3D Printing at Lincoln Public Library

What will I learn in this course?

Over the next 10 to 20 minutes, you will learn:

1. 3D printing at Lincoln Public Library.
2. How to use Cura.
3. How to change filament / change colour.

Who is this course for?

- Anyone who would like to use the 3D printer at LPL.
- Basic keyboard and Internet skills are required to complete this online course and use the 3D printer.

Course Information

- This course is intended for information purposes only. Anyone wishing to 3D print at the library must first complete this course and sign the Makerspace Agreement Form. There is no certificate of completion at the end.

3D Printing Basics

This section includes:
1. 3D printing definition.
2. Examples of what can be 3D printed.

Definition of 3D Printing

3D printing is the action or process of making three dimensional solid objects from a digital file. An extruder applies filament layer by layer to turn a digital object into a physical object.

3D Printing at Lincoln Public Library

In this section you will learn:

- How to design and print 3D objects at LPL.
- The policies and procedures for 3D printing at LPL.

LPL Makerspace

The LPL Makerspace provides access to technology, software, and classes:

- The Makerspace is located at the Fleming Branch and includes tools, laptops, creative software ([Cura](), [Tinkercad](), [freeCAD]()) and dedicated staff to support digital creativity.
- You can access 3D printers and software to design and print your own objects.
- Please visit our website for more information: [lincoln.library.on.ca]()

How to Book a 3D Printer

- Reserve the 3D printer by calling the Fleming Branch directly.
- 3D printers are also available on a first-come, first-served basis during library open hours.
- Two hours is the maximum time allowed for print jobs. Print times are calculated with [Cura]() (more below). Contact the Fleming Branch for longer prints.
- A Lincoln Public Library Card is required.

3D Printing Rules

- Review and sign the Makerspace User Agreement (see below).
- Printing items that contravene the Makerspace User Agreement is not allowed.
- Users must be 14 years of age or older. Users under the age of 14 must be accompanied by a parent or guardian at all times.

Printing Costs

- A fee of $0.10 per one gram of filament is charged for each print job.
- An average print job is about ten grams and costs $1, no charge for aborted / failed prints.

Meet Our Printer – The Ultimaker 2 Extended+

- Our printer uses a process called fused filament fabrication. This process creates 3D objects using a continuous stream of thermoplastic filament.
- We use PLA (polylactic acid) that is a biodegradable type of plastic manufactured using plant-based resources such as corn starch and sugar cane.
- Other filament types may be available at the library from time to time. Our printer can print: ABS, CPE, CPE+, Nylon, PC, TPU 95A, and PP.
- The filament is fed from a spool to a feeder to an extruder that has been heated to over 200 degrees Celsius.
- The printer head is also referred to as the extruder. As the filament moves through the heated extruder, it melts and is pushed through a nozzle to the build plate. Moving side to side, the extruder deposits lines of melted plastic at a time, forming a solid layer.
- Once a layer of plastic is complete, the build plate moves down so that the extruder can begin a new layer on top of the last. This process continues until your 3D object has been completely printed top to bottom.

Quiz Questions: Let's test Your Knowledge!

1. **Question: Where can you 3D Print at LPL?**

   Please select one of the following:

   a. At both Lincoln Public Library branches.
   b. At the Makerspace located at the Fleming Branch.
   c. At the Moses F. Rittenhouse Branch.
   d. You cannot print at any LPL location.

2. **Question: What is the maximum time to use the 3D printer?**

   Please select one of the following:

   a. 2 hours.
   b. 4 hours.
   c. 1 hour.
   d. 6 hours.

3. **Question: How much does a 10-gram print cost?**
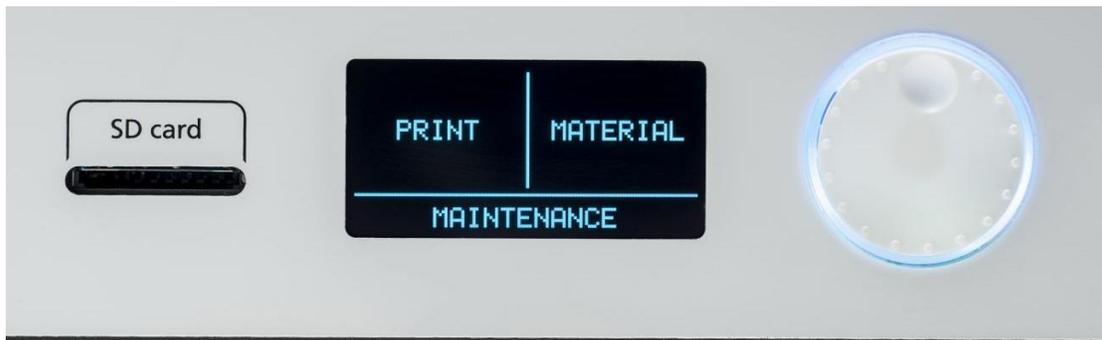
   Please select one of the following:

   a. $1.50.
   b. $10.00.
   c. $1.00.
   d. $5.00.

How to 3D Print

Control

The printer can easily be controlled with the push/rotate button at the side of the display. The button allows the following actions:

- Rotate to scroll through a menu or to select an option.
- Push to confirm a selection or action.

Display

The display at the front side of the printer shows all the necessary information for setting up and using the Ultimaker 2+. The main menu offers three options: Print, Material, and Maintenance.

Print: this menu allows you to select a print, when using an SD card. While printing, the menu also allows you to tune the print, and change the settings for instance.

Material: with this menu you can either change the material or change the settings of the material profiles.

**Maintenance:** this menu offers advanced options and should only be used by LPL staff.

Materials

For all materials that are supported on the Ultimaker 2+ it is recommended to apply an adhesive to the glass plate before starting a print.

It's advised to print all materials with a brim or raft as platform adhesion type. A brim will put some extra lines of plastic around the object on the first layer to let the model adhere well and minimize warping. A raft will put a grid structure between the print and build plate that allows for better adhesion.

Preparing a print with Cura

Here is an overview of the interface with Ultimaker 2+ selected (default on LPL laptops):
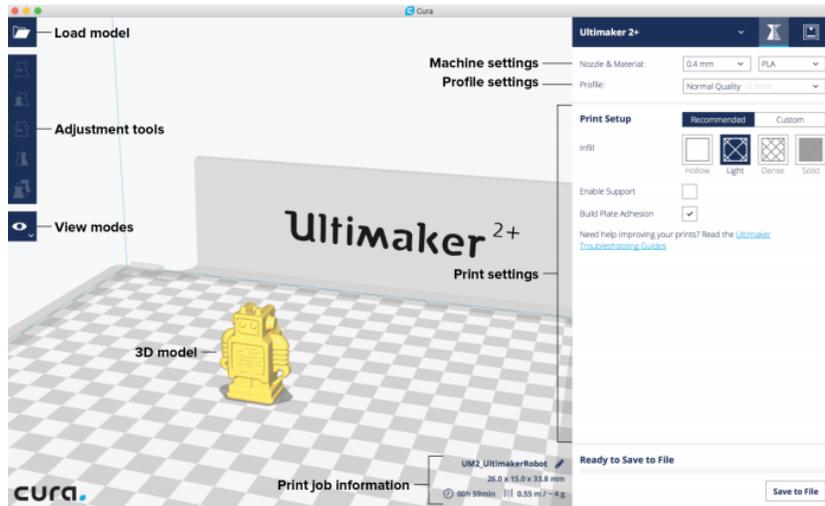
Step 1: Download or design a 3D Model

- Download 3D objects for free at Thingiverse.com.
- Downloads from Thingiverse are in ZIP format. You will need to decompress ZIP files with 7-Zip: 7-zip.org/download or another file archiver.
- Design software such as Tinkercad or freeCAD allows you to create your own objects and files (ask LPL staff if you'd like to learn more).
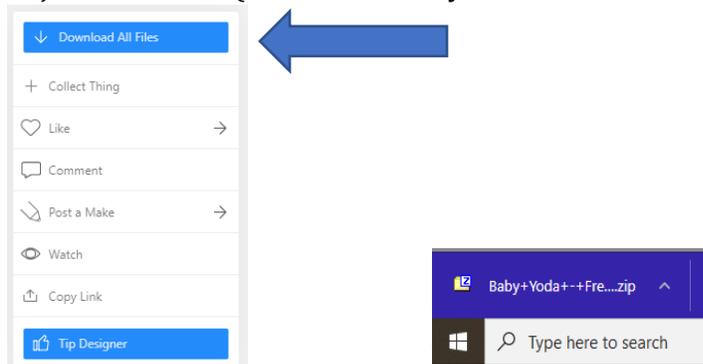
Step 2: Slice the Model with Recommended Settings

- Load the model into Cura by clicking the "Open File" folder icon (top left corner).
- Use the Adjustment Tool to position, scale, and rotate the object if desired. Please use the Recommended Settings if you are new to 3D printing.
- Save the print file via the "Save to removable drive" button to the SD card.
- Eject the SD card in Cura and remove it from your computer.

Step 3: Print

- Insert the SD card into the Ultimaker 2+ slot.
- Go to **PRINT** and select the file you want to print. A USB can have several files on it, so it's important to remember or write down your file name.
- Select your file and the print process will start.
- We suggest a thin layer of stick glue on the glass bed surface the size of your first layer. Please speak to a staff member if you are unsure.

Ultimaker 2+ Optimum Custom Settings (advanced)

- **Layer height:** 0.2mm recommended. Intermediate and advanced users can select between 0.1mm (ultra fine) and 0.4mm (coarse).
- **Infill and shell:** 20% infill recommended. Most printouts do not require infill above 25%. Less infill means less weight and filament used.
- **Supports:** Supports are like scaffolding for overhangs that extend outward from its main body. Select if overhang tilts at an angle greater than 50 degrees.
- **Build plate adhesion:** Brim recommended. A skirt (two lines printed around the base of the object) is a good option if your print is steady. Rafts are available for special prints (please speak to a staff member).

Remove Print from Bed / Print Cleanup

- **CAUTION**: the bed will be very hot after a print! Do not touch it without tools.
- Your print will probably require a palette knife to remove it from the glass surface. These are available at the Makerspace.
- You may have to remove extra filament or supports from your print. The LPL Makerspace has all the tools you need including pliers, cutters, and sandpaper.

Changing Filament / Colour

- From the touch screen select **MATERIAL** and then **CHANGE**.
- Wait for the extruder to heat up.
- When hot, the Ultimaker 2+ will automatically rewind the filament. Remove the filament and select **READY**.
- Ultimaker will ask you wat type of filament (this info will be on the filament spool).
- Load filament into the extruder until you see it move up the tube. Don't panic if it gets stuck: please ask staff member.
- Select **READY** and the filament will feed to the extruder.
- Allow filament to extrude a uniform colour and select **READY**. You are now ready to print.

Quiz Questions: Let's test Your Knowledge!

4. **Question: What is the final step when using Cura before printing?**

    Please select one of the following:

    a. Click on **ADD PRINTER** and select Ultimaker 2+.
    b. Click file, save as, and select 3D printer.
    c. Click **Save to Removable Drive**, make note of the file, and click **Eject**.

5. **Question: What type of software is Cura?**

    Please select one of the following:

    a. Web design software.
    b. Slicing software.
    c. Computer-aided design (CAD) software.

Congratulations, you are now ready to 3D print at Lincoln Public Library! Please remember to complete the Makerspace User Agreement below.

Answer key:

1. b.
2. a.
3. c.
4. c.
5. b.