# Train the Trainer: 3D Printing

All Items in this checklist should be completed during a 3D Certification.

Patrons should be given a 3D printing bookmark before beginning. At the completion of the certification, be sure a note is placed on the patron's account. **If Maker Agreement note is not listed, provide a Maker Agreement to the patron.**

- ☐ Start with introduction to the printers while pointing to the components described in all caps.
    - ☐ PLA – biodegradable plastic made from corn (Typically, PLA will completely compost in commercial compost in roughly 30-45 days. In home composting bins they may take longer. Does not recycle).
    - ☐ The FILAMENT is fed up through a clear GUIDE TUBE that enters the EXTRUDER.
    - ☐ The EXTRUDER consists of three main components; the STEPPER motor, HOT END, and COOLING FANS.
    - ☐ The STEPPER grips onto the FILAMENT and pushes the PLA into the HOT END (brass nozzle)
    - ☐ The HOT END heats to a temperature of 230 degrees Celsius. (446 deg Fahrenheit) **DO NOT TOUCH!**
    - ☐ The FILAMENT is pushed or extruded out of the HOT END by the STEPPER and then cooled as the plastic moves by the COOLING FAN.
    - ☐ This process will create parts layer by layer on to the BUILD PLATE (11"L x 6"Wx6"H). These layers make up what is called "RESOLUTION". Unsupported design features may lose detail or fail completely.
- ☐ Inform the patron of the two types of acceptable file formats
    - ☐ .STL  (Stereo Lithography)
    - ☐ .OBJ  (Usually from Sketchup)
- ☐ These files can be CREATED or DOWNLOADED
    - ☐ **CREATED**: To create a 3D model, patrons can use any of the CAD (computer-aided design) software that can export as .STL or .OBJ.
        - ☐ Patrons can use Tinkercad (works on Chrome or Firefox. No MACs or IE), Sketchup, Blender, or Solidworks.
        - ☐ A 3D file can be created from a physical object by one of two ways. Both processes are **TEMPREMENTAL** at best. Convey to patrons that this method comes with varied results, including complete failures. **BEST PRACTICE IS TO DESGIN THE FILE OR DOWNLOAD ONE.**
            - ☐ To **SCAN** a physical object, patrons can use the DIGITIZER on the MACs. **THIS METHOD IS THE LEAST SUCCESFUL**
            - ☐ A more successful way to **SCAN** physical objects is to use "123D Catch" app from their phones or from the web.

    **\*\*\*BOTH OF THESE METHODS SHOULD BE COVERED MORE THOURGHLY IN A DEDICATED 1-ON-1**

    - ☐ **DOWNLOADED**:
        - ☐ Patrons can download pre-made 3D files from THINGIVERSE.
        - ☐ Show patrons the THINGIVERSE.com webpage.
        - ☐ Emphasize the importance finding parts that are well documented with instructions and descriptions.
        - ☐ To download a file, patrons should download the files separately **NOT THE "DOWNLOAD ALL"** button.  Use the "Thing Files" tab to see available files, simply click on one to download.

    **\*\*BEST PRACTICE IS TO LOOK FOR OBJECTS THAT HAVE REAL PHOTOGRAPHS (not computer generated) AND/OR BLUE STARS OR TROPHIES ON THEIR PROFILE PICTURES.**

- ☐ Learning how to navigate MAKERWARE/ MAKERBOT DESKTOP (patron should be manning the PC)
    - ☐ Close out all PC windows and show patron the desktop.
    - ☐ Show patron the HELP UTLITIES section on the desktop. Remind patron that there is always a trained staff member or volunteer at the Fab Lab desk to assist them.

- ☐ Click on MakerWare/Makerbot Desktop icon.
- ☐ Begin with the wide black header, ONLY the "Prepare" tab should be highlighted. We will never use the others.
- ☐ Move down to the grey thin bar, point out "Settings", "Add File", "Preview" and "Print". All will be used during training.
- ☐ Begin with "ADD FILE", this will allow users to fill the BUILD PLATE with files. (Select FFLIB Keychain)
- ☐ Briefly demonstrate how each tool works, ie VIEW, MOVE, TURN, SCALE, OBJECT. **\*\*\* OBJECT TOOL  IS NEW AND ONLY AVAILABLE ON PRINTERS WITH TWO EXTRUDERS\*\*\*\***

**\*\*\*\*\*\*\*\*\*\*This is a necessary step on ONLY the 1-on-1 Training Printer and R2 in the Fab Lab\*\*\*\*\*\*\*\*\*\***

- ▪ Inform patrons that the OBJECT button allows them to choose which Extruder they can print from. For the OBJECT tool to work, the part must be selected. There are two choices, Left extruder or Right extruder.  (**Select LEFT for Training purposes**)

- ☐ Select the SETTINGS tab to open the settings window. We recommend that patrons use the "QUICK" tab only.
  - ▪ **Quality** refers to Resolution or how tight the layers of filament are laid down on top of each other. Lower quality means taller/ fewer layers but faster print time. **WE RECOMMEND STANDARD,** HIGH RESOLUTION OFTEN LEADS TO PRINT FAILURES AND JAMS
  - ▪ Patrons can choose if the file will need RAFTS and SUPPORTS \*\*\* IF USING SUPPORTS, RAFTS MUST BE USED AS WELL.
  - ▪ **Rafts** – A raft is a flat base that is printed before the object. A raft can help your object stick securely to the build plate. Objects printed with rafts, sit on this base of disposable material instead of directly on the build surface. **RAFTS ARE RECOMMENDED**
  - ▪ **Supports** are breakaway structures that provide support where your print needs them during the printing process. Because MakerBot printers cannot print into thin air, supports provide a base for overhanging parts of a print. Supports can leave surface imperfections that require finishing of the object. You can use a file to smooth them away.
  - ▪ **Shells** are outlines defining the shape of the layer. Every object you print must have at least one shell. Additional shells add to an object's strength, weight, and print time. Two or three shells are sufficient for most objects. **TWO SHELLS ARE STANDARD.**
  - ▪ **Infill** is a support structure that is printed inside an object to increase its strength. It's usually extruded in some kind of pattern; the MakerBot Slicer uses a hexagonal pattern for infill by default. **10% IS STANDARD.**

  \*\*\*\*\* For **ONLY** the Training Printer, please use the "**Custom**" tab and select "**USE THIS SETTING**". \*\*\*\*\*\*\*\*

- ☐ Select "PREVIEW" in the grey bar. This will estimate print time and material usage. Cost is $.05 per gram.
- ☐ Sending a file to be printed
  - ☐ Press the "PRINT" button at the top right of the screen.
  - ☐ Show the patron how to fill out the 3D printer pick-up form.
  - ☐ Emphasize the importance of waiting to see the printer lay down the test line and the entire 1$^{st}$ layer before leaving a print job.
- ☐ Highlight the TIPS AND TRICKS sign on the printer.