3D PRINTING

Your guide to 3D printing at APL

...make awesome stuff at your library

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What is 3D printing?

Aurora Public Library houses a MakerBot Replicator 2 Desktop 3D printer that makes three dimensional objects from a digital model.

The printer uses an additive manufacturing process to build objects layer by layer from a 3D design file, using a polylactic acid filament (a renewable bioplastic with a corn starch base), designed to prevent peeling, curling, or sliding.
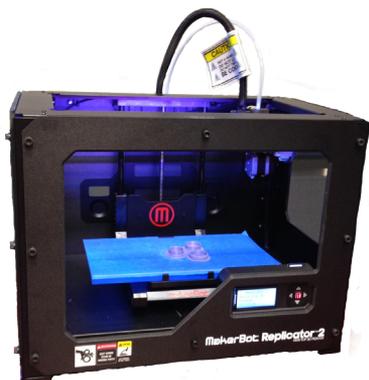
What can you make?

Anything from guitar picks and bookmarks to small scale replicas of real-life buildings or objects. It is limited only by the size of the build space (11.2"L x 6.0"W x 6.1"H).

Below are some of the objects that we've printed so far.

| Arc de Triomphe | Plant | Pencil Holder | Cell Holder |

Pre-Designed Models

If you are new to 3D printing, this is a great place to start. There are many pre-designed models available for free online. Try Thingiverse (thingiverse.com). It has thousands of objects to choose from and they are free to download.

Wherever you get your model from, be sure to select one that has an .STL file format as this is required by the printer.

Designing Your Own Model

For the more advanced user, you can design your own object with the use of 3D design software. There are a number of free websites that will allow you to do this, such as:

Tinkercad – tinkercad.com
SketchUp – sketchup.com (requires download & STL plugin)
Autodesk 123D Design - 123dapp.com/design

All of the websites mentioned above have tutorials that teach you how to use their software.

Getting Your Design Print-Ready

Slicing

Before the file can be transferred to the printer it must first be sliced to determine the amount of material needed and the time it will take. This can be done using the MakerWare software available on designated Aurora Public Library computers or by downloading it for free from www.makerbot.com/makerware.
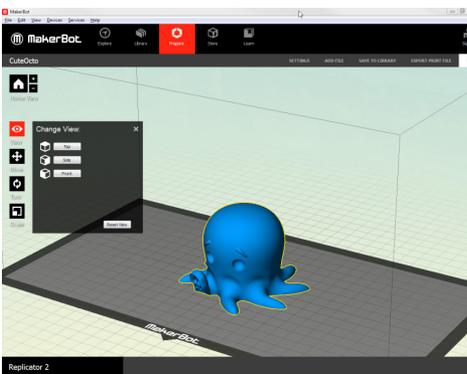
Using MakerWare

Download and install Makerware from
www.makerbot.com/makerware. Open Makerware software.
Click **Add** and select an .STL, .OBJ or .THING file you have created
or downloaded from Thingiverse.

Camera

Use the scroll wheel on your mouse to zoom in and out.
To rotate the camera, hold down the right mouse button while
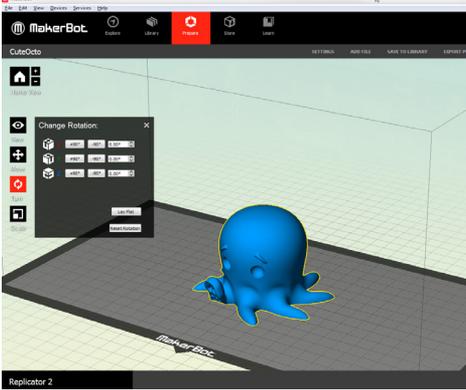dragging the mouse.

View

This mode allows you to rotate
your view around the object.
With the **View** button selected,
click on the object and drag the
mouse to change your view. If
you would like to view your
object from the top, side or
front, click the small arrow
beside the **View** button to
access those commands.

Move
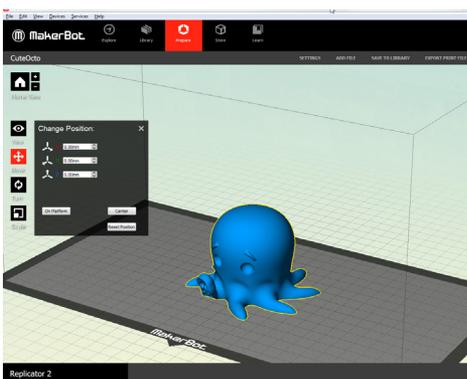
This mode allows you to move
the object around the build
plate. With the **Move** button
selected, click on the object and
drag the mouse to maneuver
the object around the build
plate. Advanced options are
available by clicking the
small arrow beside the **Move**
button. These options allow
you to change the position of
the object using set values.

Turn

This mode allows you to rotate the object. With the **Turn** button selected, click on the object and drag the mouse to rotate the object around the build plate. If you need to rotate the object along the X or Y axis, open the advanced options with the small arrows next to the **Turn** button. Once you are done rotating the object, make sure you click on **Lay Flat** to ensure the object is sitting flat on the build plate.

Scale
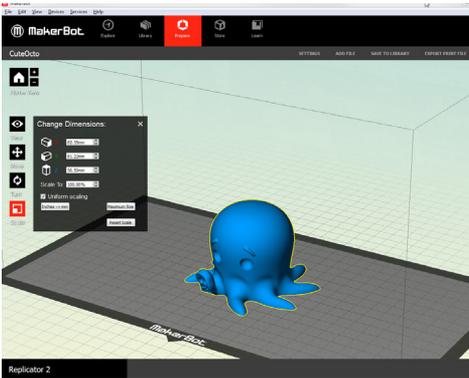
This mode allows you to scale the size of your model. With the **Scale** button selected, click on the object and drag the mouse to increase or decrease the size of the object. Advanced options can be accessed with the small arrow next to the **Scale** button. These options allow you to change each dimension individually. To ensure your object stays uniform, click on **Uniform Scaling**.

Save to Library

The save to library dialog gives you an option to save your object as an **.STL** or **.thing** file. STL files can be opened with many different programs whereas .thing files allow you to continue editing multiple objects on the build plate independently.

Settings

Cick on the **Settings** icon at the top of the screen.
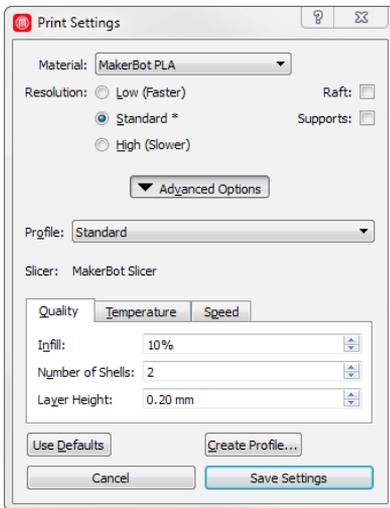
• **Material:** MakerBot PLA

• **Resolution:** Specify the quality of your build. A higher resolution will produce a better quality object but will increase the build times significantly.

• **Raft:** Used to create base support for the object. Rafts can easily be removed after the object has been completed.

• **Supports:** Used to create a support structure for objects that have overhanging parts. These supports can be removed after completion. Removing multiple supports can be time consuming depending on the complexity of your object.

• **Advanced Options:** This opens up a menu with more detailed options. These options will be set automatically depending on what resolution you choose.
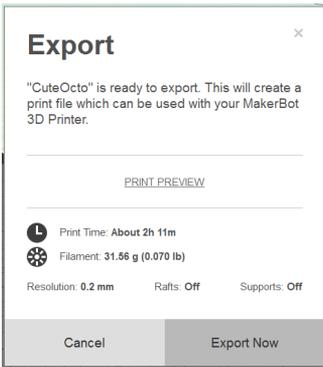
Infill is the how solid the inside of your object is.
A higher percentage will increase the time and material needed.

Shells are the outer layers of the object. The more shells you have, the stronger it is.

Layer Height sets the thickness of each layer.
The MakerBot Replicator 2 can print between 0.1mm and 0.3mm.

Export

"CuteOcto" is ready to export. This will create a print file which can be used with your MakerBot 3D Printer.

PRINT PREVIEW

Print Time: **About 2h 11m**

Filament: **31.56 g (0.070 lb)**

Resolution: **0.2 mm**   Rafts: **Off**   Supports: **Off**

Cancel   Export Now

Preview

After saving your settings, click on **Export Print File** to get the estimated build time. Cancel the export window and save your file as a .thing which you can then submit through our web form at:

http://aurorapl.ca/content/technology

Rules & Regulations

- Maximum print time is **6 hours**.
- Cost of printing: $1.00 plus $0.03 per minute + HST
- No weapons, sexually explicit material, or anything else deemed inappropriate will be printed
- Users must be registered members of Aurora Public Library
- All print jobs must be approved by a staff member
- Users must not infringe copyright when using the printer

Expectations

Please note that not all designs will be perfectly smooth and some may not work out at all, particularly those objects that have overhangs (areas with no support beneath them).

As an example of a project that did not turn out as expected, see the image on the adjacent page. The printing process halted in the middle of the run, leaving the lion incomplete.

* Instructional content derived from Makerbot MakerWare.

Aurora Public Library staff members are not experts in 3D model design. There are, however, many resources available online to help you get started. Try one of the links mentioned below or the tutorials on the 3D design software websites mentioned on page 2.

Finished Models

When your 3D model is finished you will be notified by email. The email will include the cost of the print job. Bring a copy of the email with you when you come to the circulation desk to pay for the print job and pick up your object. Clean up of the 3D model (removal of rafts and supports) is the user's responsibility. Tools that you may need for this task include: tweezers, pliers, scissors, files, and/or wall scrapers.

Additional Resources

1) How the MakerBot Replicator 2 works:
www.youtube.com/watch?v=AKTSdW7-H3Q

2) Getting Started with MakerWare:
www.youtube.com/watch?feature=player_embedded&v=YLpWWXOmzw4

3) 3D Printing Concepts:
www.makerbot.com/support/guides/printing

4) 3D Design Software 101:
www.makerbot.com/support/guides/design

Notes