# LESSON 2: USING A 3D PRINTER

Now that we've explored a bit how others are using their 3D printers, it's time for you to get started. Use this book as well as your User Manual as a solid foundation to begin. This book focuses on the MakerBot Replicator Desktop 3D Printer but includes callouts for other MakerBot 3D printers. All material covered should be applicable regardless of which 3D printer you're using.

### LEARNING OBJECTIVES

- Understand how to set up a MakerBot Replicator 3D Printer
- Be able to identify and define key components of your printer
- Define leveling and its importance

### TERMINOLOGY

- **Gantry:** A pulley and belt system that moves the carriage
- **Carriage:** The part of the printer that carries the extruder on the x-axis and y-axis
- **Build plate:** Surface on which prints are built
- **Filament:** Material used to build your 3D prints
- **MakerBot Replicator Smart Extruder:** The "hot glue gun" of your 3D printer; it uses filament to draw out the layers of your 3D prints
- **Leveling:** Process to ensure proper distance between the nozzle of the Smart Extruder and the build plate
- **Purge line:** Straight line drawn across the front of the build plate at the start of every print
- **Firmware:** The code installed on the printer's hardware that allows it to operate
- **MakerBot Desktop:** Free 3D printing software for discovering, managing, preparing and sharing your 3D prints

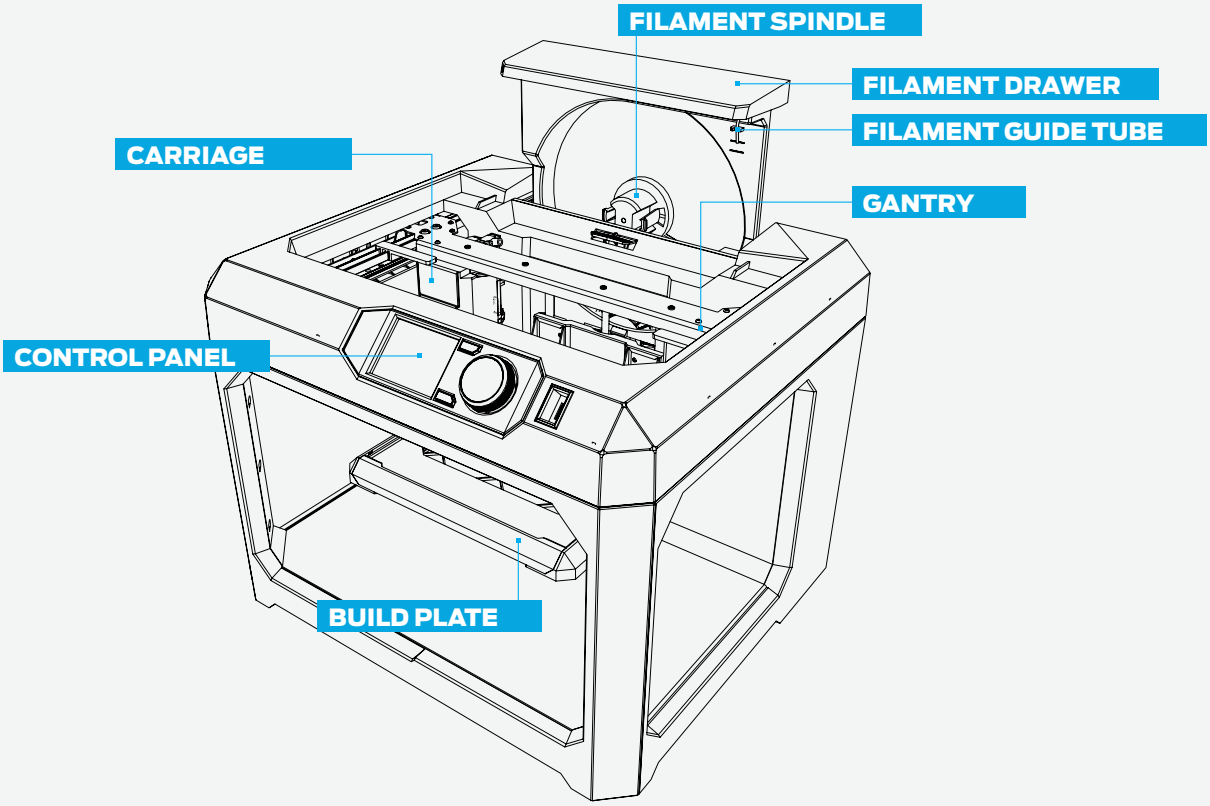
### UNBOXING AND SETUP

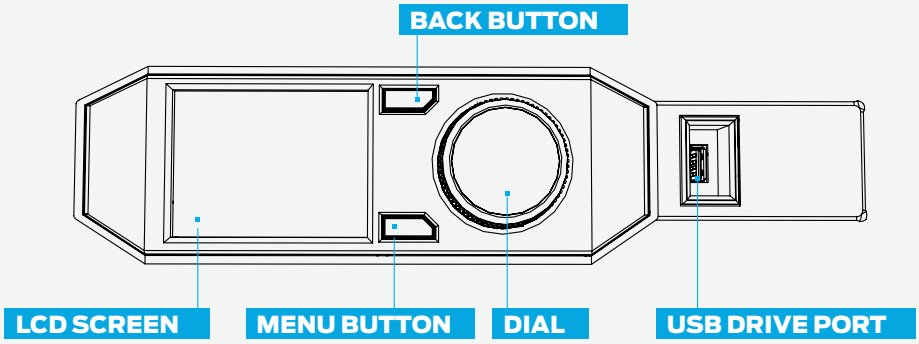
Refer to your User Manual for detailed unboxing and setup instructions. Make sure you're running the most current version of MakerBot Desktop and Firmware before starting to print. More information can be found on page 53 in the MakerBot Replicator User Manual.

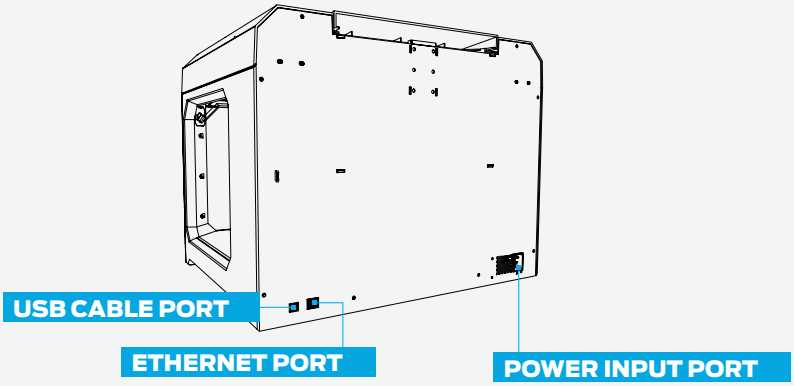
The following diagrams detail the main components of each of the printers.

**Activity:** Study the following diagrams and terminology of each of the printers. After your review, correctly identify and define the main components.

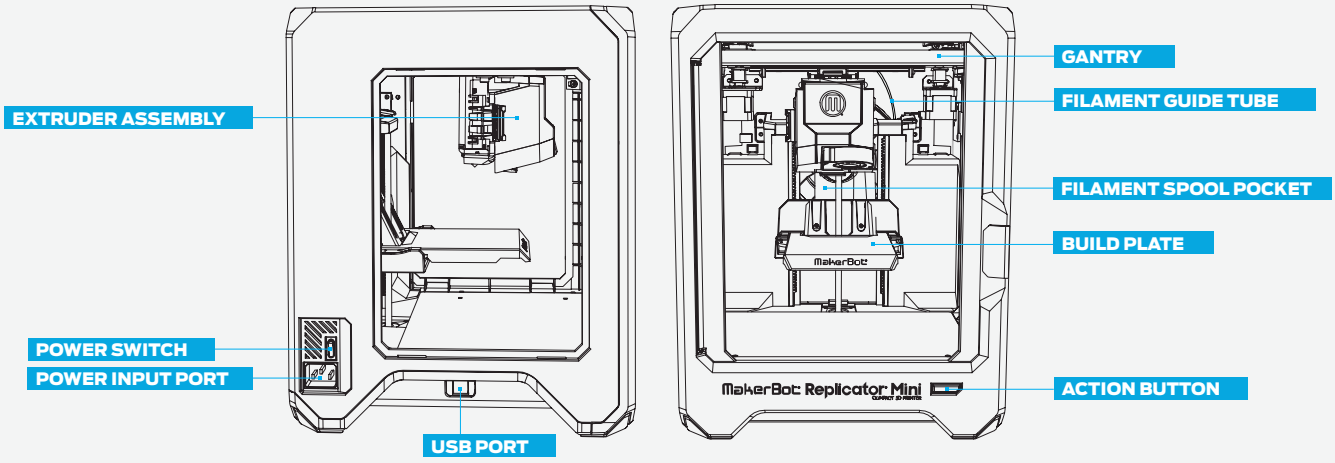
## MAKERBOT REPLICATOR DESKTOP 3D PRINTER



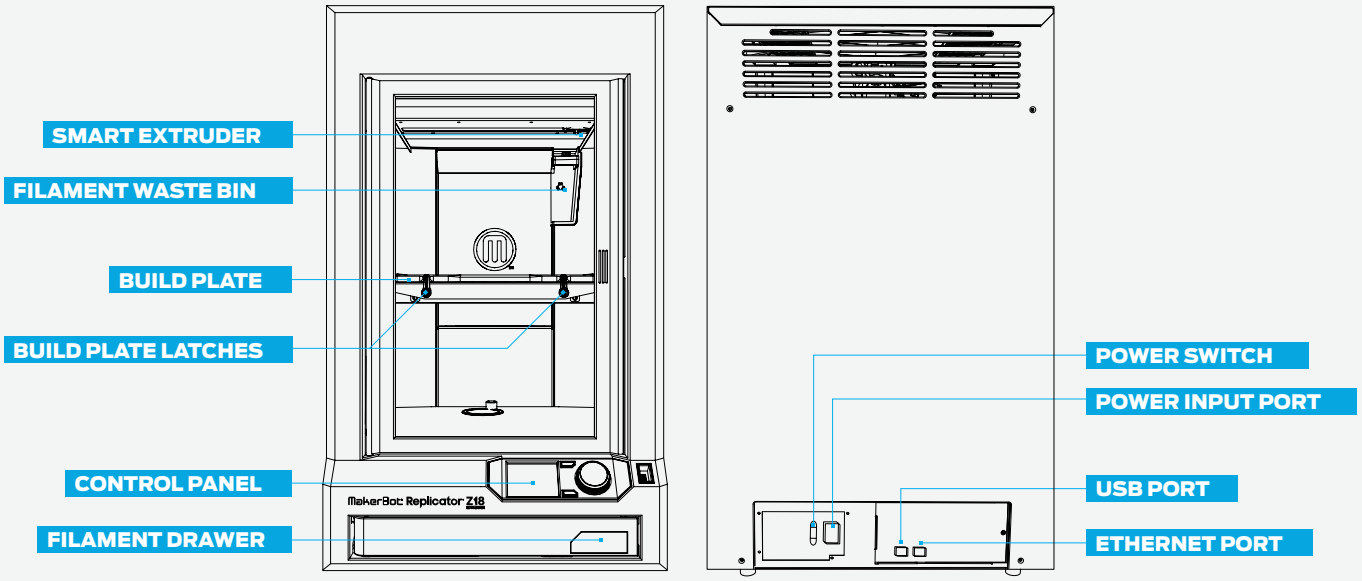



## MAKERBOT REPLICATOR MINI COMPACT 3D PRINTER




## MAKERBOT REPLICATOR Z18 3D PRINTER



## PRINTER SETUP LOGISTICS

### Printer and Filament Placement

Placement of your printer(s) can have an impact on its use as well as its performance:

- Set up your printer in a stable location that doesn't have excessive temperature fluctuations throughout the day (e.g., do not place it near an air-conditioning vent).
- It's helpful to have a space near the printer to clean prints off. You'll also need a place for print tools (see Suggested Tools below).
- Store filament in a cool, dry location, preferably in the original packaging, to help guard against humidity.

### Other Considerations

- Placing 3D printer(s) in your classroom allows for a lot of student interaction, hands-on time, and printing during class, but lessens visibility and accessibility to the school community.
- Placing 3D printers(s) in a communal space (library, front office, etc.) ensures visibility and encourages use by students, faculty, and staff, but complicates the logistics of printing during class.
- If the printer is in an openly accessible area, keep the filament and Smart Extruder in your desk or in a closet to prevent unwanted use.

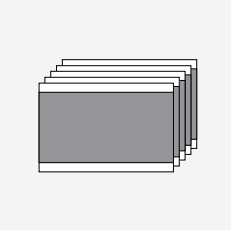
### Suggested Tools

The following tools are great to have near your printer for print cleanup and post-processing:

- **Thin metal craft spatula** – for removing prints from the build plate without tearing the tape.
- **Needle-nose pliers** – for removing support material.
- **Small wire-cutting pliers** – for removing support material and cleaning off excess filament.
- **Tweezers** – for removing support material.
- **Hand applicator** – for applying build plate tape and smoothing out air bubbles.

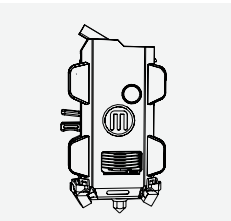
  Thingiverse (see page 36) has a large collection of printable tool holders. The task of organizing your tools is also a great opportunity for students to design and print their own tool holders.

## PARTS INCLUDED IN ACCESSORY KIT



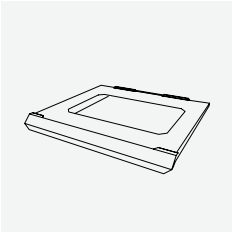
### Build Plate Tape

Five precut sheets to apply to your build plate. If you have a MakerBot Replicator Z18 3D Printer, you have one sheet.



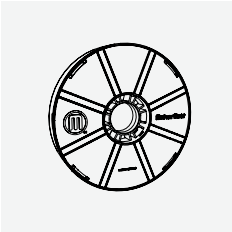
### Smart Extruder

The MakerBot Replicator Smart Extruder is an extruder with a lot of built-in sensors. The sensors help detect filament absence and clogs. The extruder attaches to the carriage via magnets and pins.



**Build Plate**

The build plates of MakerBot Replicator 3D Printers vary in type and size, depending on the model. We don't recommend printing directly onto the build plate without protective tape.

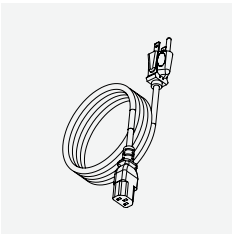


**Filament Spool**

2 lb spool of MakerBot PLA Filament. PLA is polylactic acid. MakerBot PLA Filament is a nontoxic resin made of sugar derived from field corn and has a semisweet smell (like waffles) when heated.

**USB Cable**

The USB cable is available for local printing or to set up Wi-Fi capabilities.



**Power Cable**

Your printer needs to be plugged into a power source of 100–240 VAC.

**Remove Shipping Material**

For shipping, there are plastic inserts placed below the build plate as well as a foam brace on the gantry. Remove these three components before turning your printer on. Make sure you keep these materials, especially if you plan to travel with your printer.

## FIRST SETUP

**Printer Walkthrough**

Once your printer is on, there will be a startup script. The walkthrough will prepare the printer for your first print. **Print Menu > Internal Storage** has all the demo prints in case you need to find them again.

## CONNECTING TO YOUR 3D PRINTER

Once you've completed your first print, MakerBot recommends connecting your printer via USB cable or Ethernet to download the latest firmware. If you want to connect to Wi-Fi, first you'll need to connect via these other methods. Double-check the connection in the **Devices** dropdown in MakerBot Desktop. If you're connected, it should read **[Your Printer Name Here] (USB)**.

### Updating Firmware

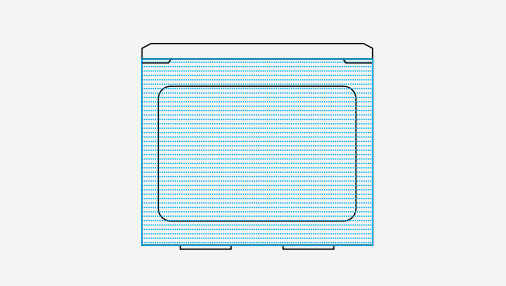
You should be prompted to download new firmware if your connected printer is out of date. Double-check in **Devices > Update Firmware**.

### Connecting via Wi-Fi

To connect via Wi-Fi, connect either via Ethernet or USB cable to your printer. **Devices > Device Preference > Network** will allow you to connect via Wi-Fi.

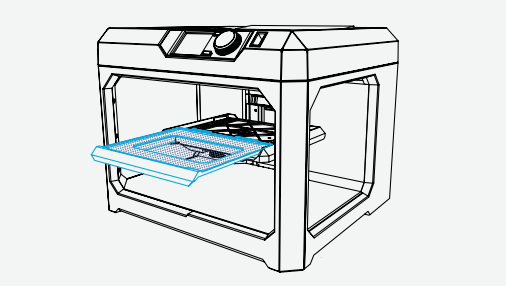
## PREPRINT CHECKLIST

Before every print, check the following:



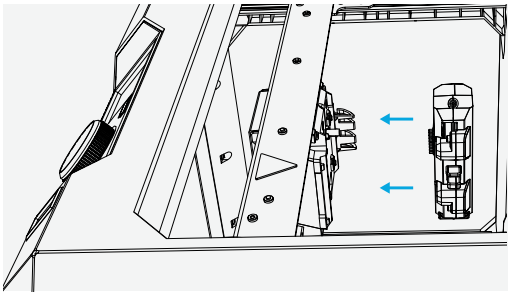
### Build Plate Tape Applied

Build plate tape is on the build plate and (mostly) free of tears. If there are more than a few minor tears, remove the build plate and apply new tape before printing.



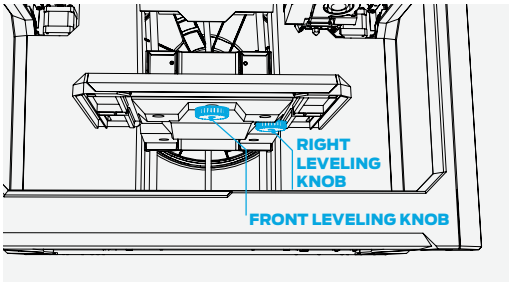
### Build Plate Installed

The build plate has been loaded properly onto the Z Stage.



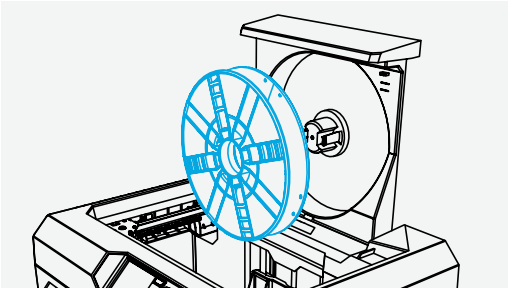
### MakerBot Replicator Smart Extruder Attached

A Smart Extruder is attached to the carriage. Double-check that the Smart Extruder is attached by scrolling the dial to **Utilities > Attach Smart Extruder**.




### Build Plate Is Level

If you were not the last person to use the printer, you should level your build plate before printing. Scroll the dial to **Utilities > Level Build Plate** and follow the on-screen instructions until assisted leveling is complete.



**Filament Loaded Properly**

Ensure that filament is loaded into the filament drawer correctly. Change filament using the **Filament** menu. When loading new filament, clip off the end, making a pointed tip to prevent clogs in your extruder.

## WHAT IS LEVELING? WHY IS IT IMPORTANT?

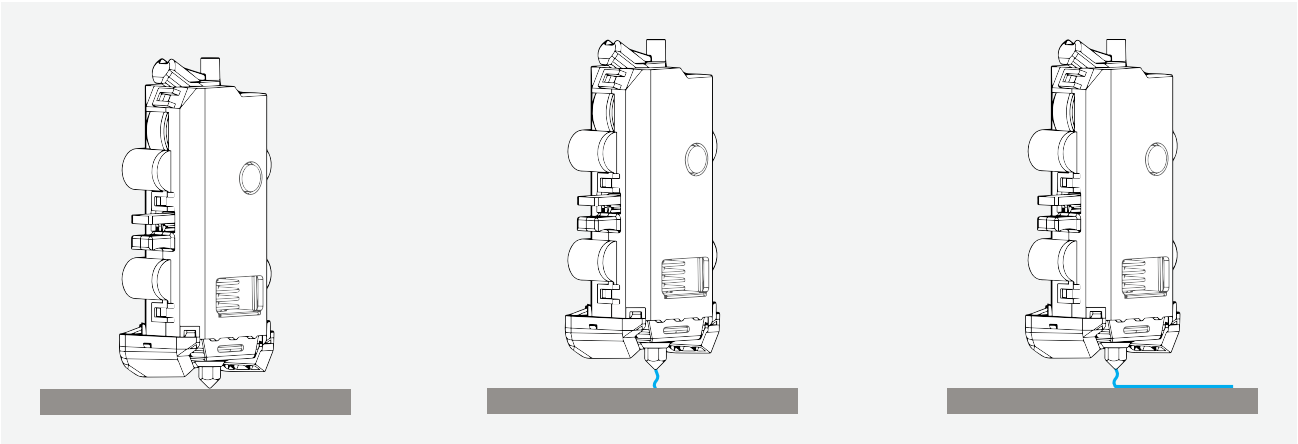
A level build plate means that the distance between the nozzle of the extruder and the build plate is the same at every point. A build plate that's not level will usually result in a poor print. For example, if the build plate is tilted slightly upward on the right side, then the first layer of the print will be squished on the right side and loose on the left side. The first layer of your print is the most important; it's like a foundation for your house. If it isn't laid correctly, the rest of the house could be affected.

The MakerBot Replicator Smart Extruder tests this distance automatically. All you need to do is adjust the build plate so it's not too close or too far away. If the printer has been moved around recently, or you're not sure when it was last leveled, it's safer to level your build plate before printing. Scroll the dial to **Utilities > Level Build Plate** and follow the on-screen instructions until assisted leveling is complete.

Leveling your build plate is perhaps the most important part of setting up and maintaining a 3D printer. If your prints are not adhering properly, chances are, you need to re-level the build plate.

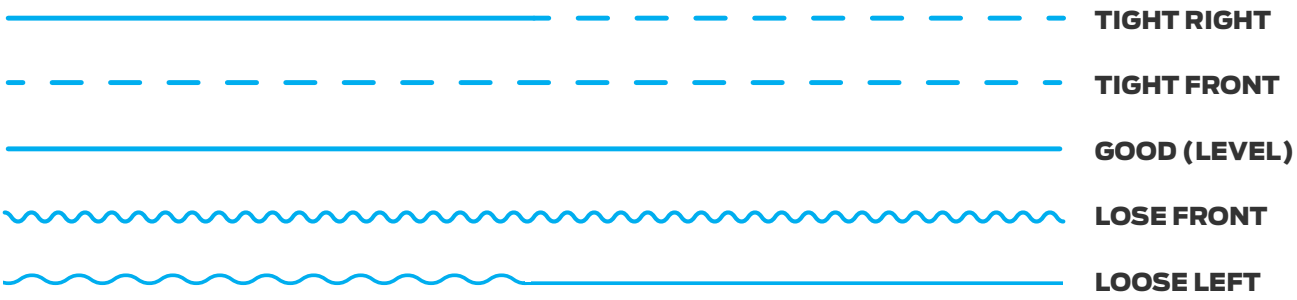
### When To Level

- The first time you unbox a new printer or attach a new Smart Extruder
- After changing the printer's location
- If filament appears squiggly on the first layer of a print
- If you hear a clicking sound on the first layer of a print
- If the nozzle is cutting into the build plate tape or filament is blocked from extruding
- After firmware updates
- When you can't remember the last time the build plate was leveled



**Activity:** The MakerBot Replicator draws a straight line across the front of the build plate at the start of every print. This "purge line" can tell you a lot of important information about your printer.

1. Start a sample print. Pay close attention to the purge line.
   a. What does the purge line look like?
   b. What does this purge line tell you?
2. Look at the following purge line examples. Explain what each tells you about the printer.




3. Save them! Have students collect, glue, and label them on a sheet of paper for future reference.

**KNOWLEDGE CHECKS**

- What are the key components of a MakerBot Replicator?
- Why is it important to level your printer's build plate?
- What should you check before starting every print?

**I'VE SET UP MY PRINTER; NOW WHAT?**

There are two major components of 3D printing with a MakerBot Replicator. One is the hardware, the 3D printer itself. The other is the software, MakerBot Desktop, which prepares your 3D designs for printing. Next, we'll explore how to set up a file for printing and the kinds of settings you can adjust to modify your 3D print.