.thingiverse.com/categories>

Functional Print

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



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