

3D Printer Training (FDM Printers)

This training covers **only** the FDM printers. For SLA printer training, please refer to the SLA (Formlabs) training document.

FDM: Fused Deposition Modeling uses extruded plastic filament applied layer by layer to build up a physical object from specifications provided by a digital 3D model.

Our FDM Printers:

- 2x Makerbot Replicator+
- 3x Dremel Digilab

Each printer uses its own proprietary software.

Makerbot Replicator+: Makerbot Print



Dremel Digilab: Dremel Digilab 3D Slicer



These utility programs are very similar, but each has a unique set of criteria required for its use.

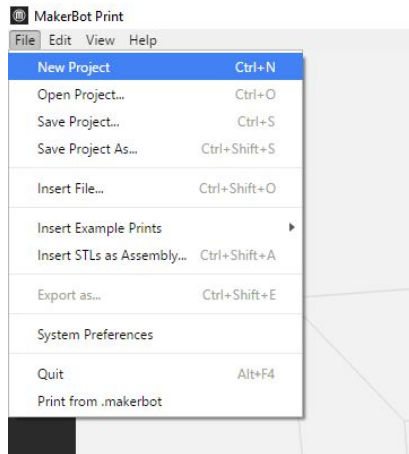
Getting Started:

- Acquiring your 3D model:
 - Make a model using a 3D modeling software (e.g. Fusion 360)
 - Alternatively, download a file from an online resource (e.g. Thingiverse)
 - This can be in a variety of file types, but the most common and recommended are those with the .stl extension (stereolithography). Most 3D modeling software can output to this file type.

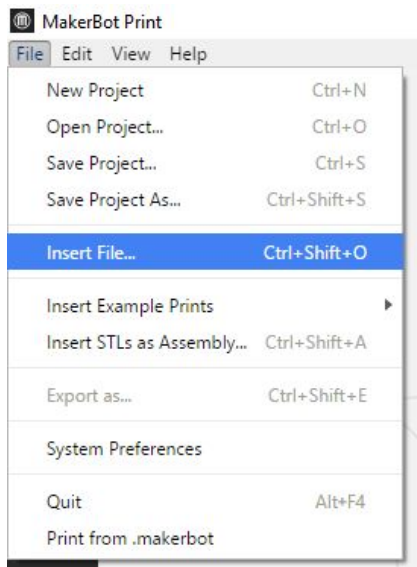
- Picking the right printer:
 - Makerbots are relatively quick, and very inexpensive to run. They have a build volume of 29.5 X 19.5 X 16.5 cm, and can easily handle multiple objects on the same buildplate. They do, however, struggle with objects with large flat surfaces, and only have a minimum resolution of 100 microns. The Makerbot can accept third-party filaments as long as the diameter and heat requirements are appropriate for the machine.
 - Dremel printers have a heated bed and full enclosure, which makes it easier to control warping of prints, particularly those with large flat surfaces against the buildplate. They have a build volume of 25.5 x 15.5 x 17.0 cm, which is noticeably smaller than the Makerbot, but still provides plenty of room for multiple small objects. The minimum resolution is 50 microns, making this printer about “twice” as detailed as the Makerbot, but material qualities can limit the actual output significantly via stringing or structural collapse. Materials are limited specifically to Dremel-provided spools due to built-in RFID material assignment.
- Choosing the right filament:
 - PLA: This is the only option we currently have for the Makerbot. It is biodegradable and will deteriorate over time, but is relatively strong, cheap and easy to work with, making it ideal for drafts and prototypes. It does absorb water over time, so ensure filament is properly stored between projects. Much of the commercially available 3D printer filament will be a variety of PLA.
 - ECO-ABS (Dremel only): This filament is similar to the PLA, and is fairly middling in all respects.
 - Nylon (Dremel only): Slightly more flexible and durable when compared to our other material options, but prone to stringing, making cleanup more of a hassle, and often obscuring finite details in the model.
 - Others: Students may purchase their own materials for use in our printers, but must check with a 3D printer trainer prior to use. Trainers please check diameter, reviews, and heat requirements for filament prior to approval. If material safety cannot be verified, the material cannot be used.

Printing with Makerbot Replicator+:

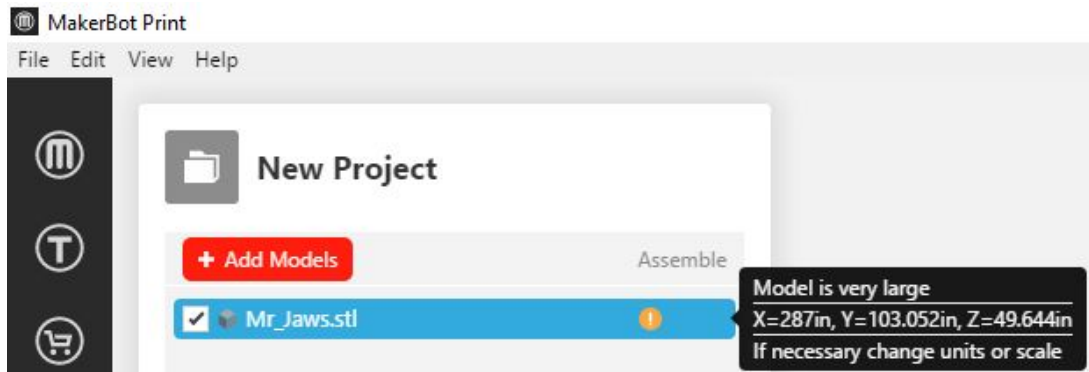
- Open Makerbot Print (if already open, File → New Project)



- File → Insert File... *OR* Drag file directly into program

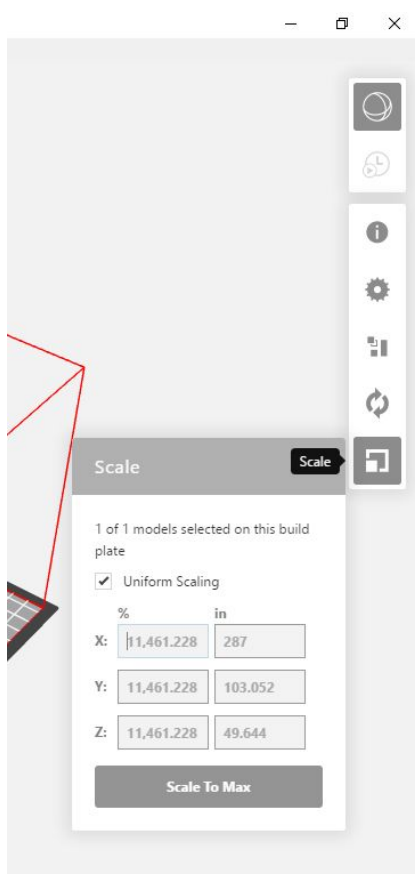


- If your object does not immediately appear, it is likely too big or too small. To fix this, open the Project Panel in the top left, and click on the object you wish to edit.



As you can see, this model is far too large for the build volume. Ensure the checkmark appears next to your model before moving on.

- Scale Object
 - Open the Scale menu on the right, and enter your dimensions, using the axis display in the bottom left to determine which dimension you choose to scale. Leave Uniform Scaling checked to ensure your proportions are maintained.



Your object may not appear right away, as objects are sometimes inserted into the program outside of the build space.

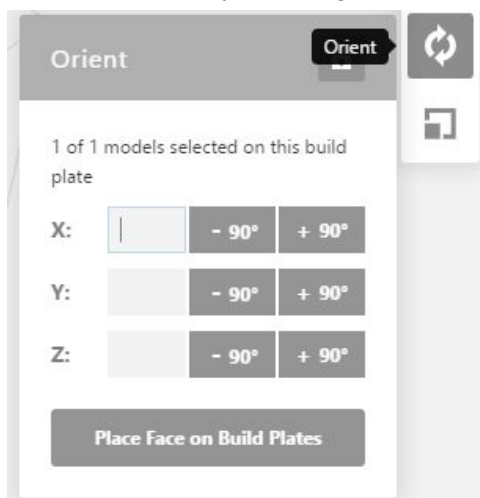
You may scale via percentage or inch measurement by clicking in any of the six boxes and entering a value.

The default units for Makerbot are set to inches.

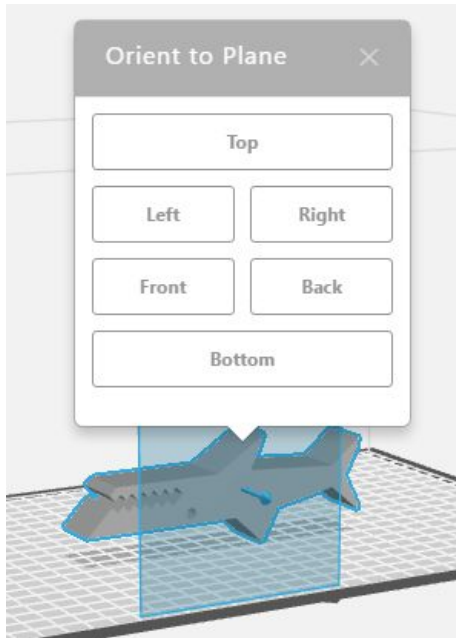
- Arrange Build Plate
 - Open the Arrange menu and click Arrange Build Plate to automatically bring your object(s) near the center of your build space.



- Orient Print
 - Ensure your object is still selected by clicking on it in the main view area or in the Project Panel.
 - You can select multiple objects by holding Ctrl and clicking the objects one by one, or select all objects on the build plate by pressing Ctrl+A.
 - Open the Orient menu on the right. You can shift objects in 90 degree increments around any axis automatically using the provided buttons, or rotate by a custom amount by entering a value in the boxes.

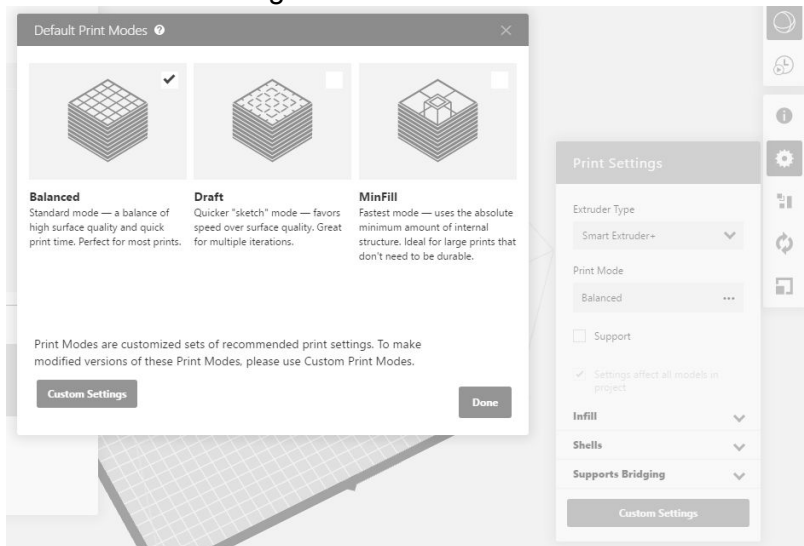


- Alternatively, you can use the Place Face on Build Plate tool and select a face you would like oriented parallel to the chosen plane (but not necessarily touching the plate).



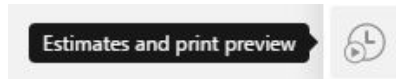
This will orient the face I have chosen (in this case the closest flat side) to whichever plane I choose). It is recommended that you place a flat face on the build plate, and that rounded surfaces be placed mostly toward the top of the print.

- Choose Print Quality
 - Once all of your objects have been properly sized and oriented, open the Print Settings menu and click on the Print Mode box.

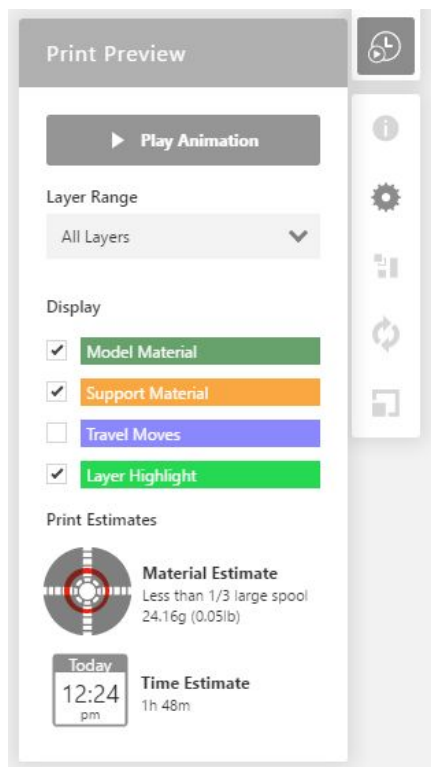


- Select a default print mode. Balanced is recommended for most prints. Further settings generally do not need to be modified.

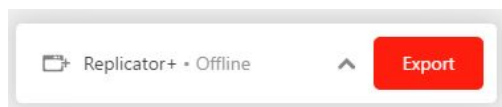
- Turn on Supports by clicking on the Support checkbox in Print Settings.
 - Most prints will require supports, and it is not recommended to print without them, as portions of your print will likely collapse.
- Click Estimate in the top right (fun fact: it will almost always hang at 83%, don't panic!)



- Once the estimate has finished calculating, make note of how much filament will be used, and how long the print will take, as displayed at the bottom of the Print Preview menu. *****Notify staff of your filament estimate before printing*****



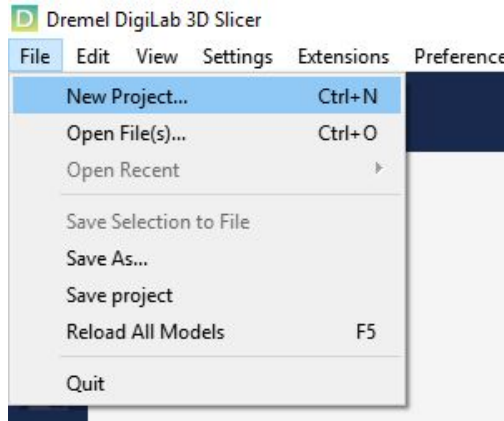
- Insert USB Drive if not already inserted
- Click Export on the bottom right and navigate to your USB Drive, then save your print.



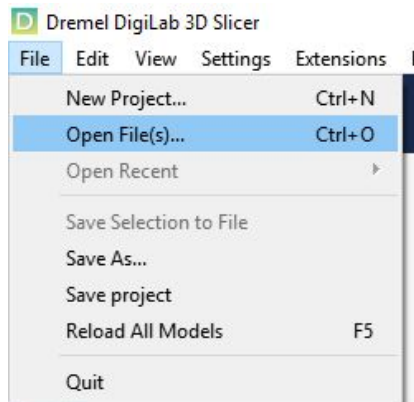
- Eject USB Drive
- Insert USB Drive into 3D printer
- Using the rolling wheel, navigate to Print → USB → Filename → Copy
- Back out using the top button, use the roll wheel to navigate to Internal Storage → Filename → Print
- Remove USB Drive
- Wait forever!

Printing with Dremel Digilab:

- Open Dremel Digilab 3D Slicer (if already open, File → New Project...)



- File → Open File(s)... **OR** Drag file directly onto workspace

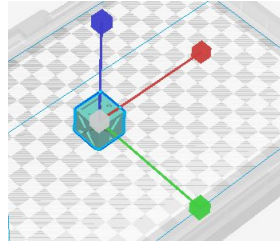


- Select object by clicking (Shift+Click to select multiple objects)
- Click Move tool on the left
 - Move your object by entering coordinates or by dragging any axis arrow attached to the object

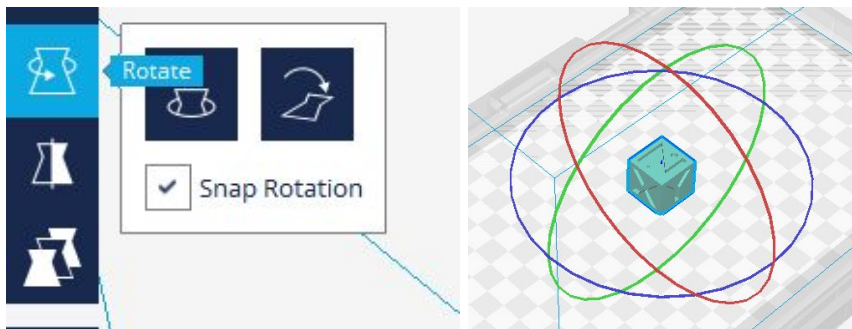


- Click Scale tool below the Move tool

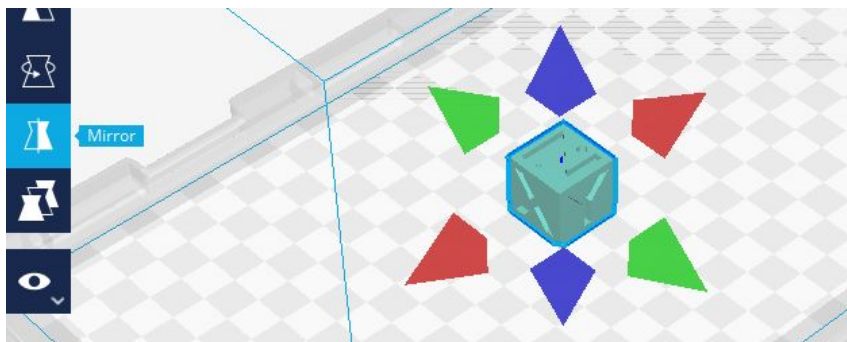
- Scale your object by entering measurements, percentages, or by dragging any of the axial boxes attached to the object
- Snap Scaling will allow you to drag-scale in set increments
- Uniform Scaling ensures your object will maintain its proportions



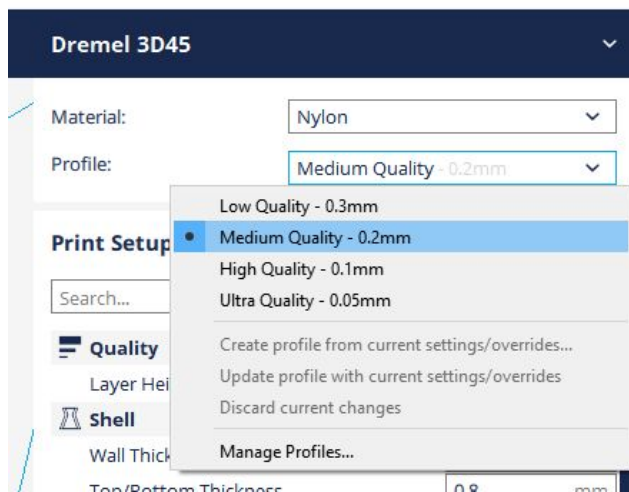
- Select Rotate tool below Scale tool
 - Rotate your object by using the orbitals around the object
 - The Lay Flat button will attempt to lay the largest face of the object flat on the surface
 - Snap Rotation will ensure your rotation is done in set increments, uncheck to rotate freely



- If your object needs to be reflected across an axis, select the Mirror tool and click the corresponding arrow near your object



- Select your print quality from the Profile dropdown
 - Medium is enough for most prototypes, Ultra may increase print time by as much as 200%



- Click Prepare

Ready to slice

Prepare

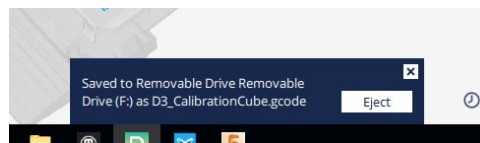
- Once your file is sliced and ready to print, make note of your print time and filament use
****Notify staff of your filament estimate before printing****
- Insert USB Drive if not already inserted



- Click Save to Removable Drive, then Eject once the option appears.

Ready to Save to Removable Drive

Save to Removable Drive



- Remove USB Drive, and insert it into the Dremel 3D printer
- ****BEFORE PRINTING, CLEAN GLASS PRINT SURFACE AND APPLY A LAYER OF GLUE TO ALL SECTIONS OF THE GLASS THAT WILL BE PRINTED ON****
- Press Build → USB (middle) → Filename → Copy to Printer (bottom right)
- Back → Back → Internal Storage (left) → Filename → Print

- Wait for a thousand years