

Designing a Whistle in Sketchup

Jay Brockman

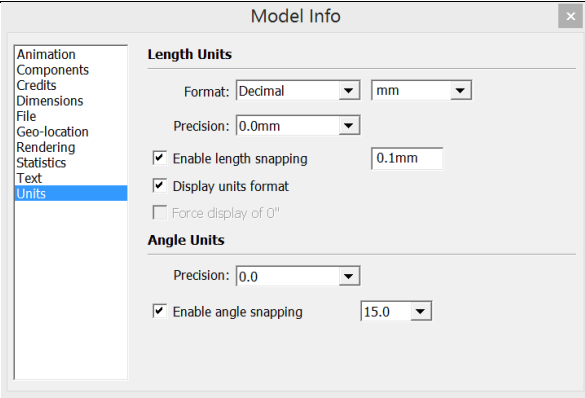
November 5, 2013

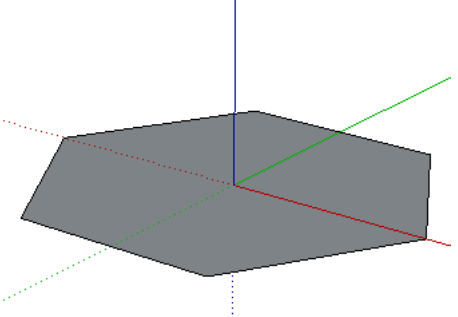
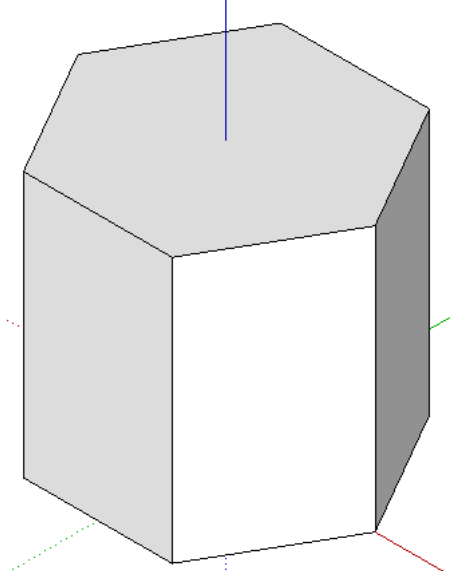
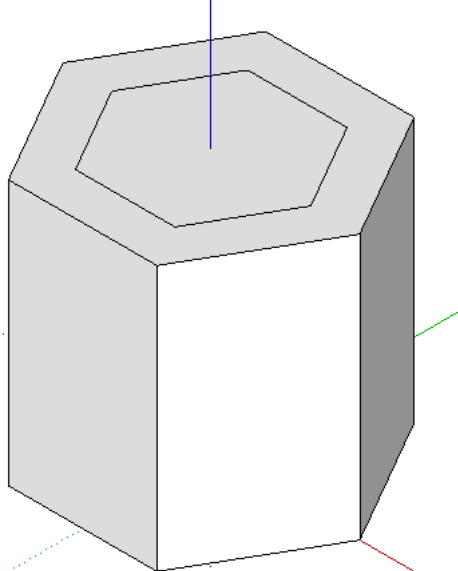
The following set of steps show how to design a working whistle mouthpiece that may be printed on a 3D printer and attached to a length of 1/2 in PVC tubing. The instructions assume that you are familiar with the concept in the Sketchup “Getting Started” videos at:

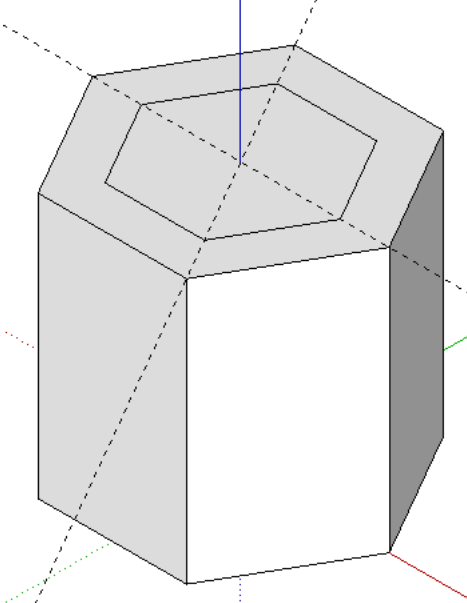
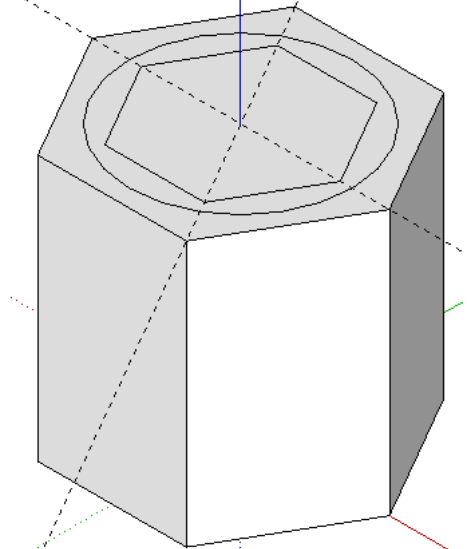
<http://www.sketchup.com/learn/videos?playlist=58>

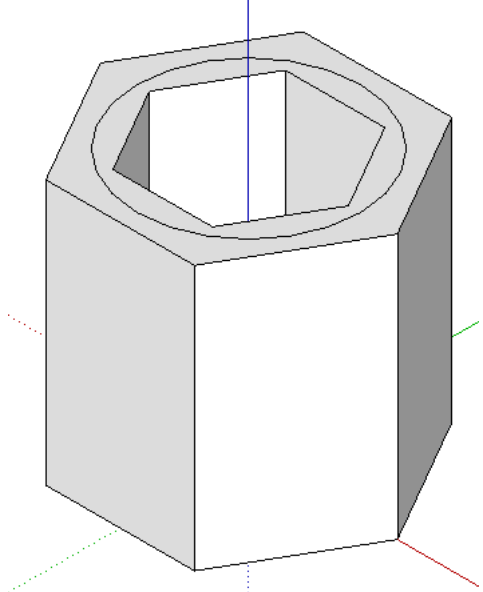
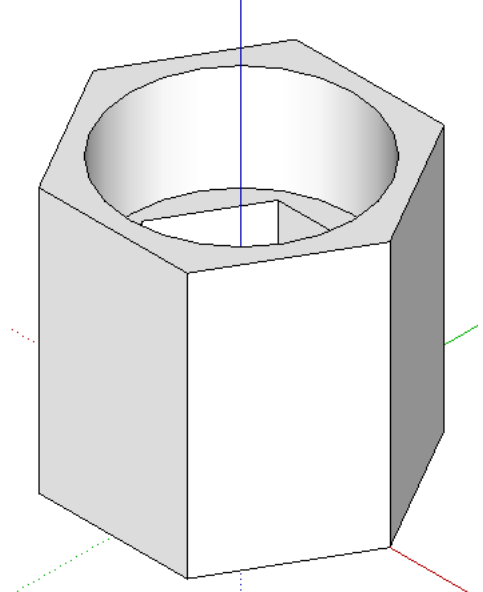
In particular, you should be familiar with the following:

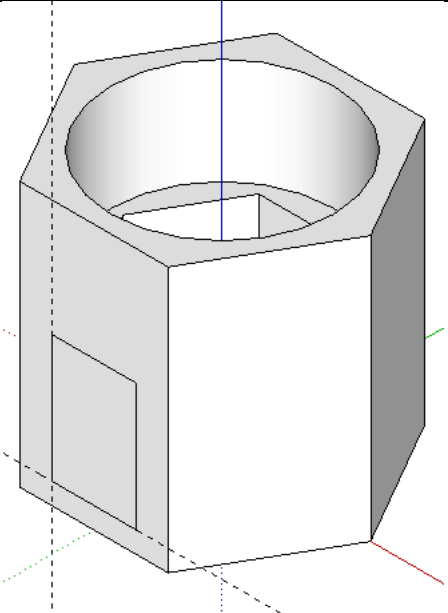
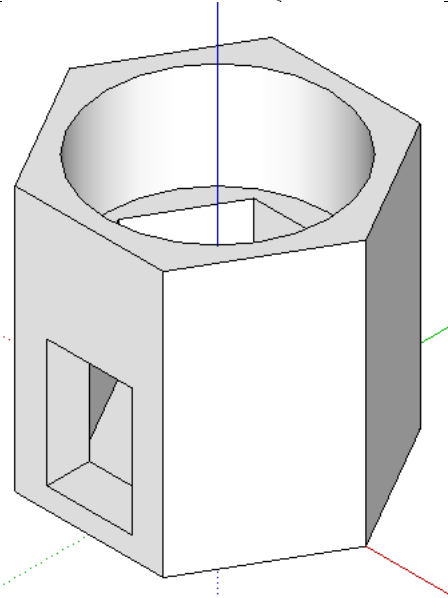
- Drawing rectangles, polygons, circles, and arcs.
- How to select edges and faces
- How to use the Move, Push/Pull and Offset tools
- How to select and delete objects
- How to use the Zoom tools
- How to rotate the view using the Orbit tool
- How to quickly jump to top, bottom, and side views using the Camera position tools
- How do draw guidelines using the Tape Measure tool.
- How to enter dimensions via the keyboard while using Sketchup drawing and editing tools for accuracy and greater productivity

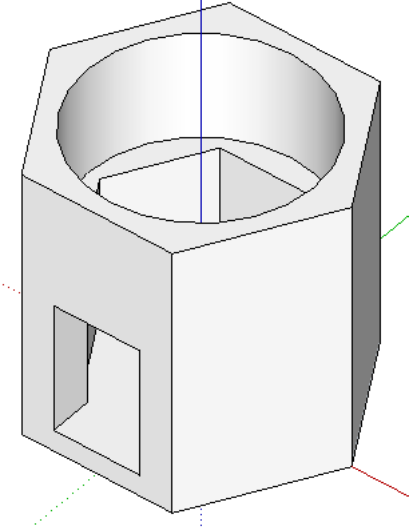
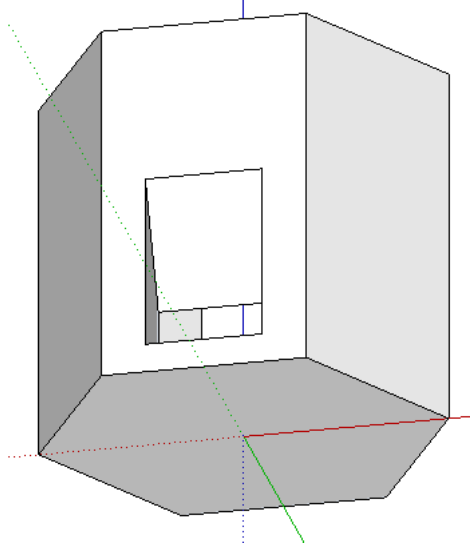
<p>0 When you open Sketchup, select the “Engineering Meters” template so that you get a blank background. Delete the picture of the man—you don’t need him to be part of your whistle! From the main menu, select Window > Model Info and under “Units” set the defaults as shown:</p> <ul style="list-style-type: none">• Format Decimal mm• Precision 0.0mm• Enable length snapping 0.1mm <p>Select Camera > Parallel Projection. This will make drawing easier, with the 3D rendering having lines parallel to the axes, rather than using a vanishing point.</p>	 <p>The screenshot shows the 'Model Info' dialog box with the 'Units' section selected in the left sidebar. The 'Length Units' section is expanded, showing 'Format' set to 'Decimal', 'Precision' set to '0.0mm', and checkboxes for 'Enable length snapping' (checked) and 'Display units format' (checked). The 'Angle Units' section shows 'Precision' set to '0.0' and 'Enable angle snapping' (checked).</p>
--	--

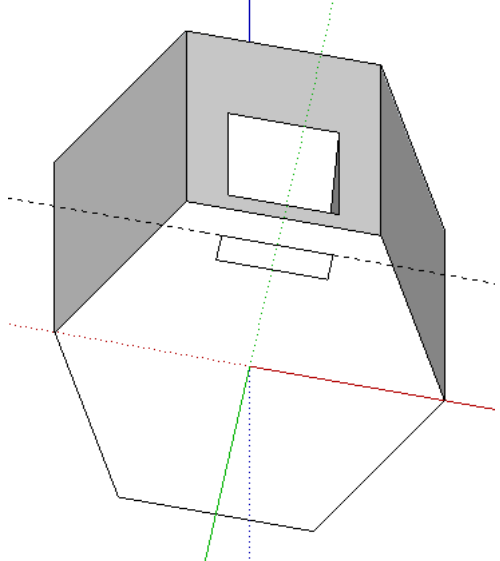
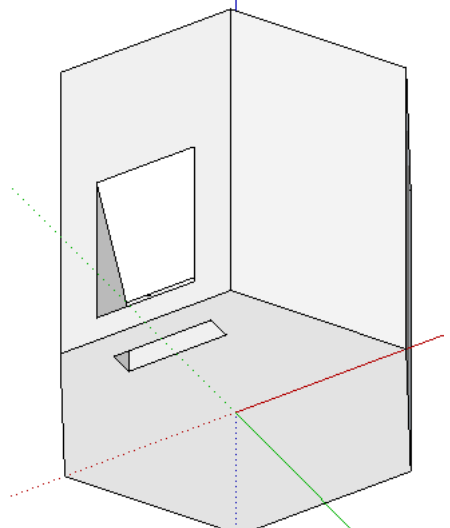
1	<p>Draw a hexagon with radius 14mm. Orient the hexagon so that an edge is parallel to the red axis. (Zoom to full extent so you can see it.)</p> <p>Change the camera mode to parallel projection (Camera > Parallel Projection), which will make drawing easier.</p>	
2	<p>Pull the hexagon into a column of height 25mm.</p>	
3	<p>Using the offset tool, offset another hexagon 4mm into the top of the column from an edge (not a corner) of the original hexagonal top. The goal of this step is to define the width of the walls of whistle to be 4mm.</p>	

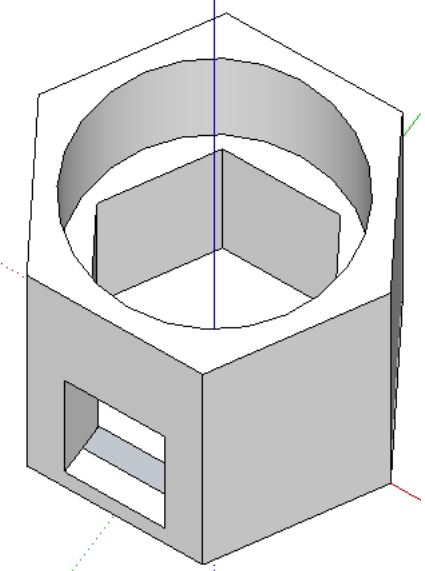
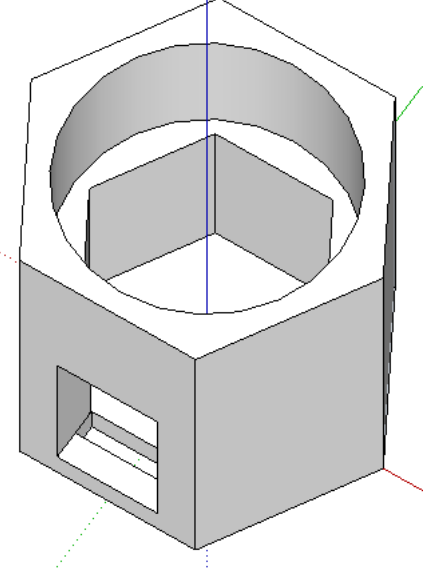
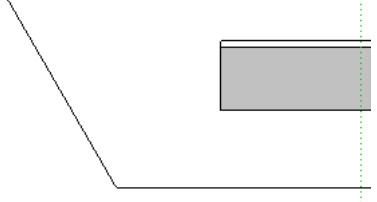
4	<p>Draw a pair of diagonal guides across two pairs of opposite corners to locate the center of the top of the column</p>	 A 3D perspective drawing of a column with a square top surface. A blue vertical line passes through the center of the top surface. Two dashed lines, one red and one green, cross diagonally on the top surface, intersecting at the center. The column is shaded to show its three-dimensional form.
5	<p>Draw a circle with radius 10.5mm centered on the top surface of the column. Delete the guides after the circle is drawn.</p> <p>Look at the whistle from the top view and confirm that all the shapes are centered.</p>	 A 3D perspective drawing of the same column as in the previous diagram. A circle is now drawn on the top surface, centered on the intersection of the diagonal guides. The diagonal guides are still present but faded. The blue vertical line and the red and green diagonal lines are also present. The column is shaded to show its three-dimensional form.

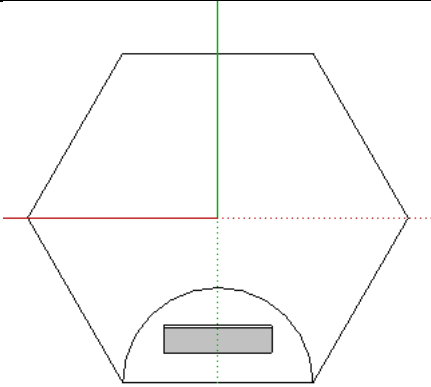
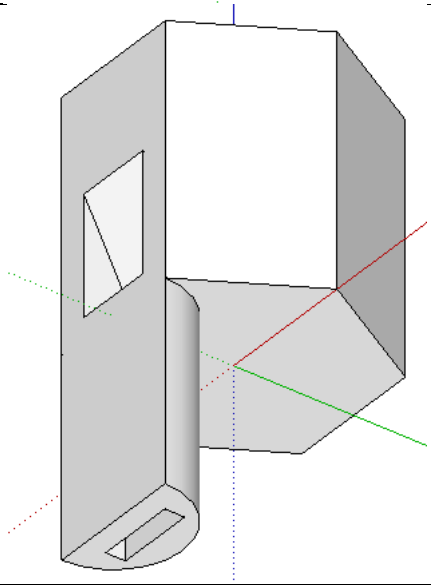
6	Push the offset hexagon down 23mm into the column (so that the bottom is 2mm thick).	 A 3D CAD model of a hexagonal column. The top surface is an offset hexagon, meaning it is smaller than the column's outer hexagon and is positioned such that its bottom edge is 2mm thick. A vertical blue dashed line represents the central axis. Three red dashed lines and three green dashed lines extend from the base of the column, representing the coordinate system axes.
7	Push the surface between the circle and the inner hexagon down 10mm into the column	 A 3D CAD model of a hexagonal column. The top surface is a circle, which is smaller than the column's outer hexagon and is positioned such that its bottom edge is 10mm thick. A vertical blue dashed line represents the central axis. Three red dashed lines and three green dashed lines extend from the base of the column, representing the coordinate system axes.

8	<p>Set up guides for positioning the sound hole on the front face, 2mm from the bottom and 3mm from the side. Draw a rectangle for the sound hole with dimensions 8mm x 12mm. Delete the guides when done.</p>	 A 3D CAD model of a hexagonal column. A rectangular guide is drawn on the front face, positioned 2mm from the bottom and 3mm from the side. The model is shown with a blue vertical axis and red, green, and blue dashed lines indicating the coordinate system.
9	<p>Push the rectangle in 4mm to cut the sound hole. Rotate the column to be sure that the sound hole is punched through the side and that its inner faces are all intact.</p>	 A 3D CAD model of the same hexagonal column, but now with a sound hole cut through the side. The hole is rectangular and passes through the entire thickness of the column. The model is shown with a blue vertical axis and red, green, and blue dashed lines indicating the coordinate system.

10	<p>Using the eraser tool, delete the little line on the floor of the whistle that marks the back of the sound hole. Doing so does not change the structure of the whistle, but it is unnecessary and will make later viewing clearer when it is gone.</p>	 A 3D perspective view of a whistle. The whistle has a hexagonal top and a rectangular body with a sound hole on the front. A small vertical line is visible on the floor of the sound hole. A blue vertical line passes through the center of the top opening. A green line is on the right side, and a red line is at the bottom right. A dotted green line is on the left side.
11	<p>Rotate the piece so that you can clearly see the top face of the sound hole. Create the blade by pulling the lower inside edge of the sound hole down by 8mm. You need to do this in a particular way to ensure that the blade edge stays properly aligned.</p> <ol style="list-style-type: none">1. Select the edge2. Click on the Move tool and click on an endpoint of the edge.3. Begin sliding the blade edge along the vertical inside edge of the sound hole. The “inference locking” features of Sketchup will keep the blade edge properly aligned4. Type 8mm to set the move distance and hit return <p>The remaining sound hole opening should be 4mm x 8mm. Rotate the piece and examine it to ensure that the blade and sound hole are correctly formed.</p>	 A 3D perspective view of the whistle, rotated to show the top face of the sound hole. The blade edge has been moved down, creating a rectangular opening that is 4mm wide and 8mm high. A blue vertical line is at the top center. A green line is on the right side. A red line is at the bottom right. A dotted green line is on the left side.

12	<p>Draw a rectangle on the bottom of the piece that locates the airway. The size and especially the positioning of the airway is critical to the correct operation of the mouthpiece. The airway should be exactly as wide as the blade (8mm) and be 2mm high. The bottom of the airway should be 0.2mm below the bottom of the blade—in other words, there should be a very small 0.2mm where air can pass below the blade. To help get the placement right, use a guide 2.2mm away from the front edge of the bottom to locate the top of the sound hole. Delete the guides when done.</p>	
13	<p>Push the sound hole in 2mm to cut through the bottom.</p>	

14	<p>This step is tricky. If you rotate the piece so that you can see the airway through the sound hole, you will notice that there is a rectangle where the airway should be, but it has not actually punched through. You will need to select the face of this rectangle and delete it manually. Be careful not to select and delete anything else</p>	
15	<p>Here's what the piece should look like when the airway is cut all the way through.</p>	
16	<p>Look at the bottom view (Camera > Standard Views > Bottom) and zoom in to the airway. Verify that there is a small 0.2mm space between the blade and the edge of the airway.</p>	

17	<p>All that's left is forming the mouthpiece. Still looking at the bottom view, use the Arc tool to draw a half circle. Do this by selecting the Arc tool and then</p> <ol style="list-style-type: none"> 1. Click on one end of the hexagon edge below the airway 2. Click on the other end of the edge 3. Before clicking again, pull up to establish the curve of the arc. When you see "half circle," click again to finish the arc. 	
18	<p>Select the face of the arc, pull it out 20mm.</p>	
19	<p>Select Tools > 3D Text to put your name or initials on the whistle. The text height should be around 5mm and it should be extruded around 1mm.</p> <p>You're done!</p>	