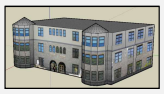
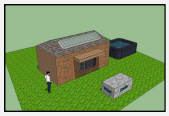
1

Using SketchUp !





Oregon State University

Mike Bailey

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http://cs.oregonstate.edu/~mjb/sketchup

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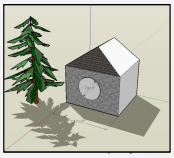
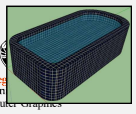


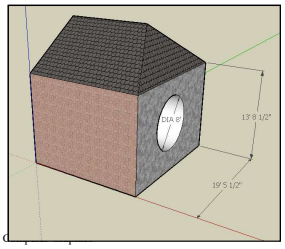


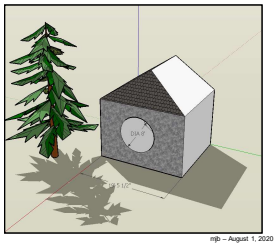
2

What is SketchUp?

SketchUp is a program which lets you sketch in 3D. It is excellent for creating buildings, houses, and even mechanical designs.

And, it's easy to do. As their tagline says, SketchUp is "3D for Everyone".



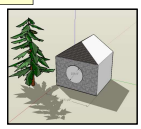


3

Getting SketchUp for Free

Go to:

`https://app.sketchup.com/app?hl=en`



This is a free *web-based* version of SketchUp.

There are also downloadable versions of SketchUp which cost money. Go to:

https://www.sketchup.com/plans-and-pricing

for more information.

4

SketchUp Student Learning Objectives

1. Learn that the computer can be used to enhance *creativity*. It's not just for programmers and gamers!
2. Learn that the computer can be used to design and plan.
3. Learn the basics of 3D interaction. This will have further application in fields ranging from engineering CAD to art and animation.

5

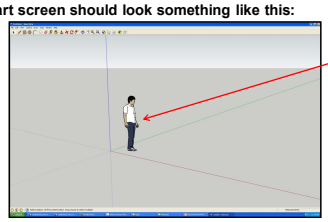
Getting Started

In the Oregon State CGEL, double-click the SketchUp icon

or click:

Start →All Programs → SketchUp 2019

The start screen should look something like this:



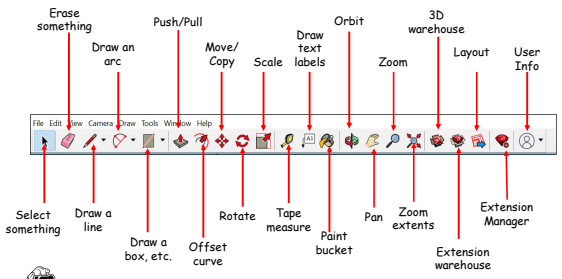
This specific person changes from version to version. They are always between 5'6" and 6' tall.

Right now, click **File→Save As** – and navigate to **C:\temp**
Hit **Save** often while you are editing

6

Getting Started Toolbar

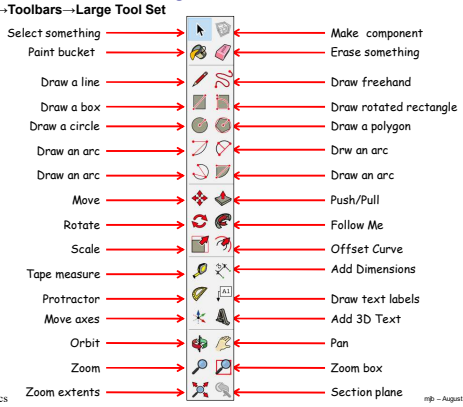
The icons across the top are *really* important:



Large Toolset Toolbar

7

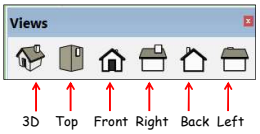
Select **View→Toolbars→Large Tool Set**



The Views Toolbar

8

Select **View→Toolbars→Views**

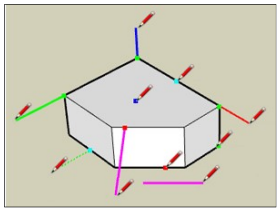


This is a *very* handy toolbar to have active because it lets you change to a specific view of your scene with one mouse click!

SketchUp "Inferences"

9

One of SketchUp's key strengths is that it doesn't require you to enter every little piece of information as many 3D computer programs do. Instead, it tries to infer what you really mean by how you do things. Oftentimes it uses colors to tell you what it is inferring.



- Green dots = Endpoints
- Red dots = On an edge
- Cyan dots = Midpoints of edges
- Blue dots = On a surface

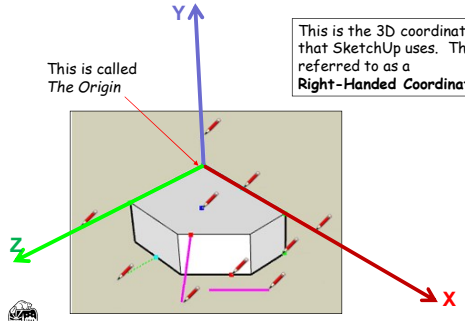
- Red line = X axis
- Blue line = Y axis
- Green line = Z axis

- Magenta line = something is parallel or perpendicular to an edge

- ***Hold SHIFT to capture and lock an inference***

Axis Coordinate System

10



This is the 3D coordinate system that SketchUp uses. This is referred to as a **Right-Handed Coordinate System**

- Red line = X axis
- Blue line = Y axis
- Green line = Z axis

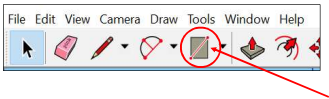
Moving the Scene Around in 3D

11

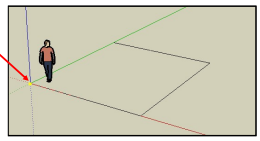
- Scroll Wheel: zoom in and out
- Middle Button: orbit
- Shift-Middle Button: pan

Drawing a 2D Box

12

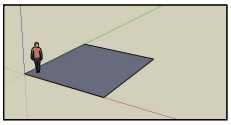


This is called
The Origin



Click on the **Draw-a-Box** icon, then click on the origin, and while holding down the mouse, drag in this direction

You'll end up with something like this:

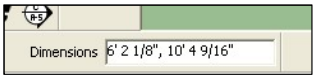


We are going to build a house, so make this square an appropriate size, given that the person is almost 6 feet tall. **Hint:** also look at the box in the lower-right corner.

13

Notice the Bottom-Right of the Screen

This is the **Measurement Toolbar**, or **MTB**

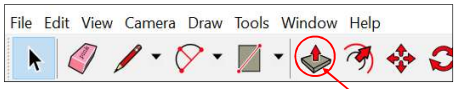


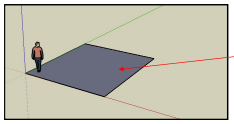
It is used to show you the dimensions, size, angle, etc. that you are currently setting

It can also be used to set exact values – just type into it while you are sizing with the mouse. But, if inputting length, be sure to use units: ' for feet and " for inches.

14

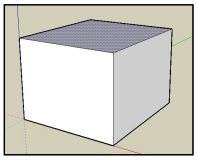
Extruding it into a 3D Box





Click on the **Push/Pull** icon, then click on the box you just created, and while holding down the mouse, drag in this direction

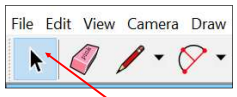
You'll end up with something like this:

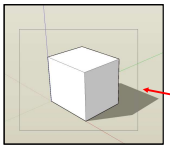


We are going to build a house, so make this height an appropriate size, given that the person is almost 6 feet tall. . **Hint:** also look at the VCB box in the lower-right corner.

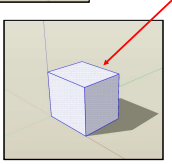
15

Deleting an Object



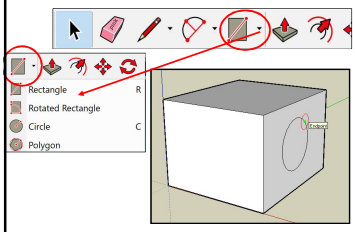


1. Select the **Select** icon
2. Select the object to delete by dragging a box around it with the cursor
3. Hit the **Delete key** *(not Backspace)*

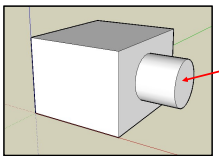


16

Adding more detail to an existing face



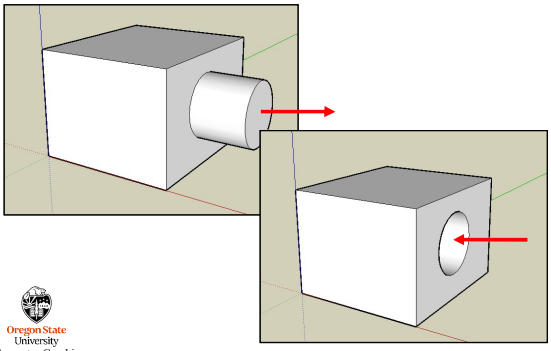
Click on the **Draw-a-circle** icon, then click on one face of the 3D solid you just created, and while holding down the mouse, drag in some direction



Click on the **Push/pull** icon, then click on the circle you just created, and while holding down the mouse, drag in this direction

17

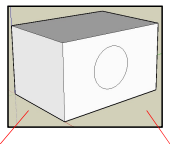
An outie or an innie :-)



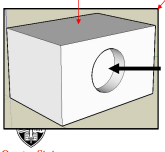
18

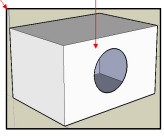
The difference between pushing a hole and cutting a hole

If you push the circle in, you get a tunnel with walls and a back face



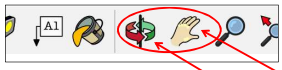
If you erase the circle by clicking on the circle, then hitting **Delete** (*not* **Backspace**), you get a window cut in the wall.

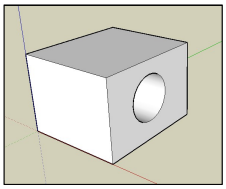




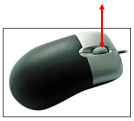
Want to see it from a different view?

19





Click on the **Orbit** or **Pan** icon, then click in the scene, and while holding down the mouse, drag in some direction



You can also **Orbit** by pushing down on the middle button on the mouse. On many mice, the middle button is also the scroll wheel.

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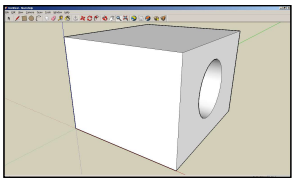
Want to zoom in?

20



The **Zoom extents** icon will zoom in as much as possible without making any of your object disappear off the screen

The **Zoom** icon will allow you to zoom as much or as little as you want

You can also **Zoom** in and out with the scroll wheel on the mouse

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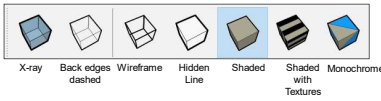
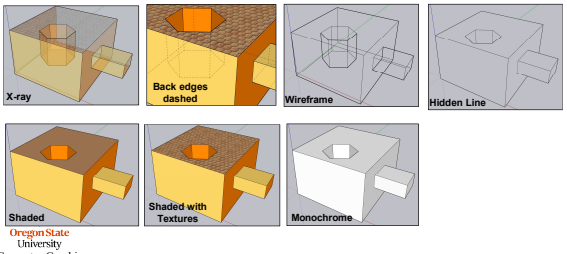
Style Menu

21

View→Toolbars→Style





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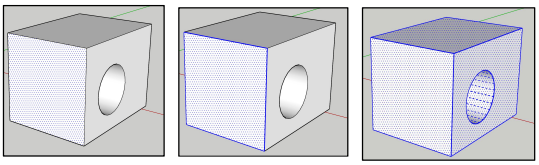
One, Two, and Three Clicks

22

Single-click (selects just the face or edge)

Double-click (selects the face and the edge)

Triple-click (selects everything on that object)



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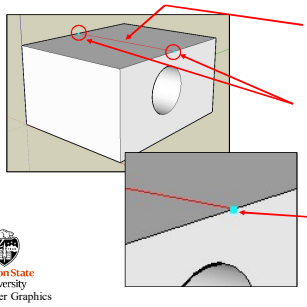
Let's give it a roof

23



Click the **Draw-a-Line** icon to draw a line across the top of the solid. But, you want the line to go midpoint-to-midpoint, which is a good place to raise the roof line from.

So, before clicking to draw the line, slide the pencil back and forth until the cyan dot appears, indicating that you've found this edge's midpoint,.

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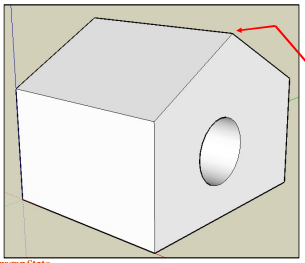
Let's give it a roof

24



Now click on the **Move/copy** icon, then click on the line you just drew, hold down the **up-arrow key**, and drag upwards

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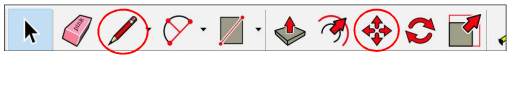
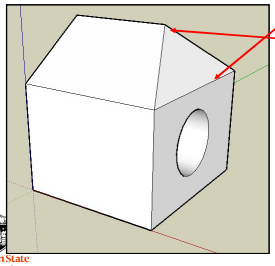
Want to Bevel the edge of the roof?

25



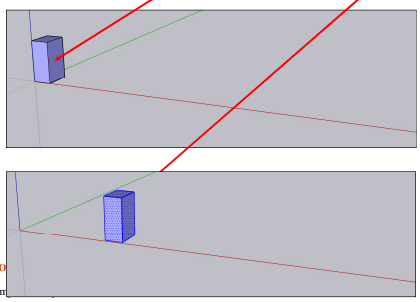


1. Draw a line here
2. **Move** the point at the tip of the roof

The Move Icon is Good to Get to Know!

26

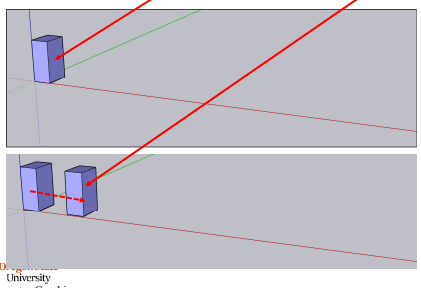
1. Create an Object
2. Select it
3. Click the **Move** and slide it in one of the red, green, blue directions



The Control-Move Does a Copy

27

1. Create an Object
2. Select it
3. Click the **Move** while holding down the **Ctrl** key

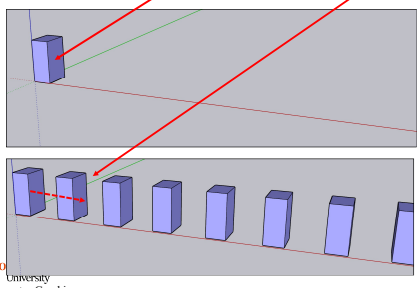


You can move the object interactively, or you can type a distance in the MTB. For example, try typing **5'** (5 feet).

The Control-Move Does a Copy

28

1. Create an Object
2. Select it
3. Click the **Move** while holding down the **Ctrl** key



You can move the object interactively, or you can type a distance in the MTB. For example, try typing **5'** (5 feet).

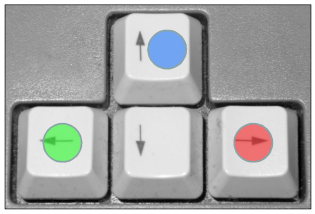
You can also generate more than one copy by typing, for example, **10x,** into the MTB.

A Move/Copy Trick

29

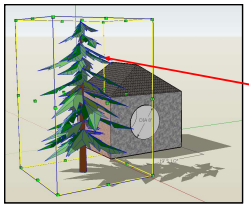
You can get SketchUp to move/copy in one of the three principal directions (red, green, or blue) by moving in that direction. SketchUp's "inference engine" will figure it out. But, you can also…

… force the Move/Copy to move along one of the 3 principal directions (red, green, or blue) by holding down one of the arrow keys as follows:

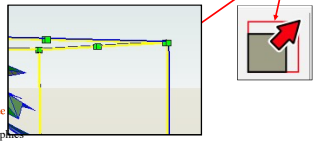


Scaling

30

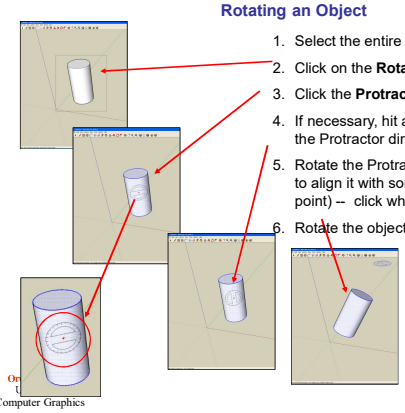


1. Select the **Select** icon
2. Select the object to scale
3. Select **Tools→Scale** or click the **Scale** icon
4. Grab a grip point and scale the object



Rotating an Object

31

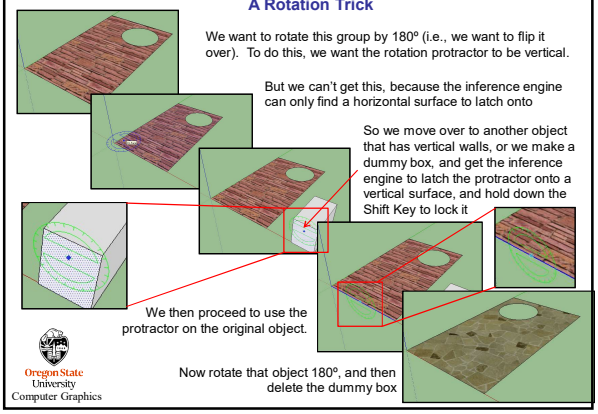


1. Select the entire object (triple-click)
2. Click on the **Rotate Tool**
3. Click the **Protractor** onto the object
4. If necessary, hit arrow keys to change the Protractor direction
5. Rotate the Protractor with the mouse to align it with something (e.g., a key point) -- click when ready.
6. Rotate the object. Click when done.

Once you've started rotating, you can also type in an exact angle into the Measurement Toolbar (MTB)

A Rotation Trick

32



We want to rotate this group by 180º (i.e., we want to flip it over). To do this, we want the rotation protractor to be vertical.

But we can't get this, because the inference engine can only find a horizontal surface to latch onto

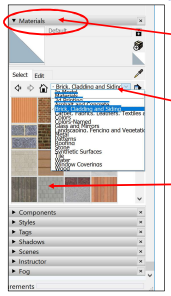
So we move over to another object that has vertical walls, or we make a dummy box, and get the inference engine to latch the protractor onto a vertical surface, and hold down the Shift Key to lock it

We then proceed to use the protractor on the original object.

Now rotate that object 180º, and then delete the dummy box

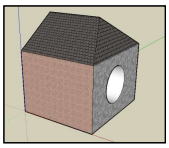
Want to make the house look more interesting?

33



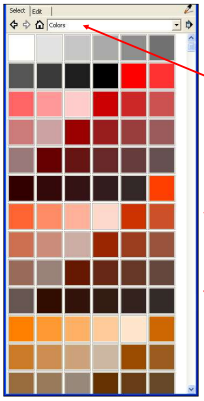
Click **Materials**

1. Click on a category
2. Click on a specific color or pattern
3. Click on the surface(s) you want to apply it to.



Pure colors are considered Materials too

34

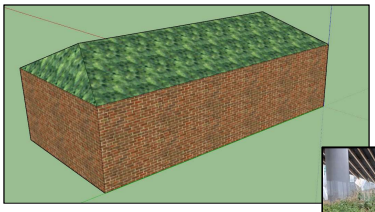


1. Select **Colors**
2. Treat the color just like you did the material

Scroll up and down to get more colors

You Could Even Put Vegetation on the Roof!

35



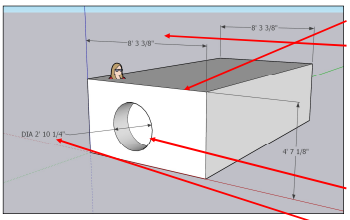
But, who would ever think to do that?!

Well, the Vancouver (British Columbia) Convention Center would!

Dimensions

36

Click **Tools→Dimensions**



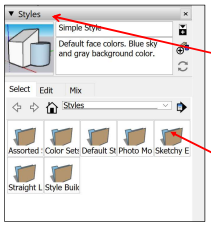
1. Click on an edge
2. Drag where you want the dimension to be drawn

Dimensions are useful if you are giving your design to someone so that they can build it

1. Click on the circumference of a circle
2. Drag where you want the dimension to be drawn

Styles

37

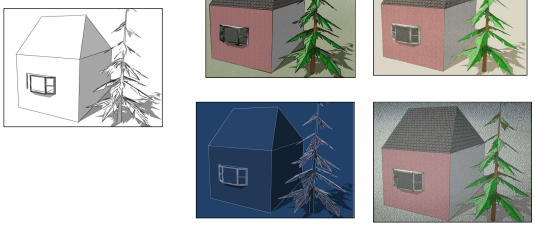


Click **Styles**

Each one of these will bring up several more styles to experiment with

Try Some of the Assorted Styles – They're Fun!

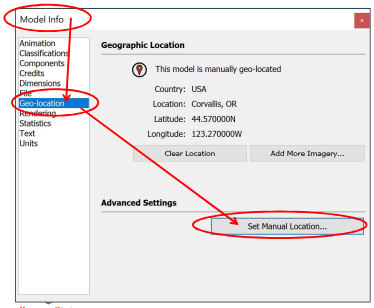
38



Setting Shadows in SketchUp

39

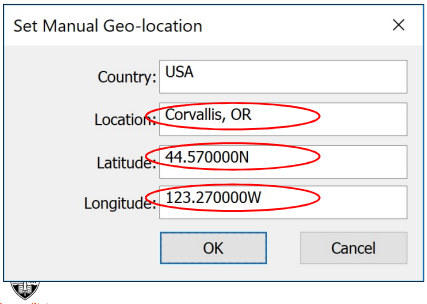
Window→Model Info→Geo-location→Set Manual Location



Setting Shadows in SketchUp

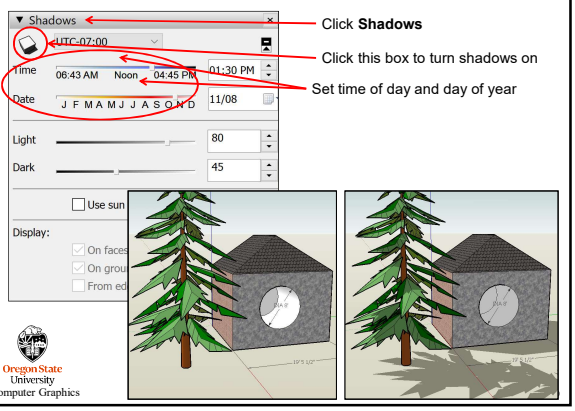
40

If you live in the Corvallis, Oregon area, type these values:



Setting Shadows in SketchUp

41



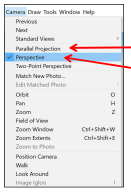
Click **Shadows**

Click this box to turn shadows on

Set time of day and day of year

Projections

42

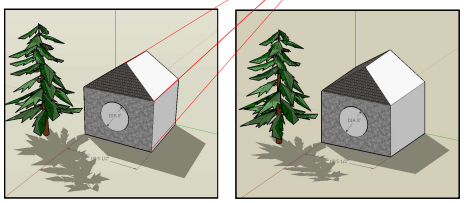


Click **Camera→Parallel Projection**

Click **Camera→Perspective**

In perspective, things get smaller as they get farther away, which is more realistic. In parallel, they don't. But parallel helps you see if front and back faces line up.

"Vanishing Point"



Perspective

Parallel

Exporting an Image File

43

Click **File→Export →2D Graphic**

Your image can be exported in one of 4 formats:

1. **BMP**
2. **JPEG**
3. **TIF**
4. **PNG**
5. **PDF**

Web browsers all know about this format

You would do this, for example, to email someone an image of your scene, to import it into a document, or to put it on your website

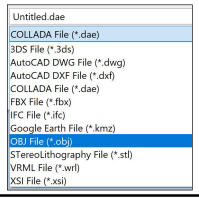
Exporting a 3D Object

44

Click **File→Export →3D Model**

Your image can be exported in one of 11 formats. The ones you *really* care about are:

1. **OBJ – as close to a universal 3D file format that there is**
2. **STL – used for 3D printing**
3. **DAE – Collada format, compatible with many artist programs**
4. **3DS – compatible with AutoDesk's 3D Studio Max**

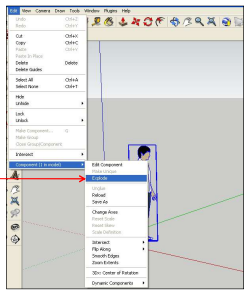


Changing the Person's Clothing

45

The person in the default scene is a SketchUp "Component", that is, he is a group of geometry collected together. To change his clothing, you need to first break, or "Explode", the collection apart.

Even easier, right-click on the person and select Explode from the pop-up menu.



After that, you can click on **Materials** and re-color or re-pattern the clothing

Creating Groups

46

Sometimes you would like to collect several pieces of geometry together and be able to treat them as a single unit. This is called a SketchUp **Group**.

Create a SketchUp Group by first clicking on the **Select** icon.

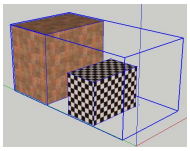
Then, click on the first object you want in the Group. It will turn blue.

Then, hold down the **Shift** key and click on all other objects you want in the group. They will also turn blue. If you select the wrong item, just click it again to un-select it.

You can select many things at once by creating a rectangle around all of them with the Select cursor.

When you are done, right-click and select **Make Group** from the pop-up menu.

To ungroup the objects, right click on them and select **Explode** from the pop-up menu.



Hiding Geometry

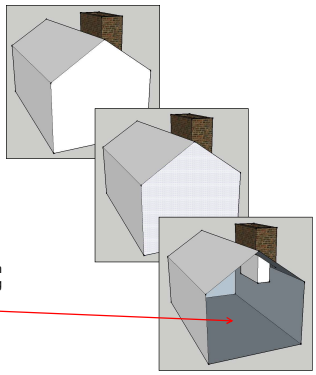
47

Sometimes it would be nice to temporarily eliminate some geometry so that you could see inside something. This is referred to as **Hiding**.

To hide one or more pieces of geometry, select all of them as if you were about to create a group.

Then, right-click and select **Hide** from the pop-up menu. The selected objects look like they are gone, but they aren't. They're just hidden.

This is useful for putting things into an object (such as furniture) or for editing the object (as is needed here).



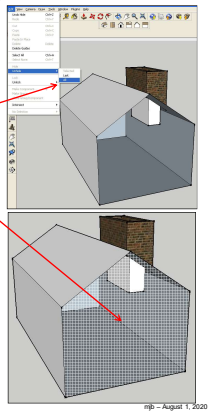
Un-Hiding Geometry

48

There are two ways to bring back hidden geometry.

The first is to select **Edit→Unhide→All**, like this:

The second is to select **View→Hidden Geometry**. This will make hidden geometry show up like this: From there, you can right-click on it and select **Unhide** from the pop-up menu.

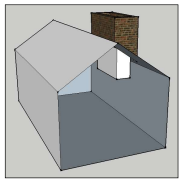


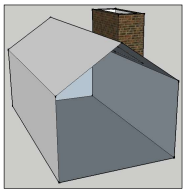
Eliminating Geometry

Sometimes extruding geometry results in it existing places it shouldn't.

To eliminate any geometry, take the **Eraser** tool and click on the edges of the geometry you want to eliminate.

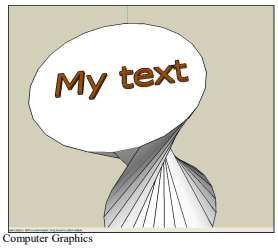
As soon as an edge of a surface has been eliminated, the surface will disappear too.



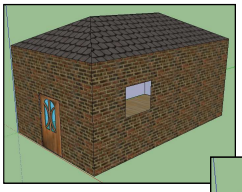


Adding 3D Text

1. Click on **Tools→3D Text**
2. Type the text into the dialog box
3. Make any text settings you want
4. Place the text by clicking on an object



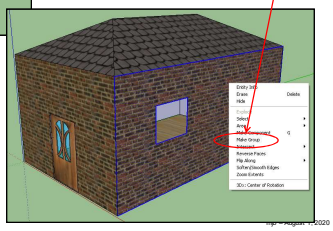
An Interesting Use for Rotation -- Building a Real Model from Paper!



Start with a model. "Boxy" models with flat faces work best.

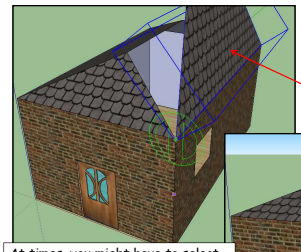
For each face:

1. Select the face and its edges by double-clicking on the face
2. Right-click the mouse to bring up the menu and select ***Make Group***

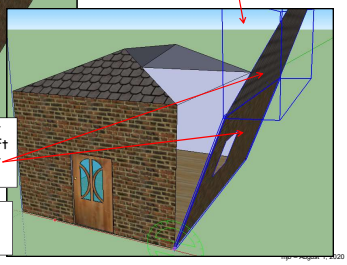


By doing this for each face, you are separating each face and its edges from the rest of the model so they can be rotated independently.

An Interesting Use for Rotation -- Building a Real Model from Paper!



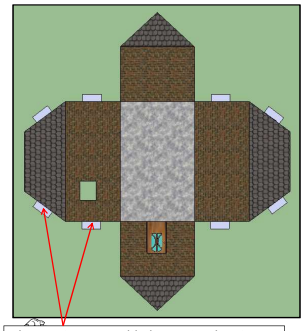
Now, for each face, select it (and other unfolded faces attached to it) and use the ***Rotate*** function to "unfold" it with respect to the face next to it, or with respect to the ground



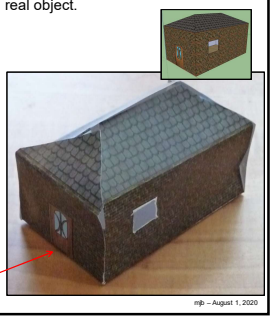
At times, you might have to select multiple faces (hold down the Shift key and click on each one), so that they can Rotate together.

This is sometimes easier in a Parallel view (**Camera→Parallel Projection**)

An Interesting Use for Rotation -- Building a Real Model from Paper!

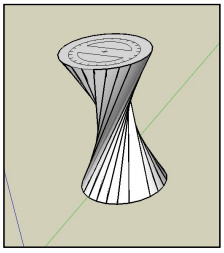


Print the unfolded scene from the bottom view (you might have to select all faces and rotate them over together), and then fold them up into a real object.



These tabs were added to make the object easier to glue together.
This was a pretty sloppy job, but you get the point...

Rotating a Face

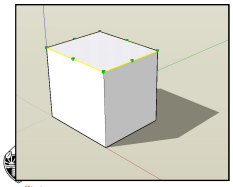


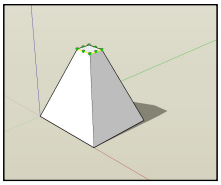
Strange as it may seem, you can also rotate just a face. Follow the same procedure, but select only the face.

You can also scale a face

55

1. Select a face
2. Select **Tools→Scale**
3. Move the grips with the mouse
4. Hold down the **Control key** if you want scaling about the object's center





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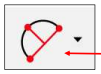
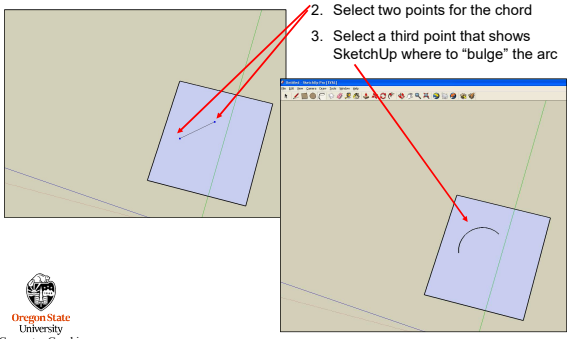
Drawing an Arc

56



1. Click on the Arc Tool
2. Select two points for the chord
3. Select a third point that shows SketchUp where to "bulge" the arc



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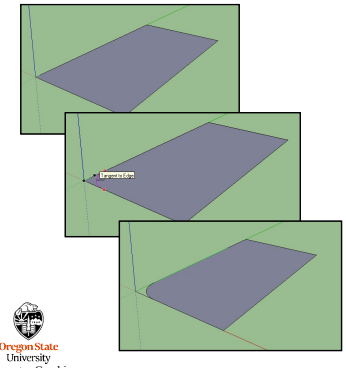
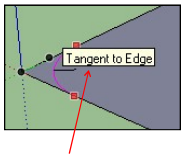
Arcs are Often used to Round Corners

57





1. Click on both edges surrounding a corner. The line will turn purple when you are the same distance from the corner.
2. When you place the third point, the inference engine will also tell you when the arc is tangent to (aligned with) the edges.

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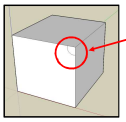
Want to create Crown Molding?

58

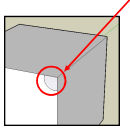


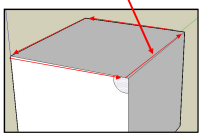
Draw an arc in the corner

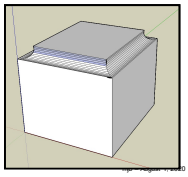
Click **Tools→Follow Me**

Click on the arc area

With th eleft button still down, move the cursor along the perimeter – don't click again until you are done with the full path







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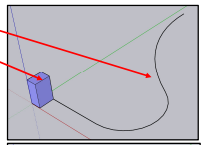
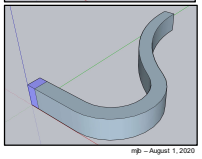
Another use for Follow Me – Extruding a Surface

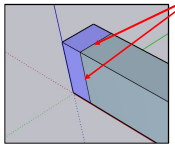
59

1. Create an object
2. Draw a line and some arcs from one corner of the object
3. Select **Follow Me**

4. Click on one face of the object and, with the left mouse button still down, slide the cursor along the curve
5. Using the pink eraser, erase the connecting lines







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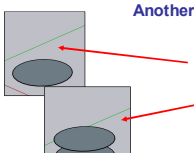
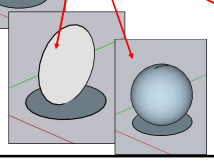
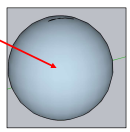
Another use for Follow Me – make a Sphere

60



1. Create a circle
2. Copy the circle using the Move Tool with the Control key held down
3. Rotate the upper circle 90°
4. Move the upper circle so that its bottom is at the lower circle's center
5. Select the lower circle, select **Tools→Follow Me**, and then select the upper circle
6. Delete the lower circle





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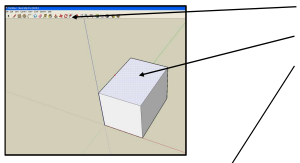
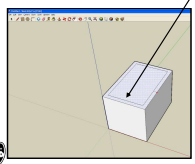
mjb – August 1, 2020

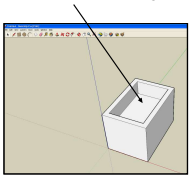
61

Offsetting a Surface



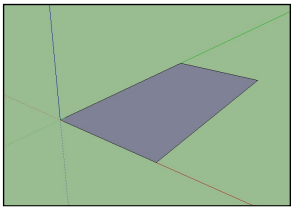
1. Click on the Offset Tool
2. Select the surface to offset on
3. Move the mouse to show how much to offset – click when ready
4. This only creates offset edges – you need to use the Push-Pull Tool to do something with it.

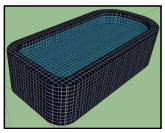




62

Combining Several Techniques: Making a Swimming Pool

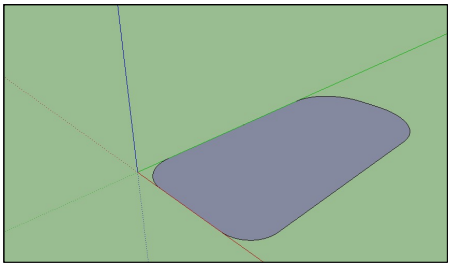




Start by creating a rectangle on the floor

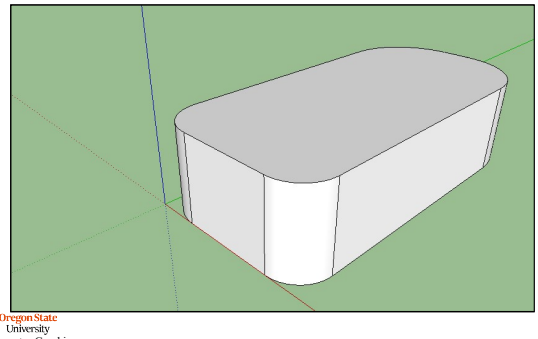
63

Use the Arc Tool and the Erase Tool to Create 4 Arcs to Round the Corners



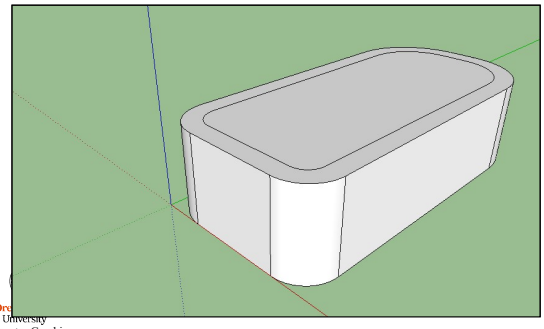
64

Use the Push/Pull Tool to Lift it into 3D



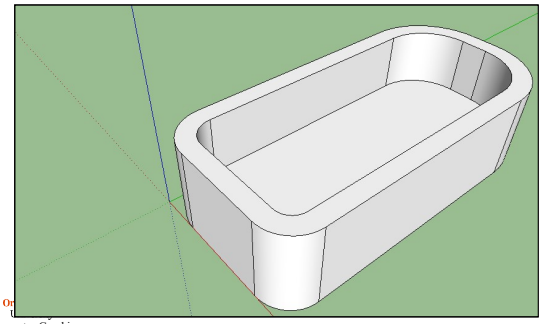
65

Use the Offset Tool to Create an Inner Edge



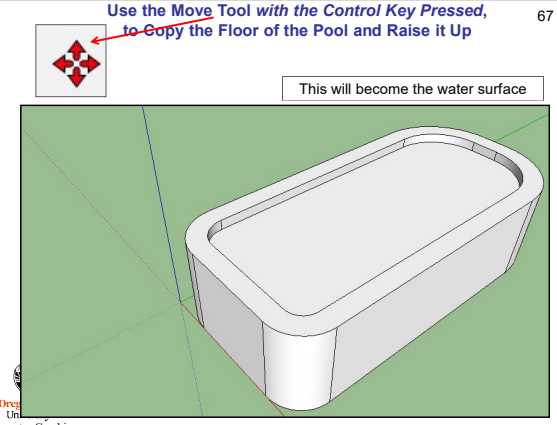
66

Use the Push/Pull Tool to Push the Middle Down



Use the Move Tool *with the Control Key Pressed*, to Copy the Floor of the Pool and Raise it Up

67

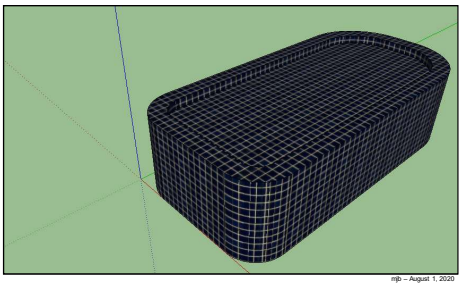


Select Materials→Tile to Apply a Surface to Your Pool

68

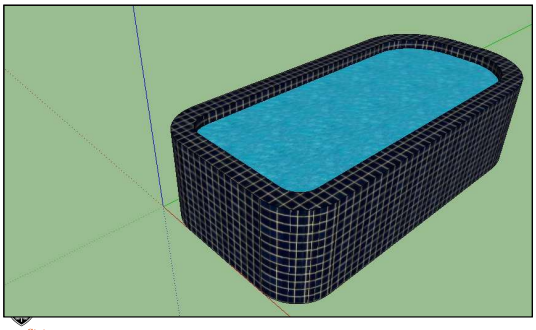
If you hold down the *Control Key* when adding the tile pattern, it will apply it to all surfaces, not just one. This saves you a lot of time.

This isn't right – the top surface of the water is currently tile instead. We'll fix this next.



Select Materials→Water and click on the top surface to change it to water

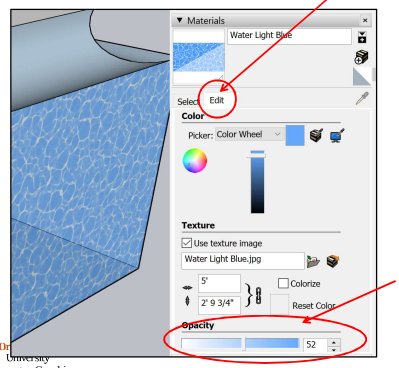
69



Make the Water Surface Translucent

70

In the Materials→Water dialog box, click on the Edit tab.

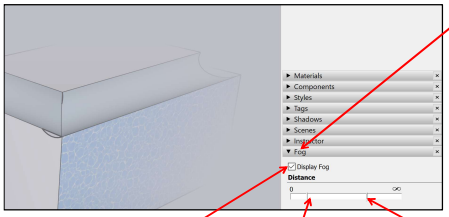


Then lower the Opacity until the water surface looks properly translucent.

Adding Fog

71

Click **Fog**



Click here to turn the fog feature on

This slider adjusts how far in front of your eye the fog starts. Items closer to you than this will not be fogged at all.

This slider adjusts how far in front of your eye the fog completely hides your scene. Items farther away than this will not be visible at all.

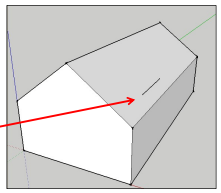
Adding Fog

72

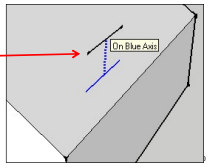
Adding a Vertical Chimney to a Sloped Roof

73

1. Draw a line along the roof using the pencil tool. SketchUp's inference engine will try to force it to be parallel to an axis. Let it do that.



2. Select the line you just drew. Use the **Move/Copy** icon with the Control Key held down to lift it up in the air. (The Control key will force it to do a Copy.) Wiggle it a little bit until you get the phrase "On Blue Axis" to appear. This indicates that you are lifting it straight up.



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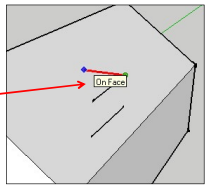
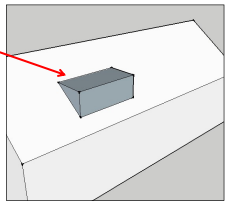
Adding a Vertical Chimney to a Sloped Roof

74

3. Draw lines using the pencil tool from the ends of this new line to the face of the roof. SketchUp will tell you when you are there. Be sure the line is a color (red in this case) to indicate that you are parallel to an axis.



4. Using the pencil tool, connect up all the points to form edges. You should have 9 lines in all. (Don't forget to look at the back of the chimney.) SketchUp will turn the edges into faces as you complete them. There should be 4 faces in all.



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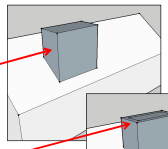
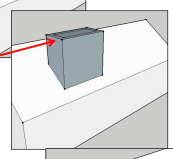
Adding a Vertical Chimney to a Sloped Roof

75

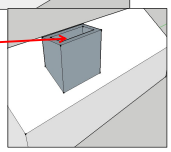
5. Use the Push/Pull tool to lift the top surface.



6. Use the Offset tool to make an inner surface on that top surface.



7. Use the Push/Pull tool to push that inner surface down.



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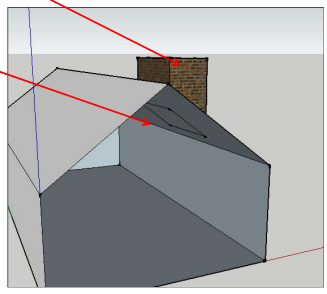
Adding a Vertical Chimney to a Sloped Roof

76

8. Add whatever **Material** decoration you want

9. Get rid of the excess chimney under the roof by hiding an end face and erasing those edges.

10. Unhide the end face when you are done



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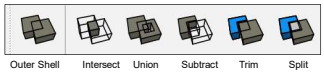
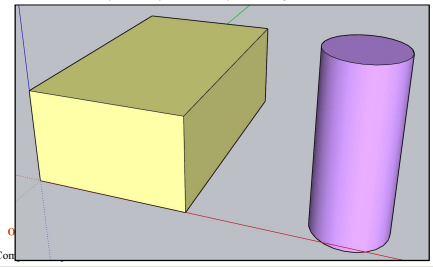
Solid Tools

77

View→Toolbars→Solid Tools



1. Start with two objects
2. Select the box (triple-click), then right-click and select **Make Group**
3. Select the cylinder (triple-click), then right-click and select **Make Group**



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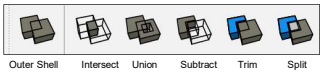
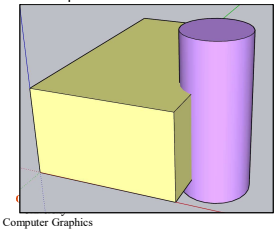
Solid Tools

78

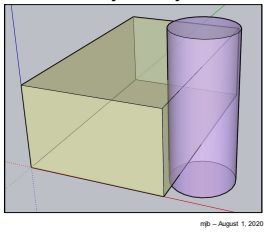
View→Toolbars→Solid Tools



Overlap them in 3D:



View→Face Style→X-ray:



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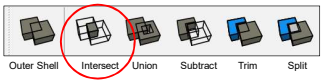
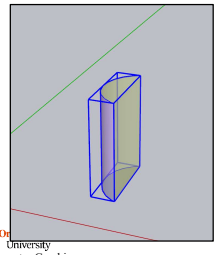
Solid Tools

79

View→Toolbars→Solid Tools



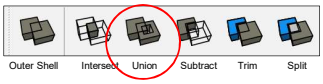
Select them both, then select **Intersect**:



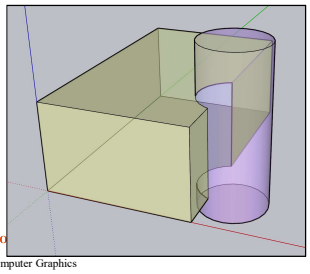
Solid Tools

80

View→Toolbars→Solid Tools



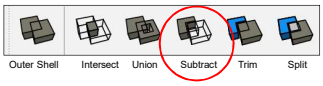
Select them both, then select **Union**:



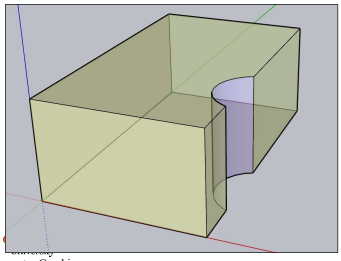
Solid Tools

81

View→Toolbars→Solid Tools



Select the cylinder, then select **Subtract**, then select the box:

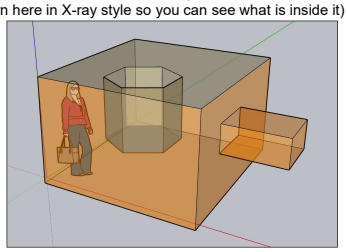


Section Planes

82

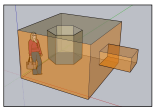
View→Toolbars→Section

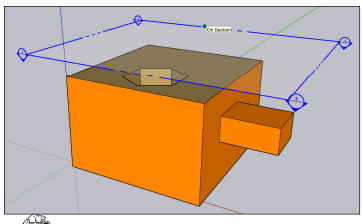
Start with something like this
(shown here in X-ray style so you can see what is inside it)



Section Planes

83

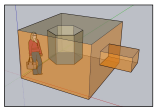




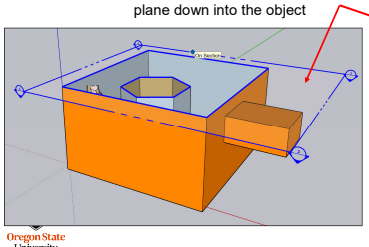
You can use the **arrow keys** to change the orientation of the section plane

Section Planes

84

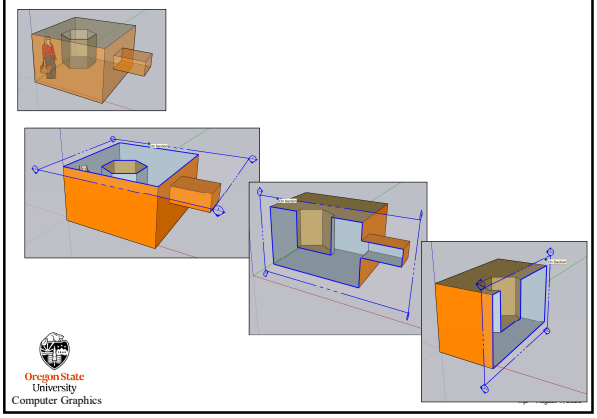


Use the **Move** icon to move the section plane down into the object



You Can Create Section Planes in All Three Directions

85



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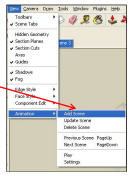
Creating a Flying Animation

86

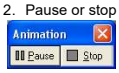
To create an animation:

1. Create a view of the scene
2. Select **View→Animation→Add Scene**
3. Create a different view
4. Select **View→Animation→Add Scene**
5. . . .

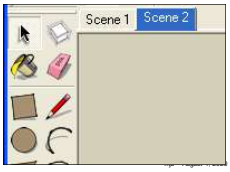


To play the full animation:

1. Select **View→Animation→Play**
2. Pause or stop the scene with these buttons



As you add scenes, SketchUp will list them. You can click on any of them to get back to that view.



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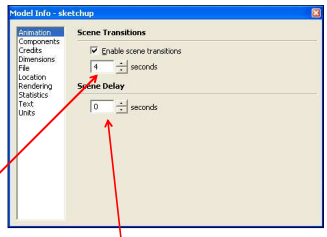
Animation Settings

87



Set how long each scene transition lasts

How long to wait before starting the animation

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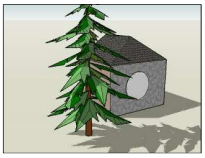
Exporting Your Animation

88

To save an animation to a file:

1. Select **File→Export→Animation**
2. Save as an MP4 file



To play the animation file:

Double-click on your MP4 file

To import your animation into PowerPoint:

1. Select **Insert→Video→Video on My PC**
2. Double-click on the image when editing the slide
3. Click on the image in Slide Show mode

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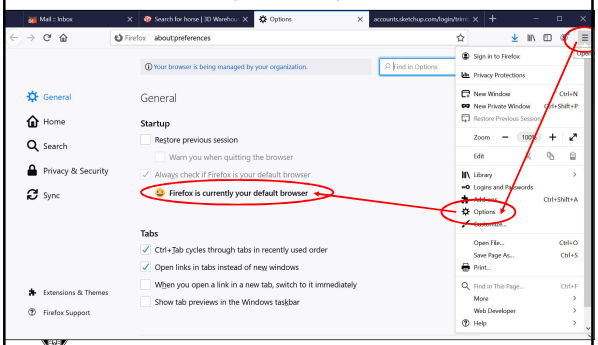
Be Sure that Internet Explorer is not your Default Browser (I like FireFox)

89



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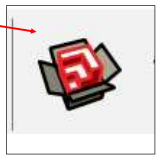
Logging into the 3D Warehouse

90

Click **3D Warehouse**



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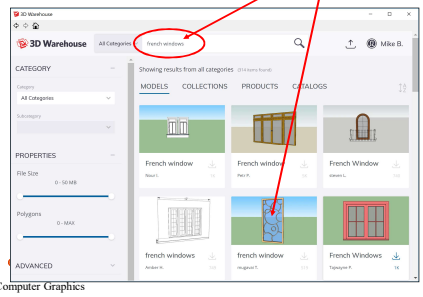
3D Warehouse Example -- Adding Picture Windows

91

Click **3D Warehouse**

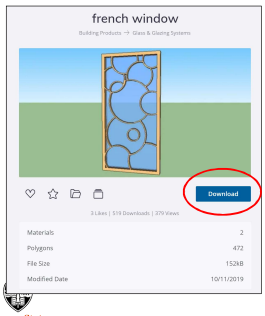
Type what you hope to find

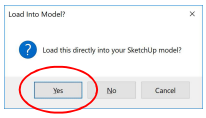
Click on the one you'd like



Adding Picture Windows

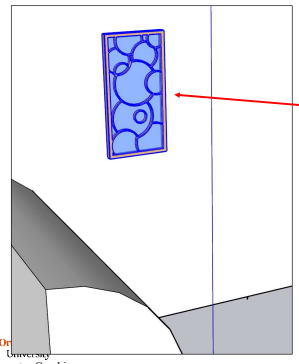
92





Adding Picture Windows

93

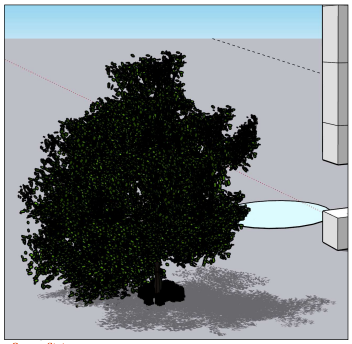


Put it where you want it.

You might have to scale and/or rotate it.

Use 3D Warehouse to Add other Components

94



But, be careful!
Too much scene detail will overwhelm your graphics card!

The SketchUp Extensions

95

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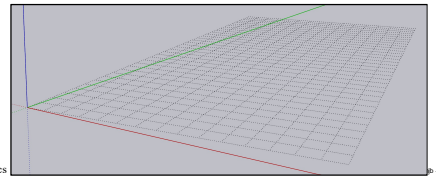
The SketchUp Sandbox

96

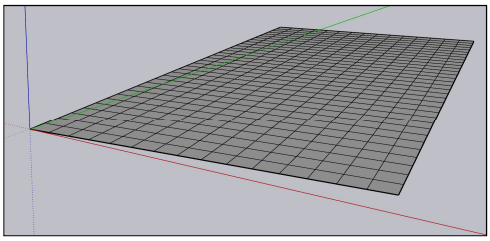
View→Toolbars→Sandbox

Create a Sandbox grid



The SketchUp Sandbox

97



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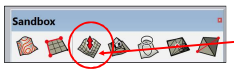
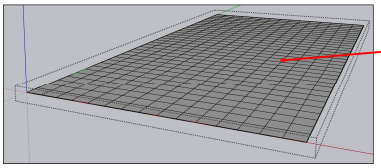
The SketchUp Sandbox

98

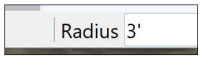


Create smooth hills



Double-click

Type a number to change the smoothing radius



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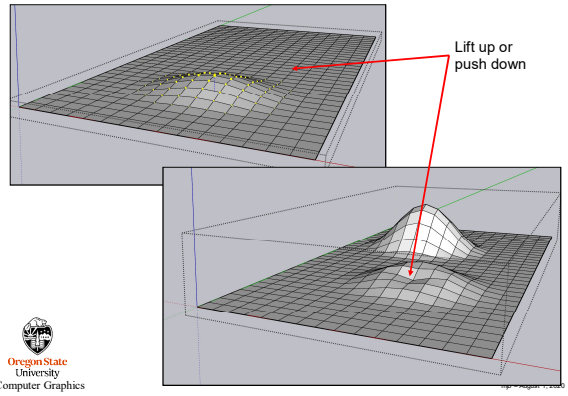
The SketchUp Sandbox

99



Lift up or push down

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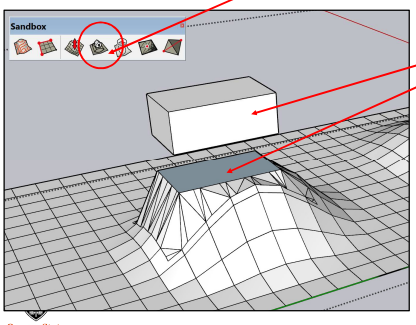
The SketchUp Sandbox

100

Select **Stamp**



Hover a 3D object over the terrain to create a flat area to place that object down on

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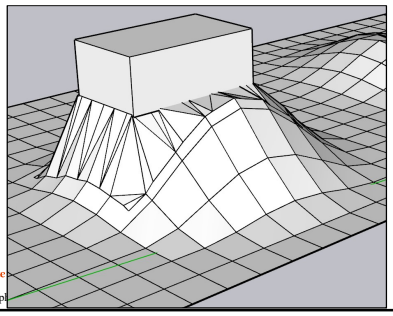
The SketchUp Sandbox

101



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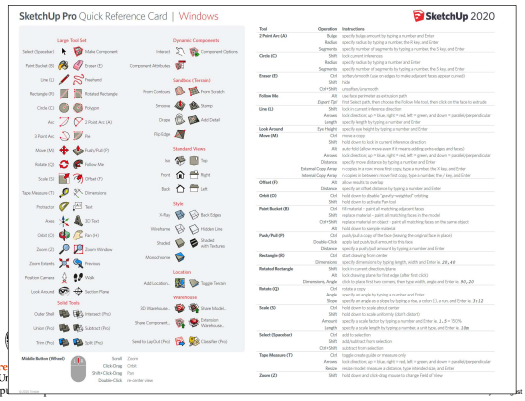
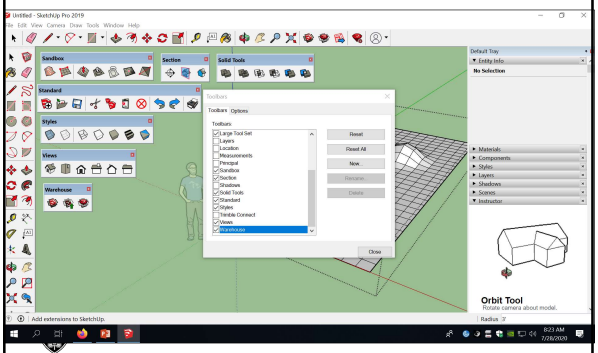
SketchUp Quick Reference Card

102



Lots of Menus are Available

103



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104

SketchUp Examples That Some of My OSU Students Did!

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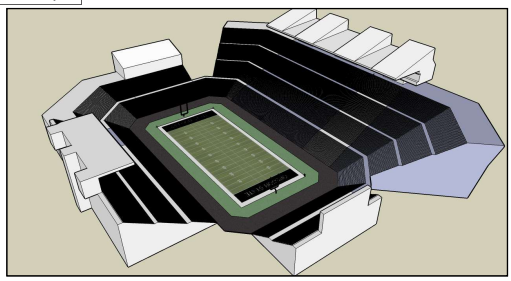
105

Other Examples

Hassan Sinky



OSU's Reser Stadium

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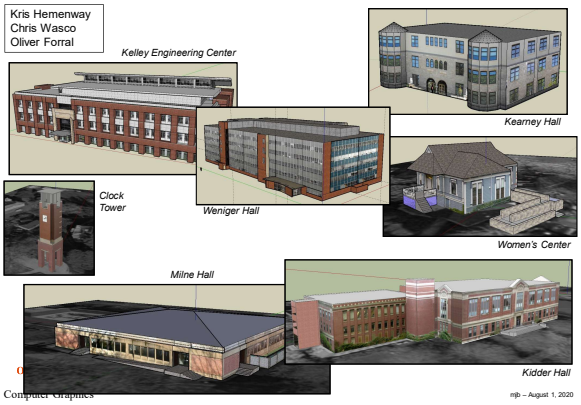
Other Examples – the OSU 3D Campus Map Project

106

Kris Hemenway
Chris Wasco
Oliver Forral



Computer Graphics

Using SketchUp !

107

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Mike Bailey
mjb@cs.oregonstate.edu
http://cs.oregonstate.edu/~mjb/sketchup

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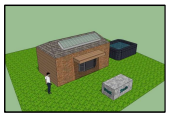

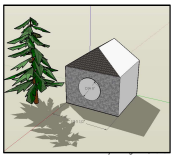

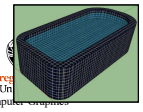

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