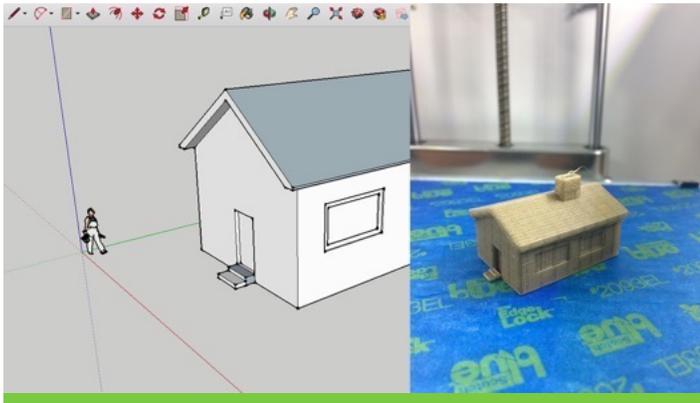


## Buildings of MTL



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### Public

12-15 y-o

adult

### Software

SketchUp

## Description

### Learning goals:

- master the basics of SketchUp
- learn about architecture

Learn the basics of SketchUp by 3D modeling a building.

Participants will use SketchUp, an architectural 3D modeling software, to replicate a building from their neighbourhood or from Montreal. Depending on the scale at which the buildings are printed, there may be enough time to print them all.

## Timing

### 1. Introduction and presentation of 3D printing - 15 mins

Introduction of the world of 3D printing with video (<http://www.dragontape.com/#!/6319966877908992>) and presentation.

### 2. Overview of the activity - 5 mins

Briefly explain the flow of steps for the day's activity.

What will the participants do? : Create a building

Which software will be used? : SketchUp

### 3. Open SketchUp for all participants - 2 min

### 4. Introduction to SketchUp - 20 min

- Interface (menu, tools, workplane)
- Changing the viewpoint (orbit, pan, zoom)
- Sketching lines (pencil, shape, arc), snap and alignment to the three axes (red, blue, green)
- Sequence for creating specific measurements (e.g., rectangle measuring 5 x 10 cm)
- Push/pull tool
- Deleting faces (e.g., from a rectangle) and re-creating the face with the pencil tool
- Offset tool for making windows
- Move and rotate tools (holding the shift-key to lock transformation to an axis)
- Measure tool and creating guides for sketching
- Make sure to draw attention to the need for models to be watertight (demonstrate what this is and how to fix it)

Also, see the user guide and tips in the software resources page for SketchUp

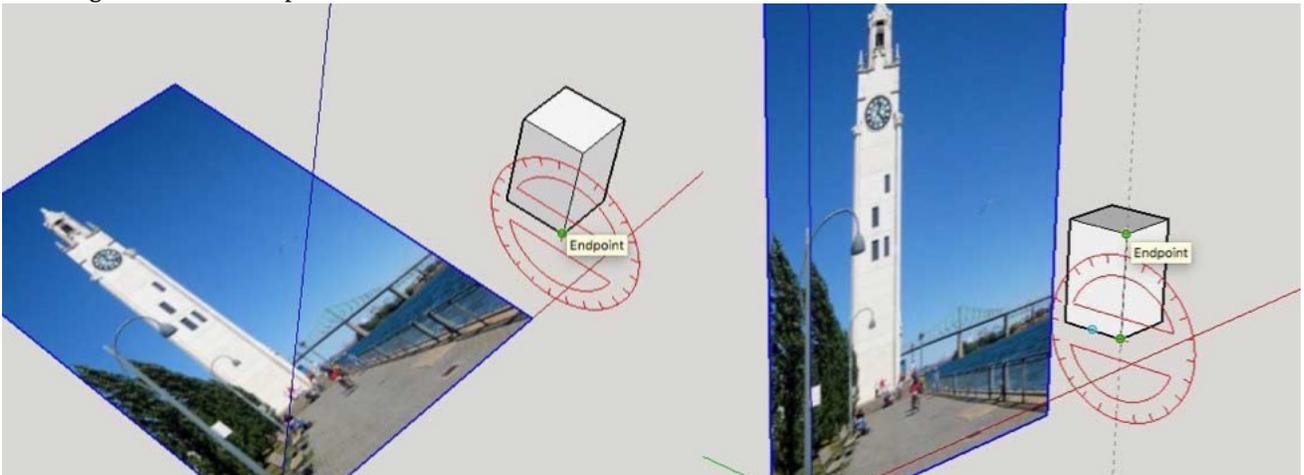
## 5. Demonstrate the modeling of a simple building - 15 mins

There are many ways to approach modeling from a reference image. For the purposes of an introduction to 3D printing, the method detailed below is not overly concerned with perfect accuracy of the final model. You may explain to participants that the purpose of the workshop is to create a likeness of the building, rather than a perfectly-scaled replica given the time constraints.

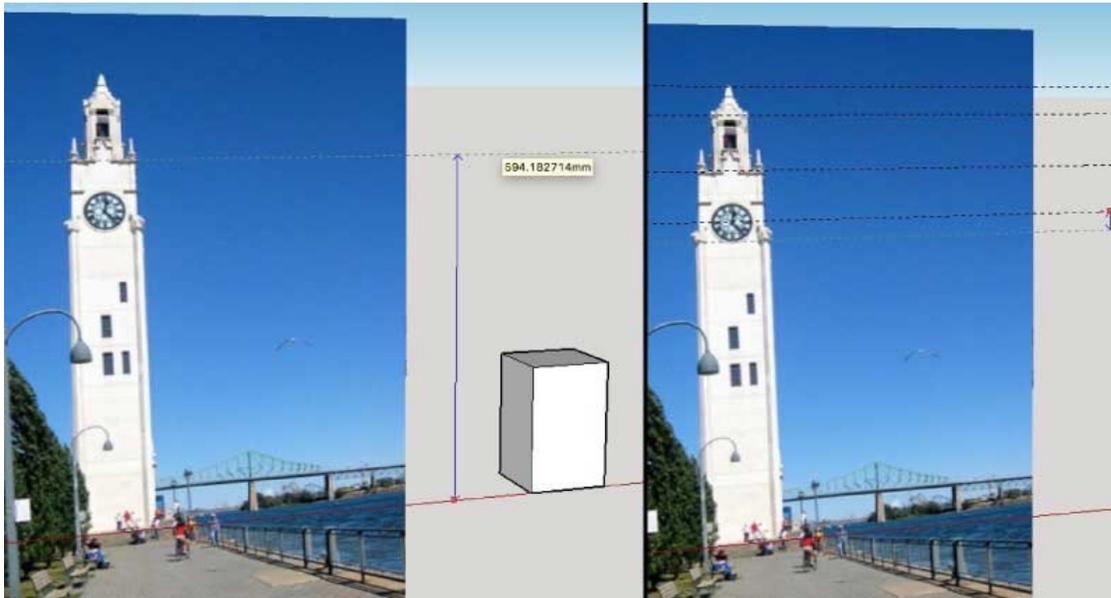
1. Start with a simple and iconic building, such as the example shown below: the Montreal Clock Tower.
2. Show participants how to grab an image online (e.g., on wikipedia) or download an image onto the Desktop before the workshop.



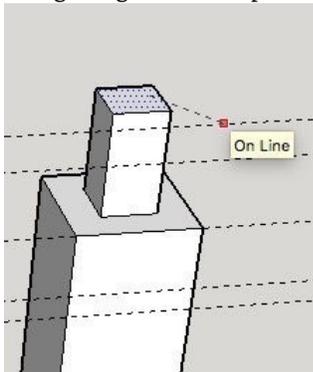
3. Open SketchUp. Drag and drop the image from the Desktop into SketchUp.
4. Rotate the image so it's on the front plane (green-blue plane). This are several sub-steps to do this. a) Using the rectangle tool, draw a square on the floor (green-red plane). b) Using the push tool, push the face up in height (blue axis) to make a cube from the square. c) Using the select tool, click on the image to select it. d) Using the rotate tool, hover over the left face of the cube, hold down Shift to lock the rotation to this face. Click on the bottom-left-front corner of the cube to define the rotation axis position. Click on the bottom-left-back corner of the cube to define the start of the rotation. Click on the top-left-front corner of the cube to complete the rotation and bring the image onto the front plane.



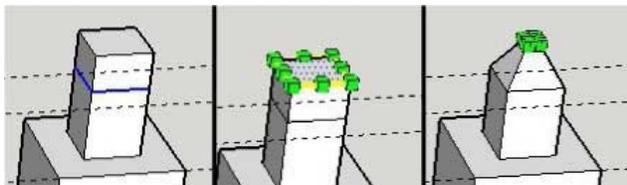
5. Add horizontal guides to the reference image to aid in approximating the building proportions. Using the ruler tool, click on the red axis and bring the ruler up to mark the steps in the building. Keep going until the heights of the most significant parts of the building have been marked with the guides.



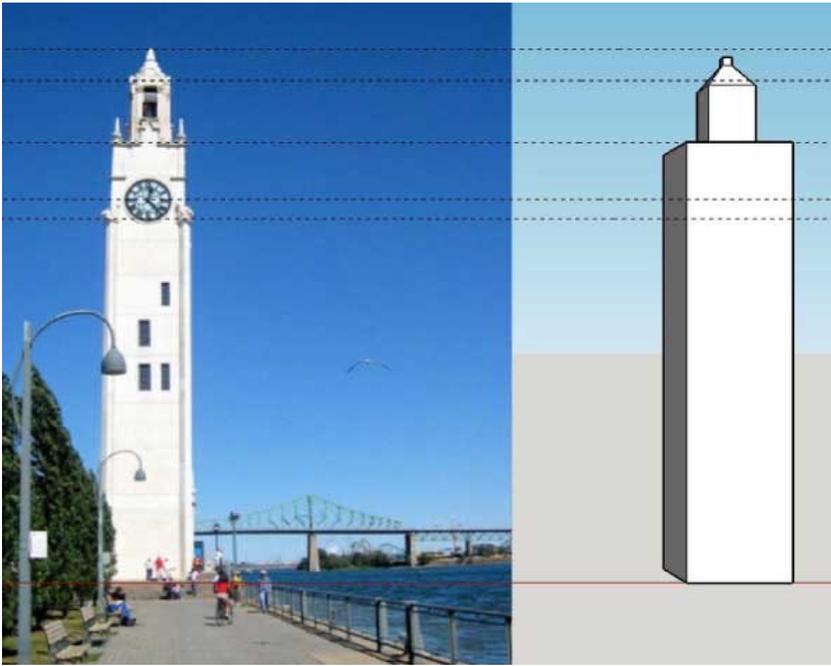
6. To roughly approximate the tower, create a tall box with a smaller tall box on top. Using the push/pull tool, pull the top face of the square up to the guide marking height of the tower where it narrows. Using the offset tool, click on the edge of the top face of the tall box, move the mouse inside the face, and click to finish creating a smaller square inside the top face. Use the push/pull tool again to pull the smaller square up to the very top of the tower, again using the guide to snap to the right height.



7. Create the prism at the top by transforming the smaller tall box you made previously. Using the select tool, click on the top face of the small box. Using the move tool, click on the edge of the top face for the starting point, move the move down in height (hold shift to lock the movement to the blue axis), press the Alt-key once to create a copy of the face, and click on the guide marking the height of the base of the prism atop the tower in the reference photo. Using the select tool, click on the very top face of the small box. Using the scale tool, click on one of the corner guides, move the mouse inside the face, hold down the Alt-key (to center the scaling on the center of the face), and click to finish the transformation.



8. Add a few more details to the building, but keep it simple and focus on the basic tools (select, move, rectangle, push/pull and scale tools). Participants will naturally explore what the other tools do. Also make sure to make note of the undo command.



9. Export the STL file. In menu bar select File > Export STL. Leave the units as *model units* (you can scale it in the slicer) and the File Format as *ASCII*. Use your name when saving the filename.

## 6. Participants create their buildings with SketchUp - 45 min

After having demonstrated the process, ask each participant to create their building, either a replica of a local building or imaginary.

Once they start playing with SketchUp, move around the room to assist and answer questions.

Demonstrate common questions or repeat challenging concepts to all participants.

**Warning! The files must be watertight in order to be 3D printed.**

After 45 minutes, ask participants to export their files.

## 7. Saving the STL file

Ask participants to export their files (see instructions above) and to name their files using their name.

Use a USB key to gather the STL files from participants.

## 8. Import the files in Tinkerine or Cura - 5 min

Open the preferred slicer software

Import the STL file

Adjust the print settings (fill, wall thickness, speed, height, ...)

Save the file (.Gcode) to the SD card

## 9. 3D Printing - 30–45 mins

Insert the SD card in the 3D printer

Select the previously saved file (.Gcode)

Start the print!

## 10. Feedback - 5 min

Ask the participants to provide feedback on the workshop while the models are being printed.

## Participant's guide

See the SketchUp quick reference card (<http://help.sketchup.com/en/article/3000081>).