Fox River Valley Libraries
Dundee Library • Randall Oaks Library

INTRODUCTION TO 3D PRINTING

What is 3D Printing?

3D printing is the process of taking designs created using computer-aided design (CAD) software and turning them into three-dimensional objects made of plastic, metal and other materials. Our 3D printer uses plastic.

Our Printer

The Fox River Valley Public Library District has a MakerBot Replicator 5th Generation Desktop 3D Printer. The 3D printer uses PLA (polylactic acid) plastic known as filament to create objects.

PLA filament is a bioplastic that is derived from corn and contains no heavy metals, phthalates or BPA. Once a design is sent to the printer, the printer feeds the filament through an extruder with a metal nozzle on the end. The extruder heats up to 215 degrees Celsius (419 degrees Fahrenheit) and extrudes the filament into sheets, layer-by-layer, on what is known as the build plate or build platform. As these sheets cool, almost instantaneously, they bind together to create an object.
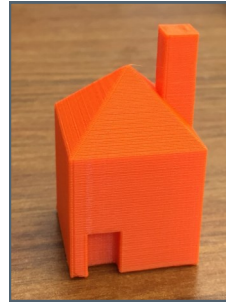
Creating Designs

3D printed objects can be designed in a number of different programs. Some are free and some are not. In this course, we will create a house using two of the easiest to use programs.
1. **SketchUp**—Available as a free download.
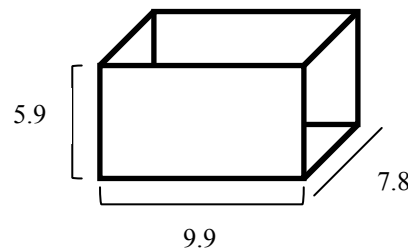2. **Tinkercad**—Available on the Web for free.

SketchUp Model

Tinkercad Model

Print Dimensions

The maximum size of an object that the printer will create is 9.9 long x 7.8 wide x 5.9 tall.


SketchUp Make

SketchUp Make is "the easiest, most fun, entirely free 3D drawing tool in the world." It is available as a free download for any computer. At the Library, we have SketchUp Make installed on all of our public and lab computers. **To download SketchUp Make at home:**

1. Go to **www.sketchup.com/products/sketchup-make**
2. Click **Download SketchUp**

Getting Started

Step 1: When you open the software, you will be prompted to select a template. Choose either **3D Printing—Feet and Inches** or **3D Printing—Meters**. If you are unfamiliar with meters, we recommend selecting feet and inches. This will give you a simulation of a 3D printer platform.
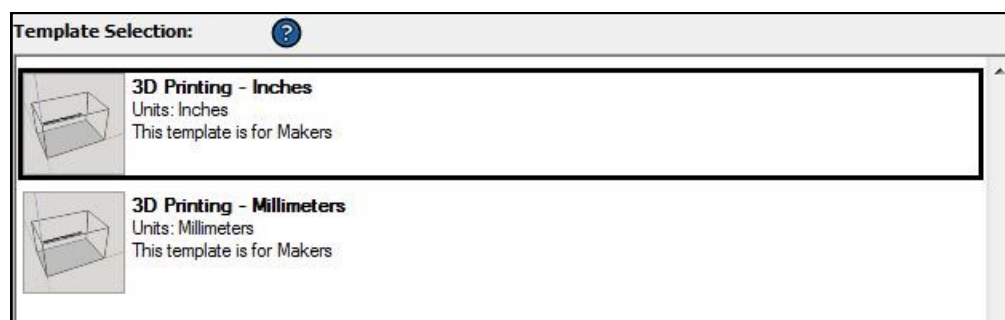
Step 2: Let's take a look at the tools that are available to us in SketchUp. Below you see the main toolbar that is used in SketchUp. We will cover what all of these tools do in class.
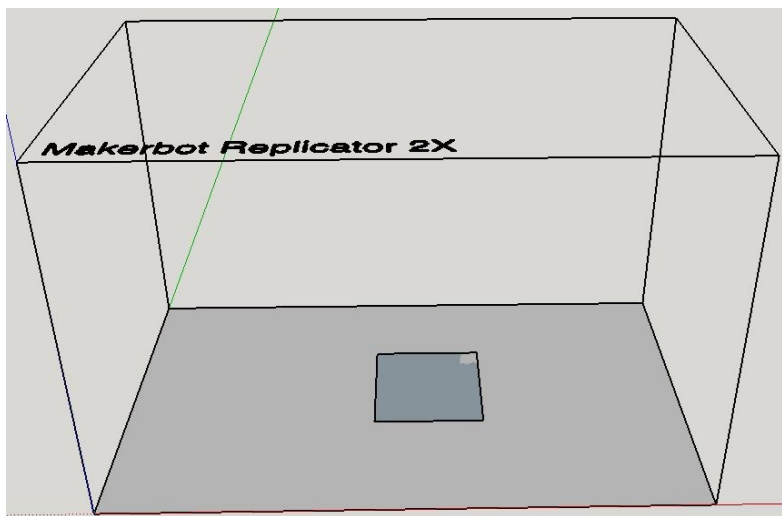
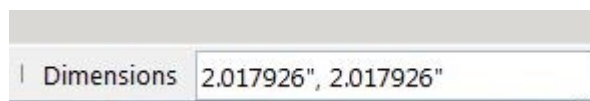**Step 3:** Use the shape tool to draw a box.
- Click the **Shape** tool.

- Move your cursor onto the platform and click once. Now drag your mouse to create a square in the size you want and click again to finish your box.

- Notice while you draw your box you will see the dimensions of it in the bottom right corner of the screen.

Dimensions 2.017926", 2.017926"

If you already know the dimensions of the shape you want, you can create a box with exact dimensions by:
- Clicking the **Shape** tool
- Moving your cursor onto the platform and clicking once
- Type your dimensions using the keyboard. For example:
    - Type 1", 1" and hit enter.
    - This will make a square that is exactly 1 inch by 1 inch.

Step 4: Use the **Push/Pull** tool to make the object three dimensional.
- Click the **Push/Pull** tool.
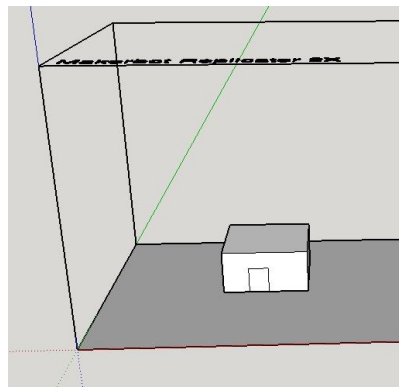- Click the top of the square and pull up to create a block.

The **Push/Pull** tool in SketchUp is going to be the main tool that you'll use to transform shapes into 3D object.
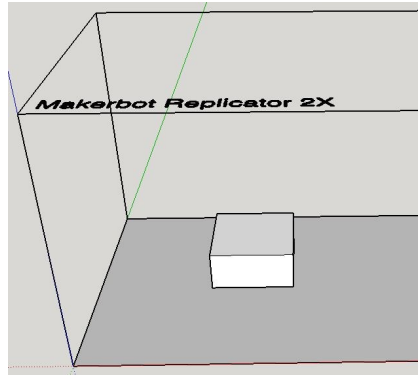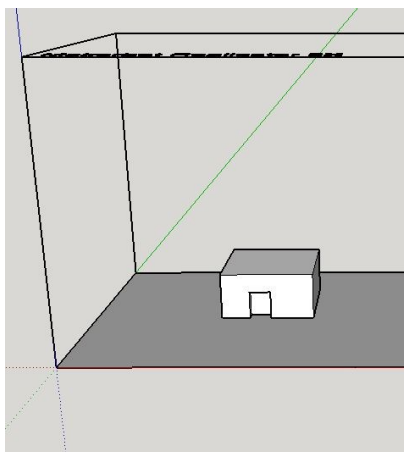
Step 5: Now, let's create a door for our house.
- Select the shape tool again.
- Draw a rectangle on top of the front of the house.

Step 6: Use the Push/Pull tool to pull up. This will push the rectangle in creating a door!
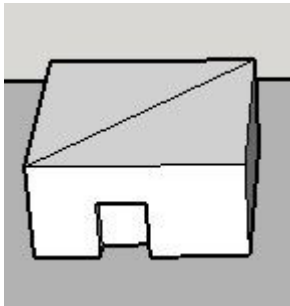
Step 7: Create a roof.

- Creating a roof is a bit more advanced than the tools we've used so far, however, it utilizes the same maneuvers.
- First we need to draw an **X** on top of our square.
- To do this, select the **Line** tool.

- Click in one corner of the top of the square and draw a diagonal line across to the other side of the square.


- Next, click in an empty corner and draw a diagonal line across to the other side of the square to form a square.
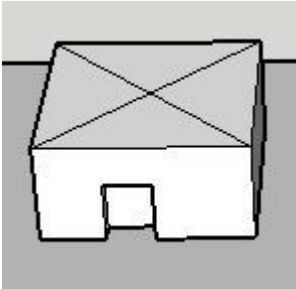
- To make our roof go "up" we will be using the push/pull tool.
- Select the **Move** tool and hover and click directly over the center of the **X where the lines converge.**
- Pull up with your mouse.
- You should see the roof move upwards.
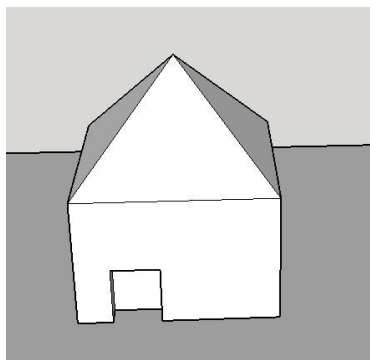
Step 8: Now let's build a chimney. Use the tools you learned in steps 1—4 to create a rectangle.
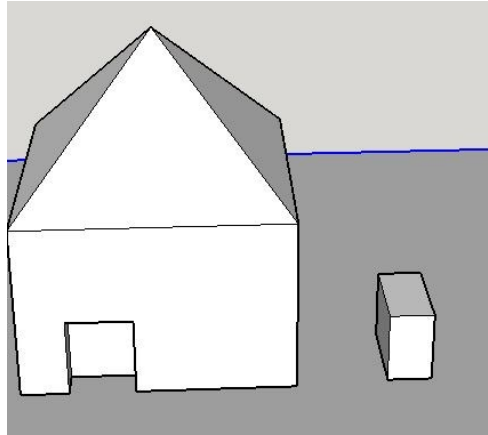
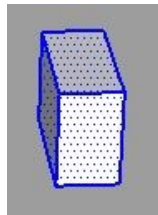
Step 9: Move the chimney.
- To move the chimney, we must first select the object.
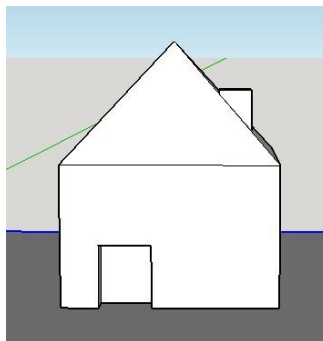- Click on the **Select** tool.

- Draw a square around the chimney so that it's entirely highlighted in blue.

- Now that the object is selected, we can move it using the move tool.
- Move the object on top of the house so that it resembles a chimney.

We should now have something that resembles a house!

Step 10: Saving your file!

- When creating designs in SketchUp, it's important that you save often so you don't lose your work. **To save a file:**
    - Click **File, Save** and then give it a name.
- By default, when you save a file in SketchUp it will save as a .skp file. Unfortunately, our 3D printer cannot read .skp files but don't worry.

If you are using SketchUp Pro, the paid version of SketchUp, you can export the file into a format our printer can read. **To do this:**

- Click **File**, **Export** and select **.obj.**

If you are using SketchUp Make, the free version of SketchUp, just send us the .skp file and we'll convert it and print if for you!

Or, if you're feeling up to it, you can use the free program **MeshLab** to convert a file to a format that our printer can read. More on this later.

For more on using Google SketchUp, go to:
http://www.sketchup.com/learn/

Tinkercad

Tinkercad is by far the easiest 3D modeling tool available. It is entirely based in the cloud and can be accessed from anywhere that you have an Internet connection. In Tinkercad, you combine shapes to create three dimensional objects.

Getting Started

1. Go to **www.tinkercad.com**
2. Click **Create Free Account**
3. Fill in the information to create an account. **Note: If you are not 13 years or older, you must provide a parent's email address and a parent must confirm your account in order to start creating your own designs. You can still go through the design tutorials without a parent's consent.**
4. Once you have created an account, you will automatically be brought to the first tutorial. I encourage you to go through these at a later date. For our purposes, we are going to skip these and create another house!
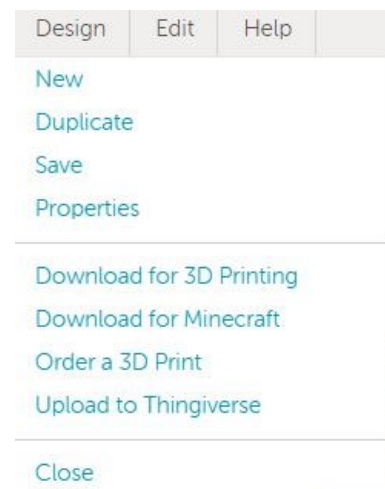
If you are under 13 years old, we will provide you with a login to use for this class.

Step 1: Create a new design.

- To start a new design, simply click the **Create new design** button.

Create new design

- You will be taken to a blank canvas.
- You will notice that Tinkercad automatically gives your design a name. To change this, click **Design** in the top left corner of the screen and select **Properties**.
- Then, replace the automatic name with whatever you would like to call the design.

Design	Edit	Help

New
Duplicate
Save
Properties

Download for 3D Printing
Download for Minecraft
Order a 3D Print
Upload to Thingiverse

Close

Thing properties   ×

Name   Amazing Turing

Public access settings

Visibility   Private ▼   Not publicly listed, visible only to you

License   Attribution-ShareAlike 3.0 ▼

This license lets others remix, tweak, and build upon your work even for commercial purposes, as long as they credit you and license their new creations under the identical terms.   More info on Creative Commons licenses

Cancel   Save changes

Step 2: Choose **Millimeters** or **Inches**.

- The default grid will be in **millimeters**.
- To change this to **inches**, click the **Edit grid** button in the bottom right corner of the screen.

Edit grid
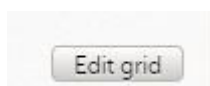
- In the **Grid properties** box that appears, select **inches.** You can also change the size of your workplane.

Grid properties   ×

Units
Inches ▼

Width   Height   Use a Preset
7.87   7.87   Default ▼

Cancel   Update Grid

Step 3: Drag a **box** onto the platform. To resize a shape, make sure it is selected and that handles appear around the shape. Click and drag a handle to resize the shape.
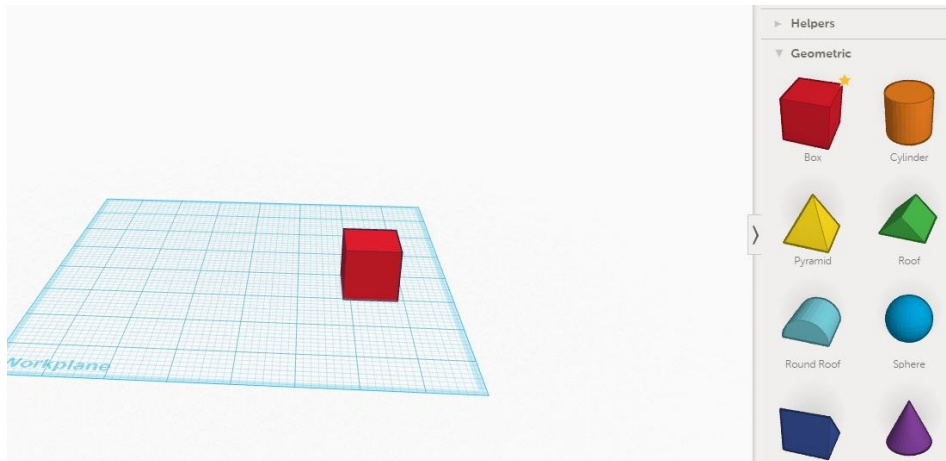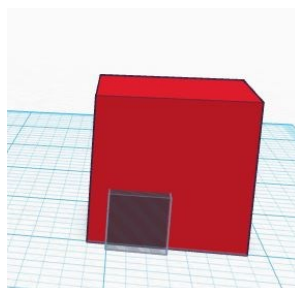

Step 4: Create a door.

- Drag another box onto the platform.
- With this box selected, choose the **Hole** option from the **Inspector**.
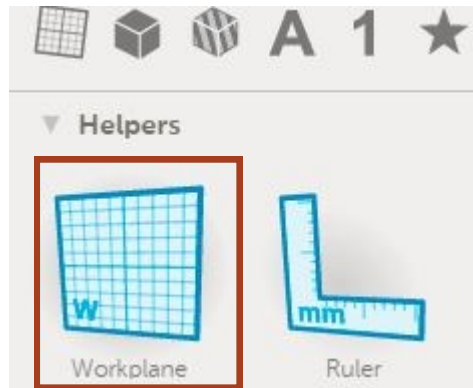- The box should now appear to be see through. Resize the box into the shape of a door.
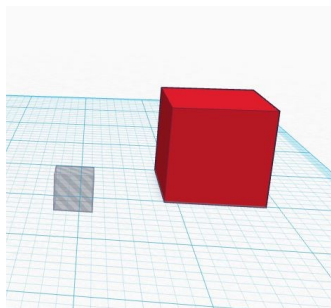
- Move the door into the block to create a door.

Step 5: Create a roof.

- We want to first make sure that we are working on top of our house.
- The easiest way to do this is to use the **Workplane** tool.
- Click the **Show Helper shapes** icon from the top right of the screen.
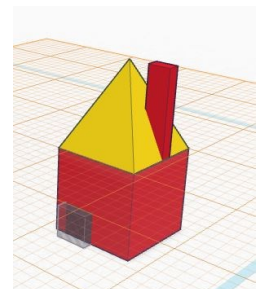- Select the **Workplane** tool.

- Hover over the top of the box and click. You should see a workplane appear on top of your box.

- Drag a **pyramid** on top of the box. Resize it if you would like.
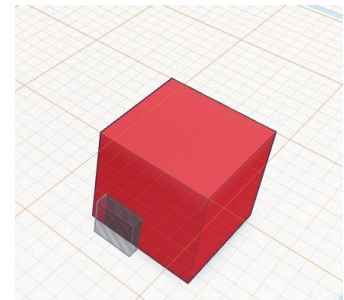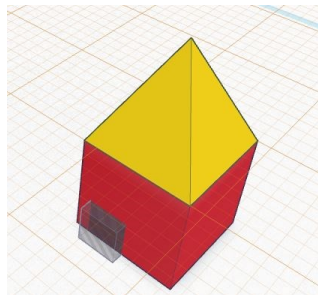
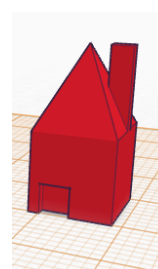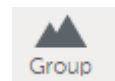**Step 6:** Create a chimney.

- Drag a box onto your workplane and resize it so that it looks like a chimney.
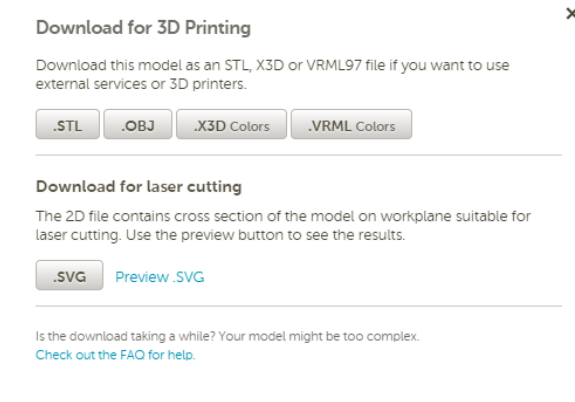- Move the box onto the roof.

Step 7: Group your objects.

- Draw a square around your design to highlight the entire object and then select **Group** from the toolbar at the top. This will group your objects for 3D printing.

Step 8: Download for 3D printing.
- Because Tinkercad is cloud based, your designs are always automatically saved, however, you have to download the file in order to have it 3D printed.
- **To do this:**
    - Select **Design** and choose **Download for 3D Printing**
    - Choose **.STL**

Download for 3D Printing

Download this model as an STL, X3D or VRML97 file if you want to use external services or 3D printers.

.STL .OBJ .X3D Colors .VRML Colors

Download for laser cutting

The 2D file contains cross section of the model on workplane suitable for laser cutting. Use the preview button to see the results.

.SVG Preview .SVG

Is the download taking a while? Your model might be too complex. Check out the FAQ for help.

For more on using Tinkercad, go to:
www.tinkercad.com/about/learn

Submitting Designs

Designs may be submitted in two ways.

1. **Email:** Send an email to **3Dprinter@frvpld.info** with the subject "Request for 3D Print" that includes:
    - A completed **3D Print Request form**
    - Your file in an appropriate format

2. **In-person:** Fill out a **3D Print Request form** and bring it to the Library along with your file in an appropriate format.

3D Print Request forms can be found online and in both Libraries.

If you have any questions or concerns, please email Jason Pinshower at **3Dprinter@frvpld.info** or call **224-699-5835**.

Feb. 2015