

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:

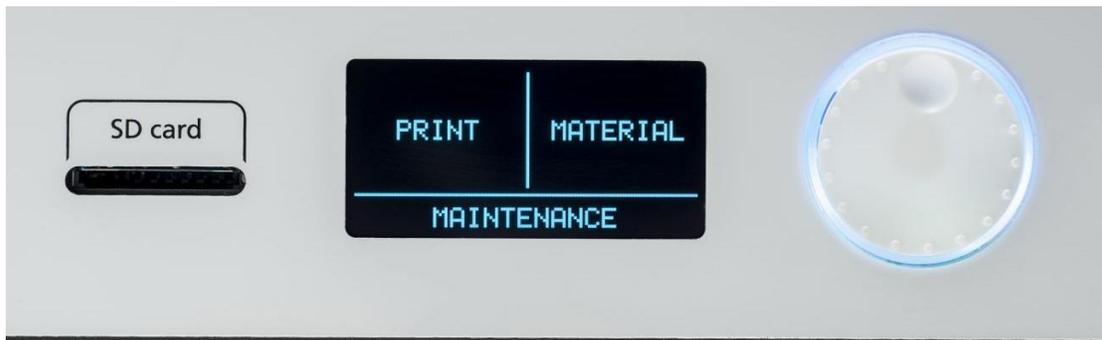
- a. \$1.50.
- b. \$10.00.
- c. \$1.00.
- d. \$5.00.

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.

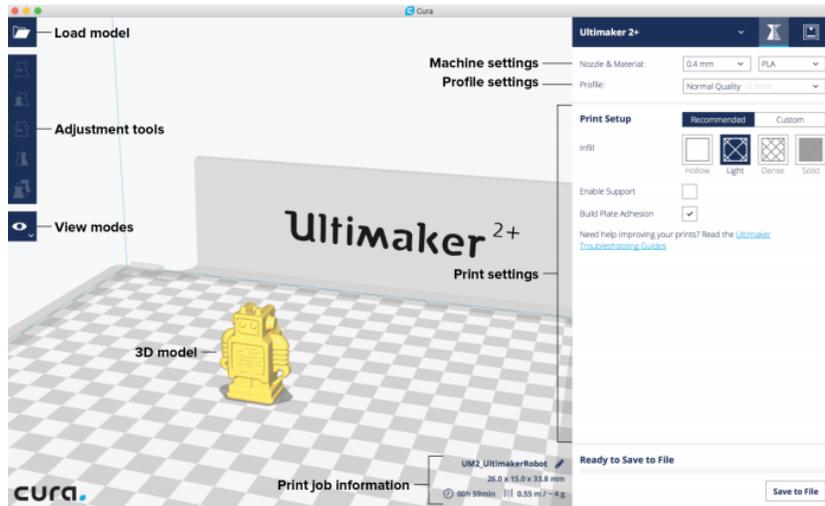
Materials

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.

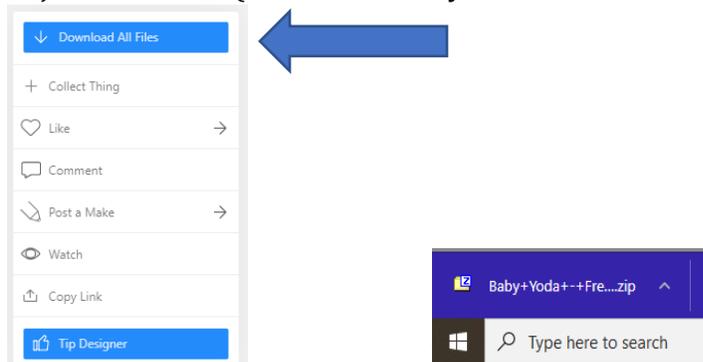
Preparing a print with Cura

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](https://www.thingiverse.com).
- Downloads from Thingiverse are in ZIP format. You will need to decompress ZIP files with 7-Zip: [7-zip.org/download](https://www.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 what 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.



Lincoln Public Library

Makerspace User Agreement Form

The Makerspace is available to members who meet the following requirements:

- A Lincoln Public Library card in good standing.
- 14 years of age or older. Users under the age of 14 must be accompanied by a parent or guardian at all times. The parent or guardian will be considered the primary user.
- Completion of the Makerspace User Agreement form.
- For minors between the ages of 14-17 using the space independently, the signature of a parent or legal guardian is also required.

User Information: Please Print

Name: _____

First Name Last Name

Date of Birth: ____/____/____

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Library Card #: _____

Phone #: _____

Email Address: _____



Please review the practices and guidelines set forth below.

Acceptance of, and compliance with these provisions is required for your use of the makerspace and the tools, equipment and materials provided within.

- The Makerspace is subject to LP Library Use Guidelines – Code of Conduct and Internet Use (BRD-15), Library Membership and Use (BRD-22) and 3D Printing (BRD-29) policies.
 - Users under the age of 14 must be accompanied by a parent or guardian at all times. The parent or guardian is considered the primary user and must supervise any children in their care while in the makerspace.
 - Prior to using the Makerspace, the user must complete a Makerspace User Agreement form. A nonblocking note will be placed in the user's library account indicating that a signed agreement form is on file.
 - Upon arrival to the Makerspace, the primary user is required to check-in with a staff person and present his or her Lincoln Public Library card. Library cards are not transferable.
 - Equipment must be used in the Makerspace and cannot be taken off-site.
 - Makerspace equipment is available on a first-come first-served basis.
 - The user may access Makerspace equipment for a maximum of 2 hours per day. Extensions may be granted based on availability and at the discretion of library staff.
 - The library reserves the right to make advanced reservations for programs and events.
 - Makerspace computers are reserved for makerspace activities only and are not available for general computer use such as email, word processing, internet browsing, social media, etc.
 - All files on Makerspace computers will be wiped clean after each session. Users are responsible for saving their own work to an external storage device such as a USB.
 - Consumable materials, such as filament and adhesive vinyl, will be provided free of charge on a limited basis.
- Filament is limited to 2 hours of daily print time
 - Adhesive vinyl is limited to a maximum of 12x12 inches per day
 - All 3D printer and vinyl cutter jobs must be approved by staff.
 - All 3D prints must be completed 30 minutes prior to closing time. No print jobs are to be sent with less than 30 minutes to closing.
 - 3D printed items that are not picked up within 14 days will become property of the Library.



- The library does not accept responsibility if a project is destroyed, does not print or cut correctly, does not work, or if any of the users' personal equipment or materials are damaged while accessing any of the library's makerspace equipment.
- The Makerspace may be used for lawful purposes only and cannot be used to create content that is:
 - Prohibited by provincial or federal law
 - Unsafe, harmful, dangerous, or poses an immediate threat to the wellbeing of others.
 - Obscene or otherwise inappropriate for the Library environment.
 - The user assumes responsibility for complying with applicable intellectual property laws.



By signing this user agreement, you the user, and/or the parent or legal guardian signing on behalf of your child, agree to:

- Comply with this Makerspace Agreement Form and 3D Printing Policy as well as any subsequently published Makerspace practices or policies relating to the Lincoln Public Library Makerspace.
- Be held liable should any damage be incurred to either the space or the equipment resulting from the lack of knowledge, familiarity, or training with the space, and the equipment occupying the space.
- Return equipment in the same condition in which it was issued, barring normal wear and tear, and agree to pay the costs associated with the equipment damage, loss, or cleaning, if the user's intentional or negligent actions caused the damage or loss.
- Release and hold the Library harmless from any claims of personal injury, property damage, or any other loss in connection with the use of the Makerspace, including the equipment, tools, and materials therein. I, the undersigned, agree to take full responsibility for the actions of myself and/or my child. I am aware that Lincoln Public Library staff may temporarily or permanently suspend access to persons who fail to follow the established guidelines and rules set out in this form.

Name (Please print): _____

Signature: _____

Date: ____/____/____

(MM DD YY)

If user is between 14 and 17 years of age:

Parent or legal guardian's name (Please print): _____

Parent or legal guardian's signature: _____

Date: ____/____/____

(MM DD YY)

The personal information contained on this form is collected under the authority of the Freedom of Information and Protection of Privacy Act, 1990.

MFIPPA\Regulations 29. This information will only be used for the provision of library services and programs by Brampton Library. Questions about this collection should be directed to the Chief Executive Officer, Lincoln Public Library, 5020 Serena Drive, Beamsville, ON L0B1R0.



Answer key:

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