CS211

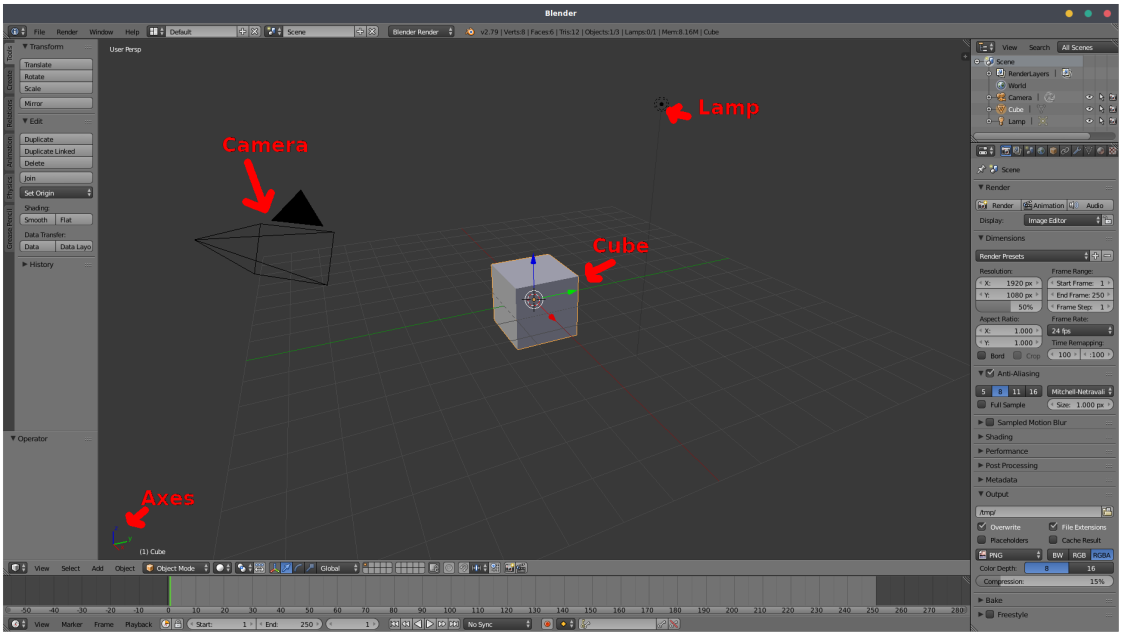
Week 6 - 3D Modeling

27 March 2018

In this Blender tutorial for beginners, you'll learn the basic setup of Blender by creating a cute creature you will undoubtedly recognize from the 8-bit days. :] This tutorial won't cover everything Blender can do, just the stuff you need to know to get started making objects and using them in games!

> **Note**
>
> If you don't have Blender installed on your computer, download a copy from `https://www.blender.org/` (V 2.79).

Once you have Blender installed, launch it and you'll be greeted by a splash screen. Click anywhere outside of the splash screen to get started. You should see the default scene that contains a cube, a camera and a lamp, as illustrated in the screenshot below:



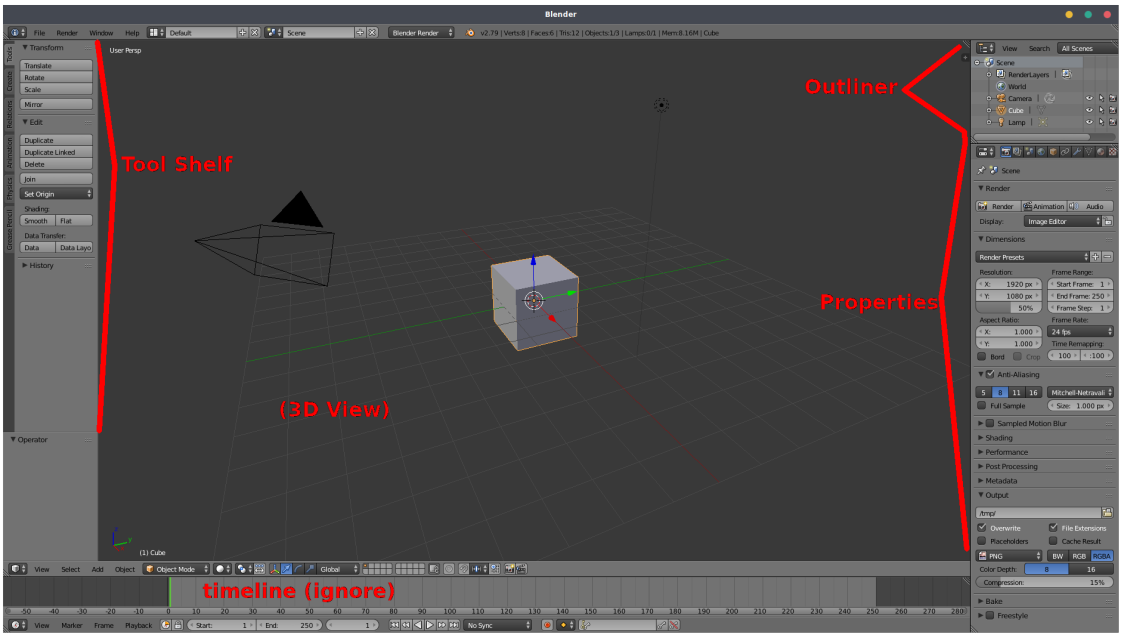
These objects are located in the 3D view that has X, Y, and Z axes. These axes help position and edit your objects in 3D space.

To help tell them apart, the X-axis is red, the Y-axis is green, and the Z-axis is blue. The grid you see on the screen represents the XY plane, and the Z axis extends perpendicular to the XY plane. You can always confirm the orientation of your view by checking the mini axis in the bottom left-hand corner of the 3D view.

There are four panes on the screen that you'll use to create your 3D objects:

- Outliner: lists all objects in your scene.
- Properties: allows you to edit the properties of whatever object or material you are working with.
- 3D View: contains all the objects you're creating. Note the toolbar at the bottom, you'll be using this quite a bit later on.
- Tool Shelf: displays any relevant options for the action you're currently performing in Blender.

The following screenshot shows the relative positions of the four panes noted above:



Step 1 – Controlling Your View

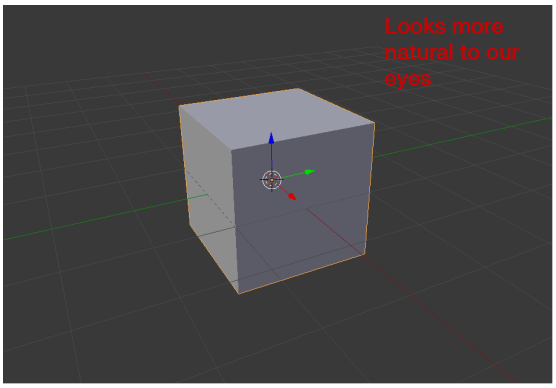
Navigating around your 3D view is something you'll be doing frequently, so you should get really comfortable with the navigational controls. The primary ways to manipulate your view are as follows:

- To rotate your view: hold the middle mouse button and drag around.

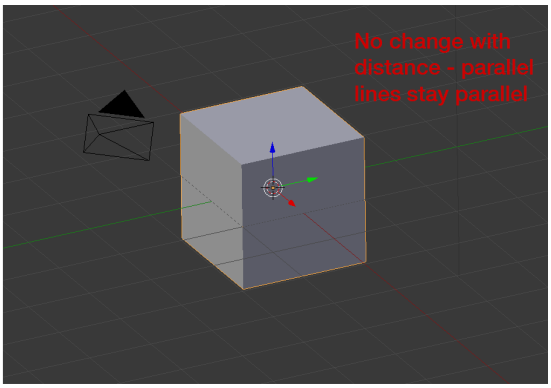
- To zoom your view: use the mouse scroll wheel
- To pan up and down: hold down ⇧ and use the mouse scroll wheel
- To pan right and left: hold down ctrl and use the mouse scroll wheel

There are two views for your 3D scene: orthographic, which means your object is drawn linearly without any perspective distortion, and perspective, which means that objects further away in your view appear smaller, and lines on your objects display perspective distortion.

The difference between these two views is illustrated below:

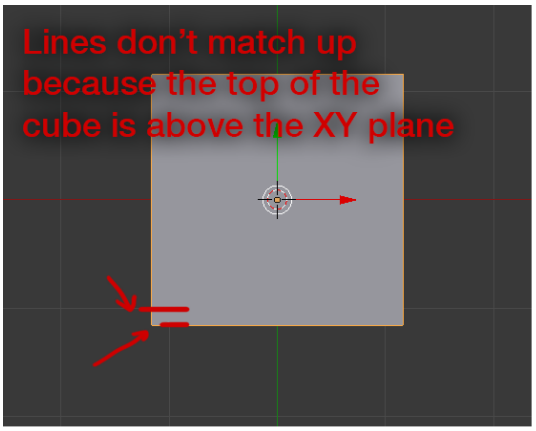


Perspective

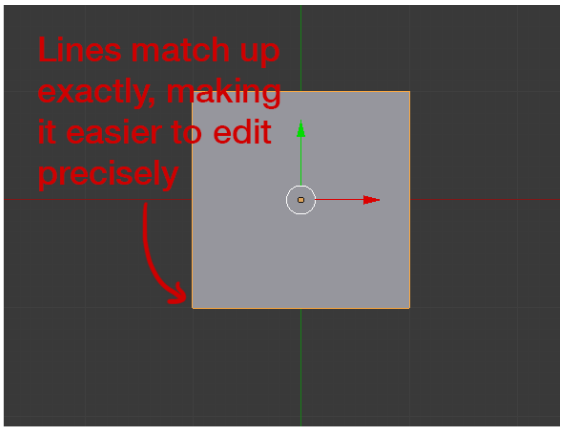


Orthagonal

Although perspective view looks more natural, you'll probably find it easier to design your objects using the orthographic view where you can view and edit objects on a flat plane. The images below show the benefit of designing in the orthographic view:



Top Perspective

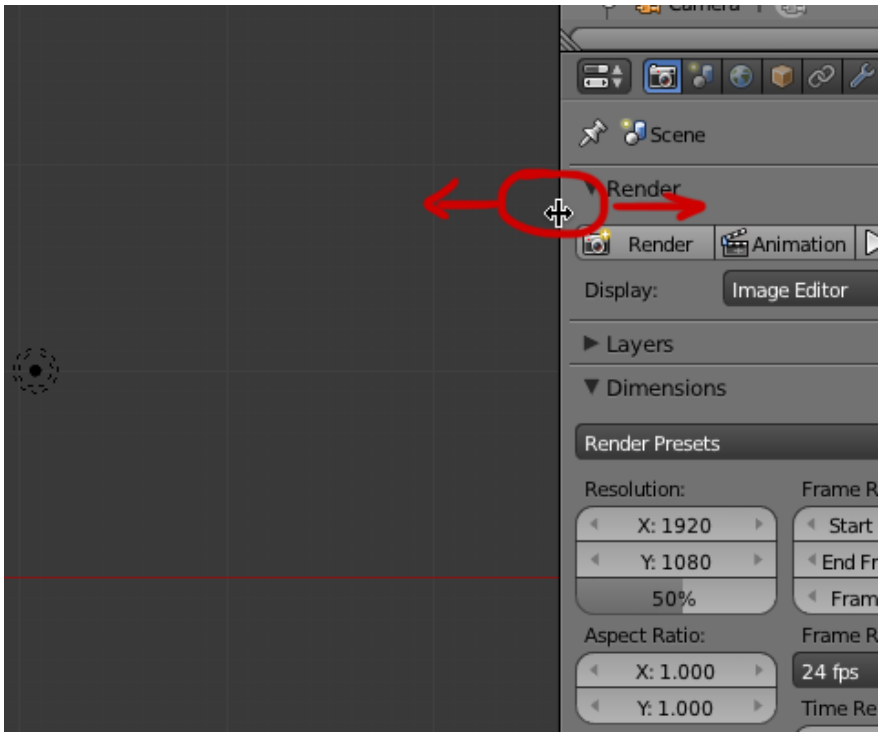


Top Orthagonal

The default view for a new scene is the perspective view. To switch between orthographic and perspective views, select View > View Pers/Ortho (from the toolbar under the 3D View); alternatively, press 5 on the numpad. To choose a specific pre-defined view, rather than rotating around with the center mouse button, choose the view from the View menu.

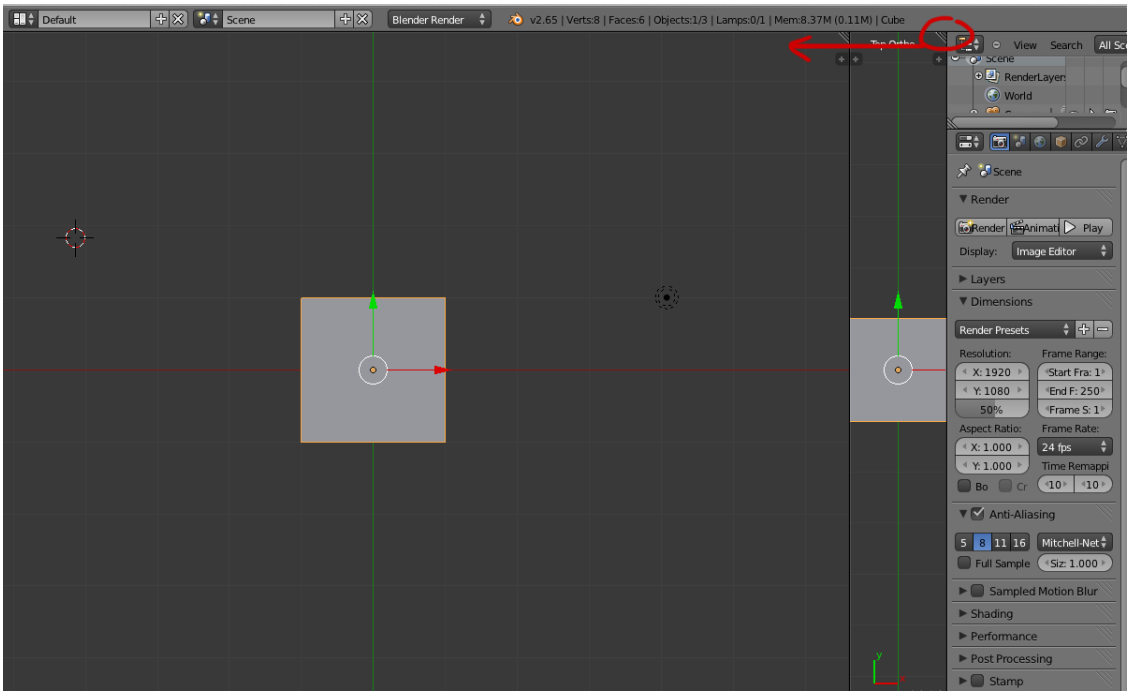
Step 2 – Modeling Windows

To resize the various toolbar panels, simply mouse over the edge of the panel and resize it to suit as shown below:



If you move the panel a little too far and — whoops — it disappears, click and drag the little transparent plus icon tab to pull the panel back out.

Sometimes you'll want to have two views of your object open at the same time. To create another view window, click and drag the triangle at the top right or bottom left of the current window, as shown below:



To get rid of a view window, click and drag the top right triangle of the window you want to keep onto the window you want to remove. The window to be removed darkens; release the mouse and the second window disappears.

Step 3 – Manipulating Objects in Object Mode

Blender works in several different modes. At this point in the tutorial, you're in Object mode (which you can see in the toolbar below the 3D view), where you can add, delete, move, scale, and rotate your object. A little later on, you'll move on to Edit mode — but for now you've got some work to do in Object mode.

Selecting Objects

Note that the cube in your scene should have a yellow outline; this means that the cube is selected. There are a few ways to select and deselect objects in Blender:

- To select an object: click it with the right mouse button.
- To deselect an object: click ⇧ and right mouse button.
- To toggle selecting all objects or no objects: press the A.

Deleting Objects

You're here to design a mushroom, not a sugar cube, so you'll need to get rid of the cube from your scene. If the cube is not selected, click the cube with the right mouse button, press the X key, and choose Delete.

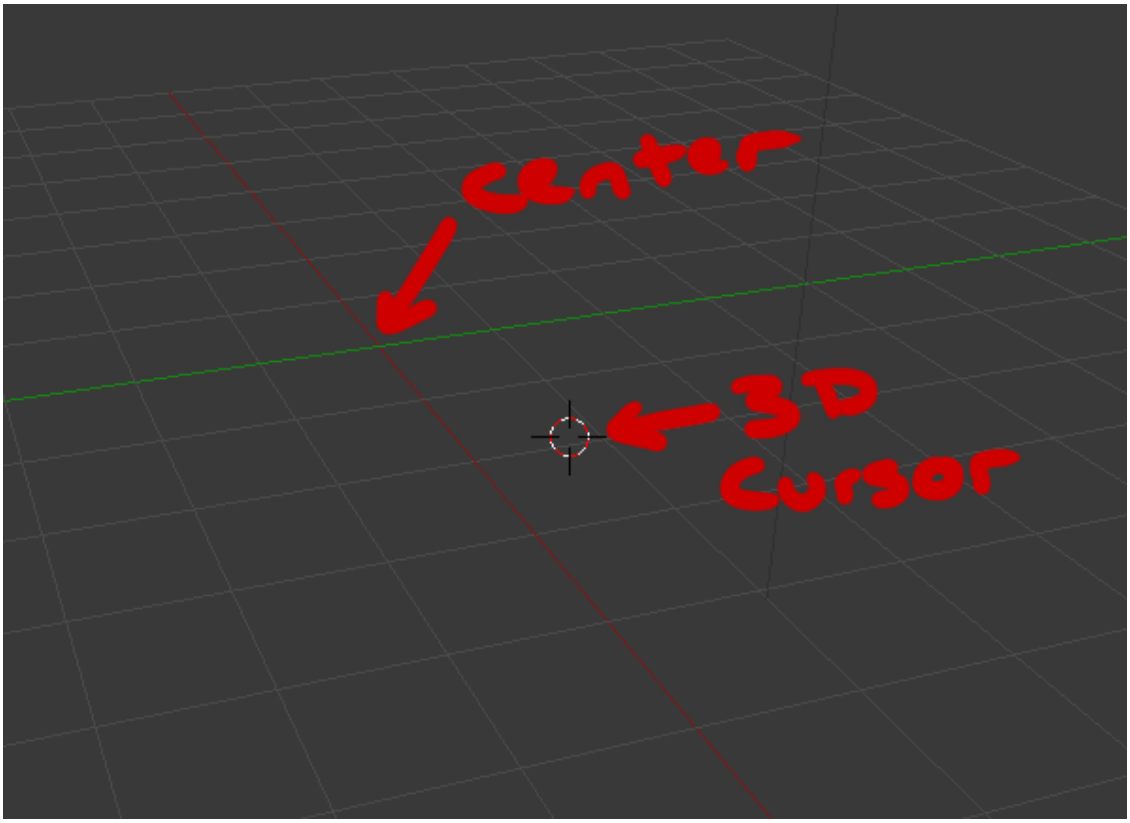
3D Cursor

So your scene has been cleared, and you're ready to add some new shapes to your scene. But how do you know where to add them?

The 3D cursor shows you where new objects will be added.

To set the position of the 3D cursor in your scene, click on your scene with the left mouse button.

In the scene above, the 3D cursor is not set to the center of your scene; it's down and off to the left somewhere. You'll need to draw your object centered in the view, so you'll need to move the 3D cursor back to the origin. You could try to click on the origin with the mouse, but there's an easier way.



To reset your 3D cursor to the origin, choose Object › Snap › Cursor to Center; if you're a fan of keyboard shortcuts, hit ⇧+ S Cursor to Center.

Adding Objects

Now that your 3D cursor is at the origin, press ⇧+ A to display the Add menu. Select Mesh, and you'll be presented with all types of shapes that you can add.

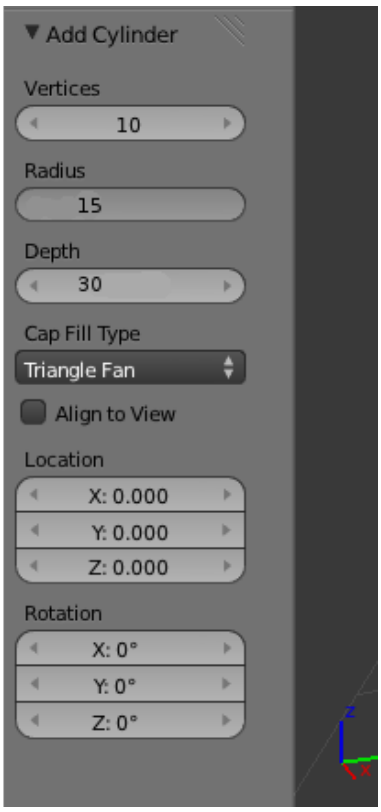
Select the Cylinder shape

Now that you have a cylinder in your scene, check the bottom-left panel to see which options are available to edit your shape. These only appear immediately after you add the object and before you've done any other editing, so now's your chance to get the settings right!

Modify the following properties in the left-hand panel as follows:

- Vertices: `10`
- Radius: `15`
- Depth: `30`
- Cap Fill Type: `Triangle Fan`

Leave all other properties as-is.



Step 4 – Transforming Objects in Object Mode

In Object Mode, you can transform the entire object by moving, scaling, or rotating it. There are three ways to transform objects: using the shortcut key, using the transform handles, and using the transform panel.

Transforming with Shortcut Keys

To use the shortcut keys to transform the object, first ensure the object is selected. Next, press the appropriate key to begin the action, and then move the mouse to start the transform. The further you move the mouse, the greater the magnitude of the transformation.

The shortcut keys for transforms are as follows:

- Move: G
- Scale: S
- Rotate: R

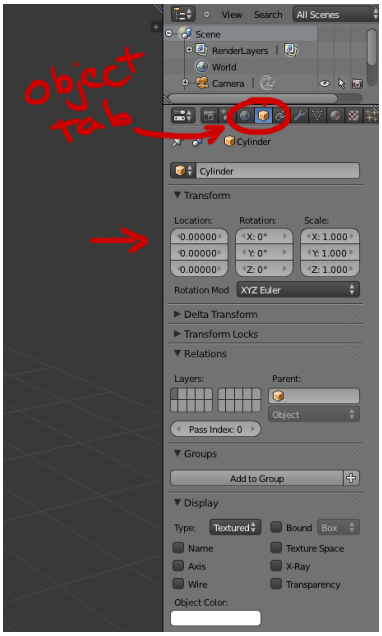
You can constrain transforms to a particular axis by pressing X, Y, or Z. Therefore if you only want to scale along the Z axis, press S (then release) and then press Z (then release). You can only constrain to one axis at a time.

To accept the changes, click the left mouse button; to discard the changes, click the right mouse button. If you've accepted the changes, but then change your mind, Blender provides the good old ctrl/ ⌘+ Z keystroke to undo your last action.

Transforming with the Properties Panel

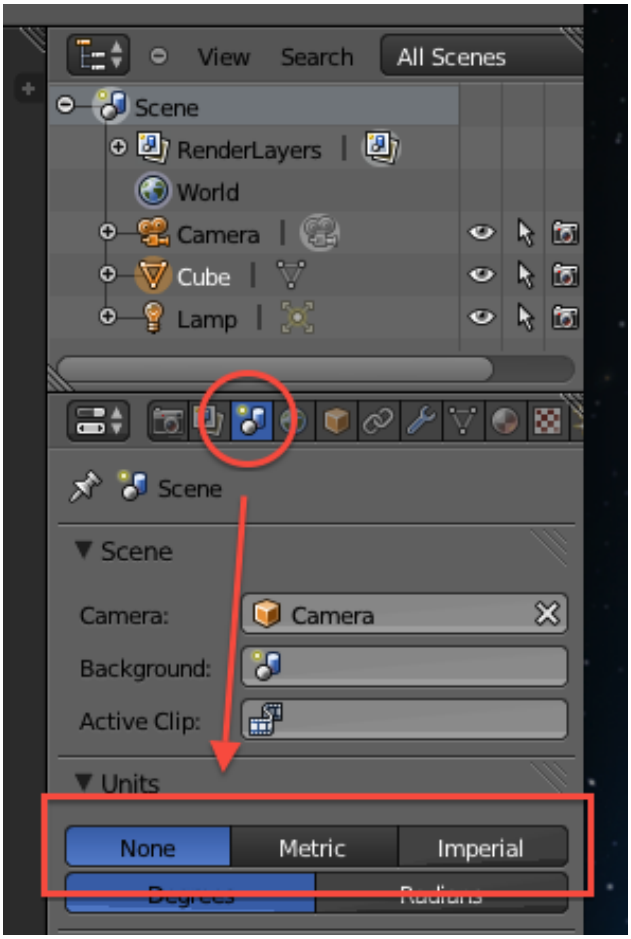
The third method of transforming — editing the object properties directly — offers the most control; you can use this method if you need very specific control over the shape and size of your object.

To edit the properties of your object directly, go to the Properties panel on the right-hand side of the screen and click the Object icon. This brings up all the properties of the object; you can transform the object by changing its properties in the Location, Rotation, and Scale tables, as shown below:



A note about measuring distance in Blender: distance in a 3D space is entirely relative. Blender measures distance by using Blender Units which corresponds to one grid space in the 3D viewport.

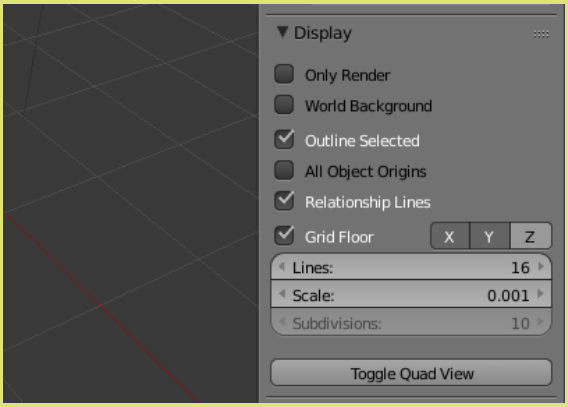
If you're a stickler for traditional measurements, you have the option of switching to Metric or Imperial measurements. Simply select the Scene icon in the Properties panel, then select your desired measurement system as shown below:



For the purposes of this tutorial, any instructions involving measurements are given in millimeters. Select Meters, length Metric and Unit Scale 0.001

Note

The grid floor unit is independent from the scene settings. In order to have the same unit and scale go to the Property Panel > Display > Scale to 0.001 and Lines to 100. In case Properties Panel is not displayed, use either the top right + sign or the N shortcut to make it appear.

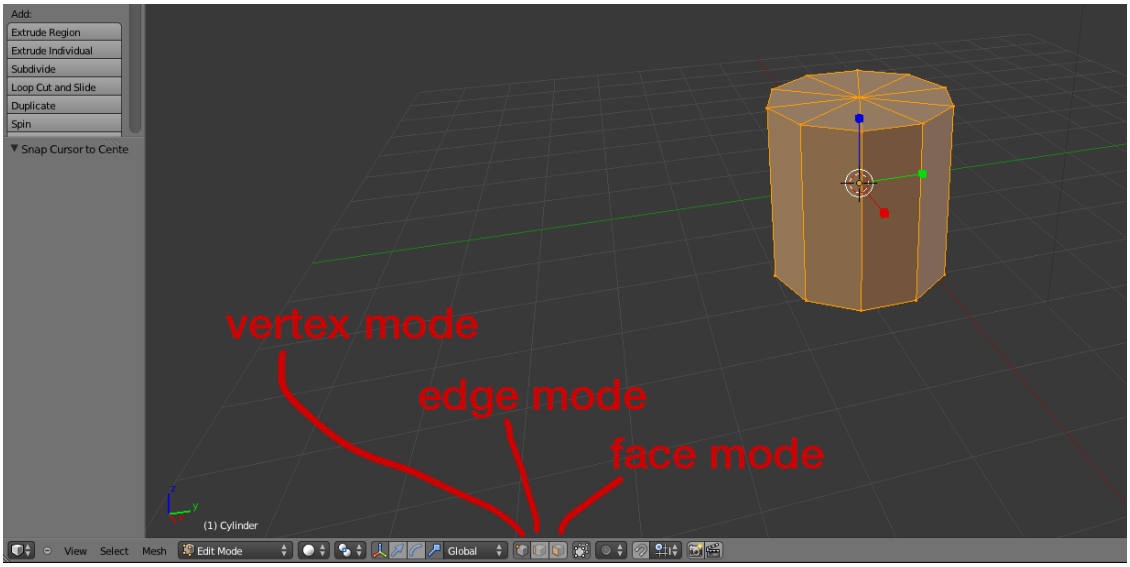


That covers most of what you can do in Object Mode. Now it's time to edit the vertices, edges, and planes of the object — you'll do that in Edit Mode.

Step 5 – Editing Objects in Edit Mode

To enter Edit Mode, select the object to be edited and press →|.

You'll see that the object turns yellow and all of the edges highlight. Look down to the bottom toolbar, to three icons that show little cubes. These icons tell you which select mode you are in: Vertex mode (left icon), Edge mode (middle icon), or Face mode (right icon), as shown below:



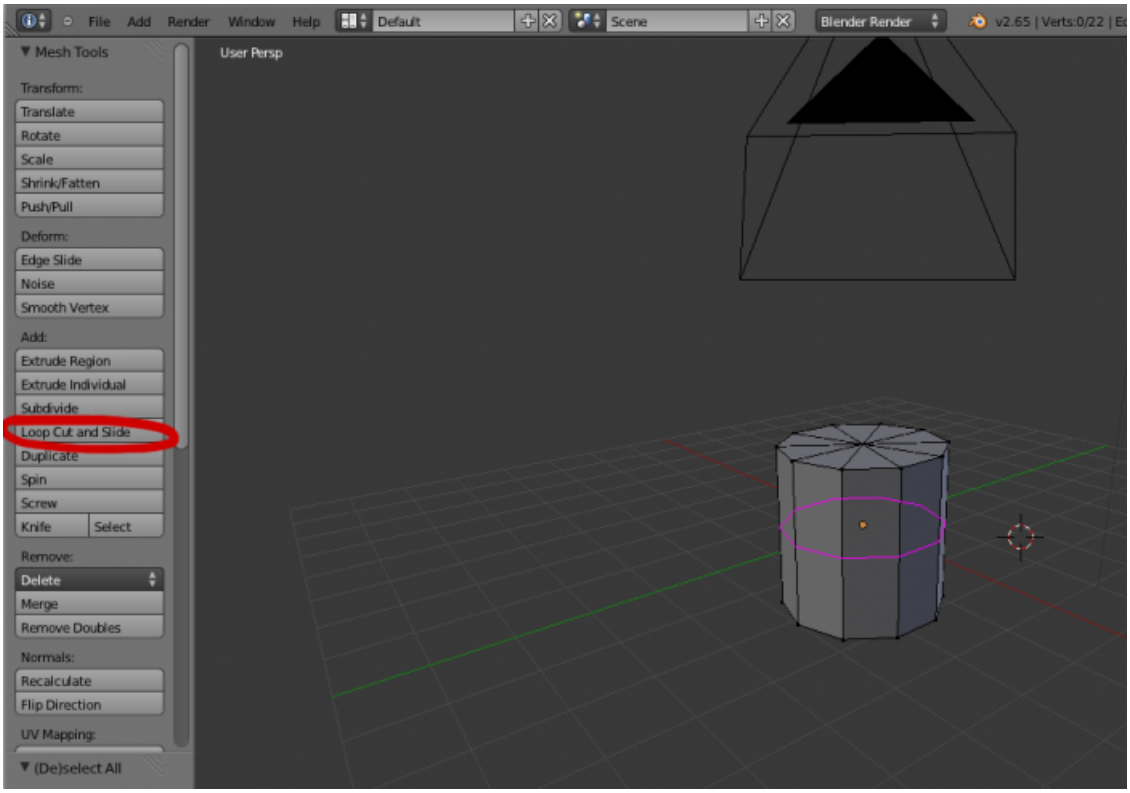
At the moment, you're in Vertex mode, with everything in your object selected. Press the A key to deselect everything.

Move your mouse over a vertex and select it with the left mouse button. Hold down ⇧ to select multiple vertices. Press A again to deselect everything.

Loop Cut and Slide

At the moment, your object doesn't look much like a mushroom, does it? Before you can deform your cylinder to look like a mushroom, you'll need to add a few more segments to your object.

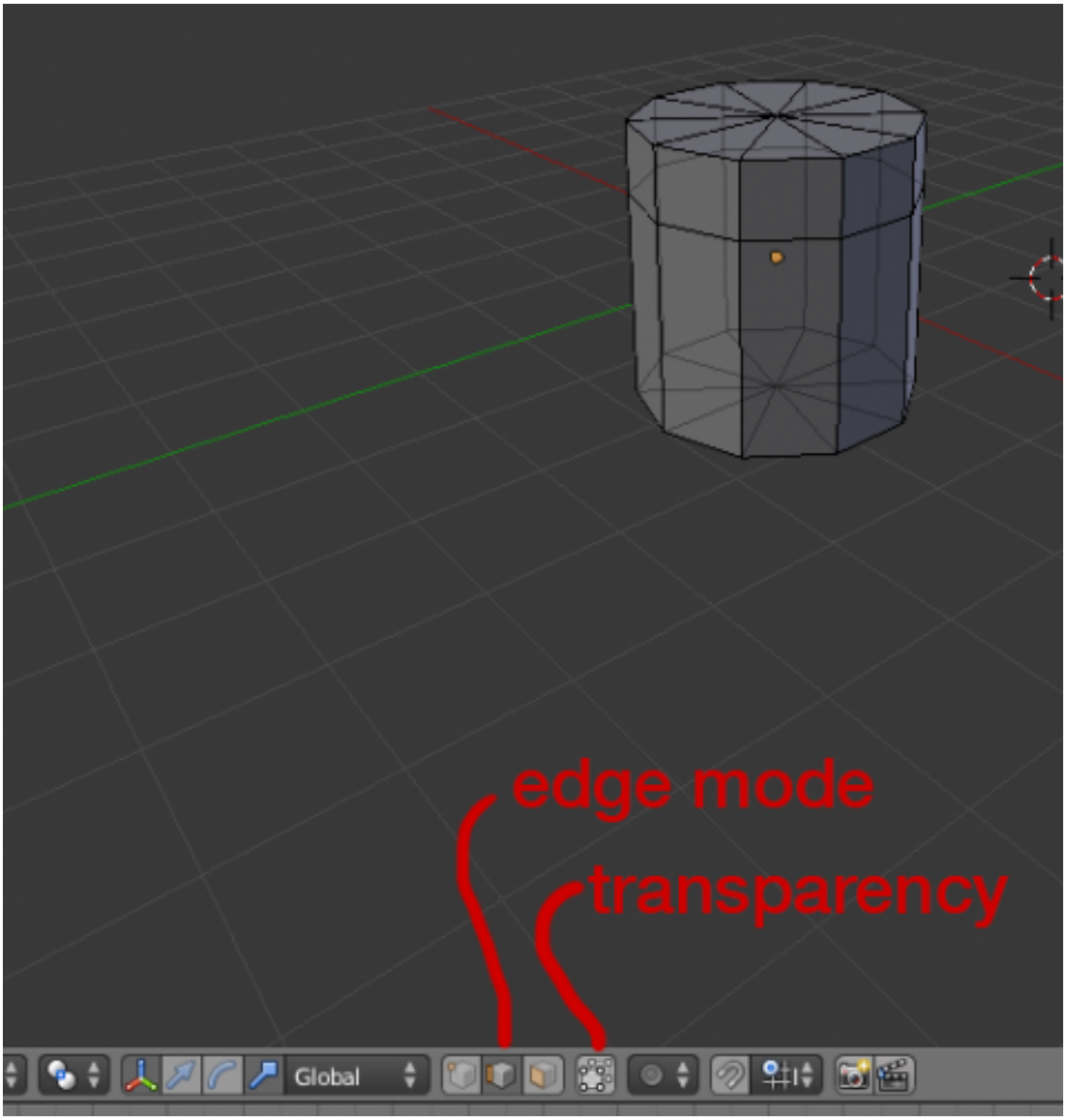
To add segments, locate the Loop Cut and Slide function on the left-hand side of the screen, as shown:



Move your mouse over your cylinder, and you'll see a purple edge ring show up midway down the cylinder.

Click the left mouse button once; the purple ring turns yellow indicating that the vertices are selected and movable. As you move your mouse, and the ring will follow. Click the left mouse button once more to place the ring about 2/3 of the way toward the top.

Now press the A key to deselect all objects in your view. If you don't like where the loop ended up, you could use ctrl/ ⌘+ Z to undo the action. Alternatively, you could move the loop to a different location. To do this, first click the Edge mode icon and the Transparency toggle buttons as shown below:



This puts you in Edge mode where you can select the edges of your objects; turning on Transparency mode lets you "see through" your object so that you can see all of the edges.

Step 6 – Selecting Vertices, Edges, and Faces

You could select the edges to be moved by clicking them with ⇧ and right mouse button, but that can be cumbersome when you've got a lot of edges to select. Fortunately, there are three options for selecting edges.

Box Select

Box select allows you to draw a box around the items you want to select.

Move the view (using the middle mouse button) so that you can see the loop you want to select. Now press B for Box Select mode, hold down the left mouse button and draw a box that encloses the edges you want to select. Move the view around the object to make sure you got all of the edges you wanted to select. If not, ⇧-select the remaining edges.

Circle Select

In addition to Box Select, you can use Circle Select, which is just as it sounds: selecting with a circle instead of a box.

Deselect all with the A key. Now press C for Circle Select. The dotted white circle indicates the selection area in use. Scroll up or down to increase or decrease the radius of the selection circle;

Once your circle encompasses the edges you wish to select, click the left mouse button to select them. Now press the left mouse button to select . You can continue to left-click to add to your selection. When you are done, press the right mouse button to exit circle selection mode.

Lasso Select

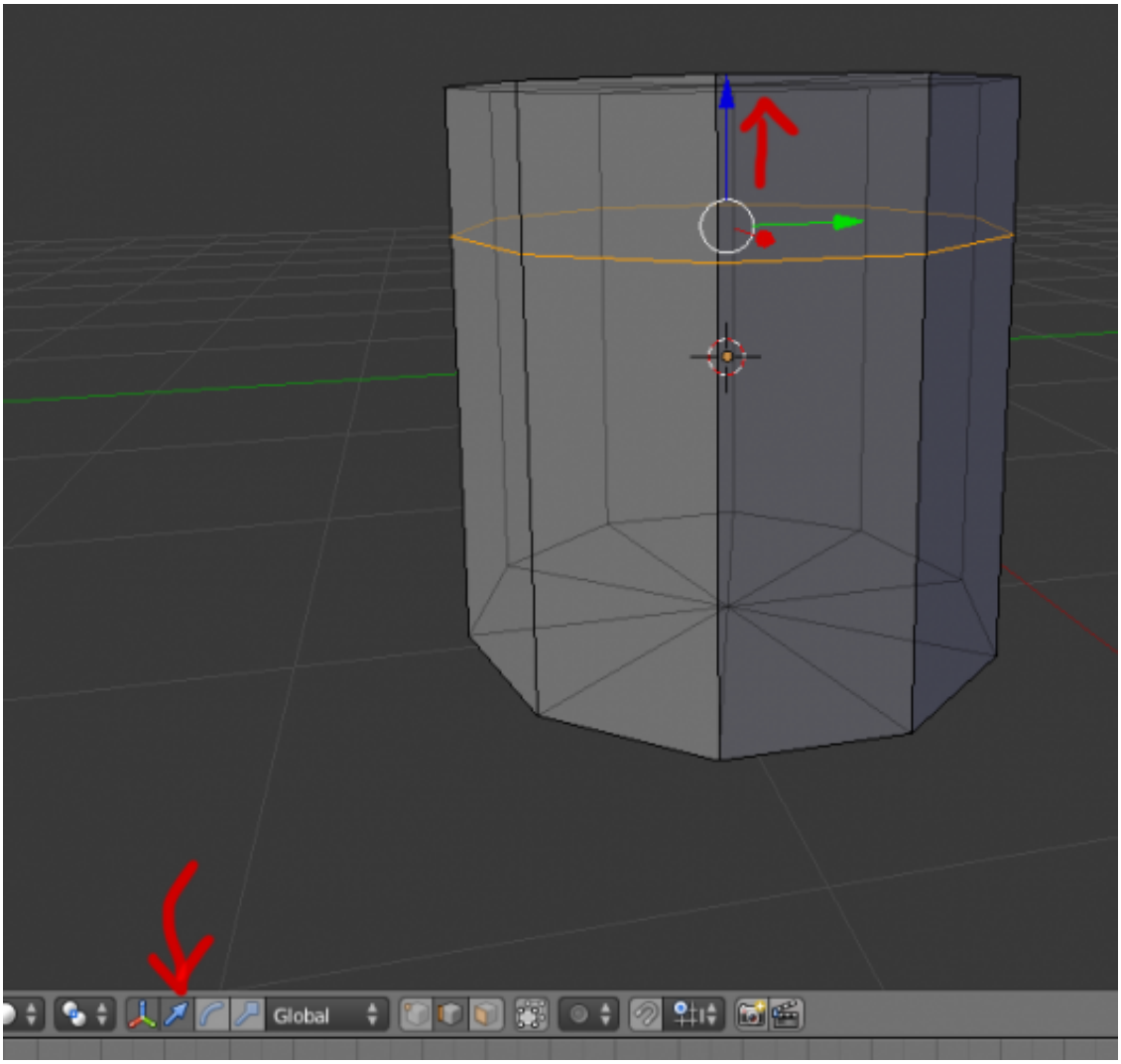
Lasso Select is probably the option that you'll find most useful.

Press A again to deselect all. Now hold down ctrl and press the left mouse button. Drag the cursor around; you'll see a dotted white outline around your selection

Step 7 – Transforming Edges, Vertices, and Faces

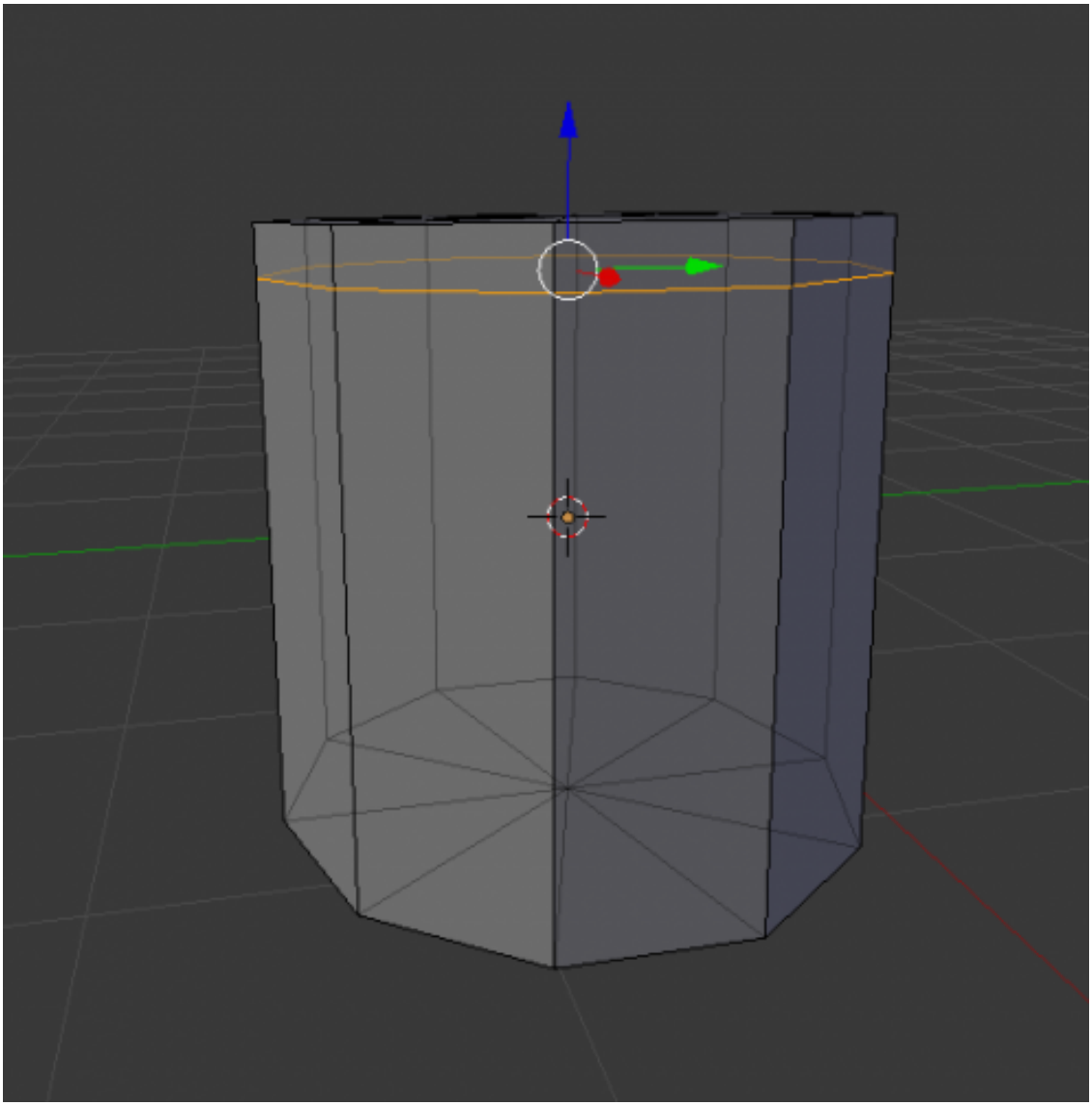
Transforming edges, vertices, and faces is very similar to transforming the entire object: you can do it by using the transform handles, the shortcut keys, or the properties panel.

Go down to the bottom toolbar and click the Translate manipulator — the little arrow icon next to the red, blue, and green axes icon — as indicated below:

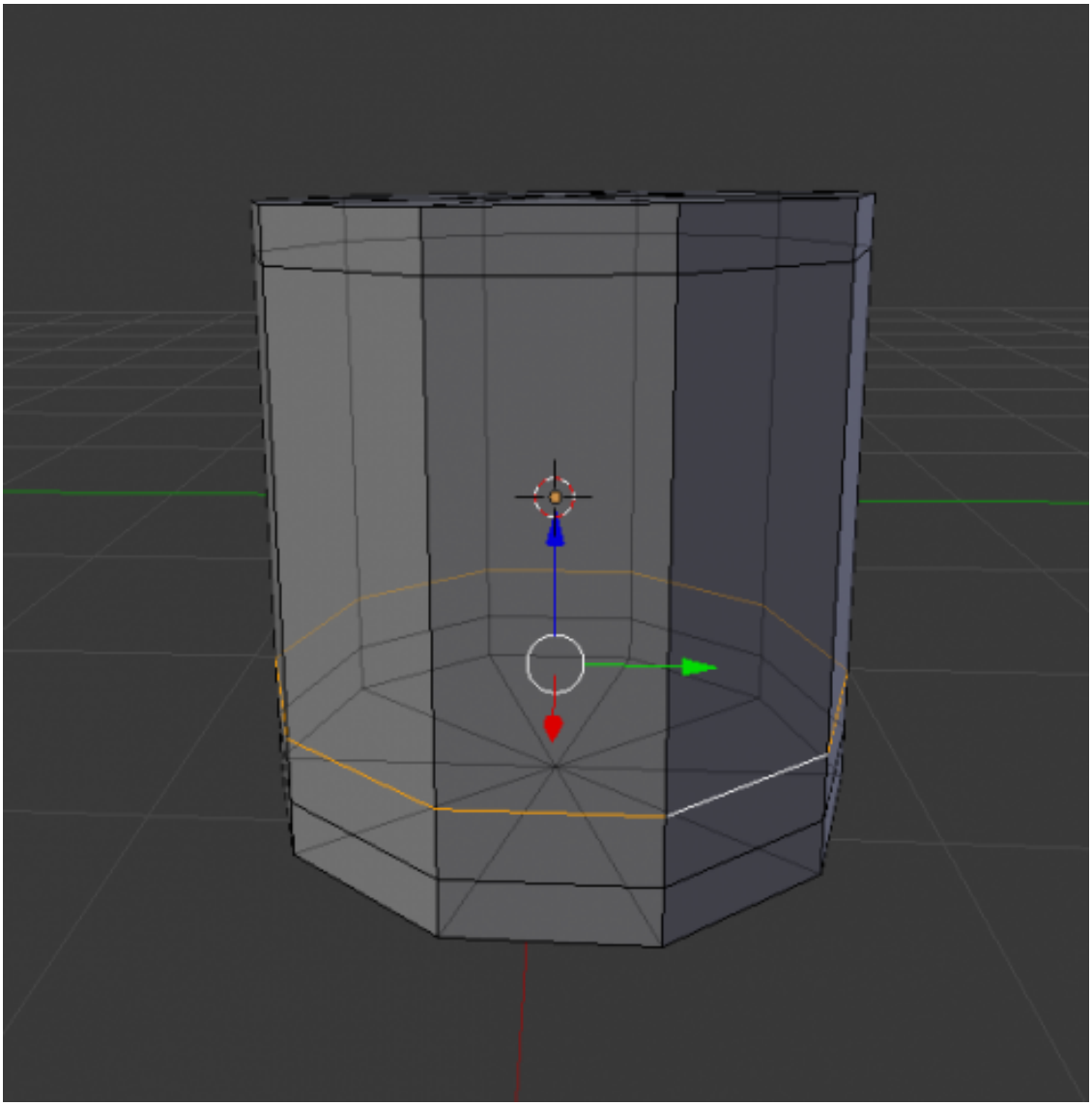


The other two icons are for Rotate and Scale.

Click and drag the blue arrow (i.e., the Z-axis) to move the selected edges up. Release the mouse when they are near the top, as so:

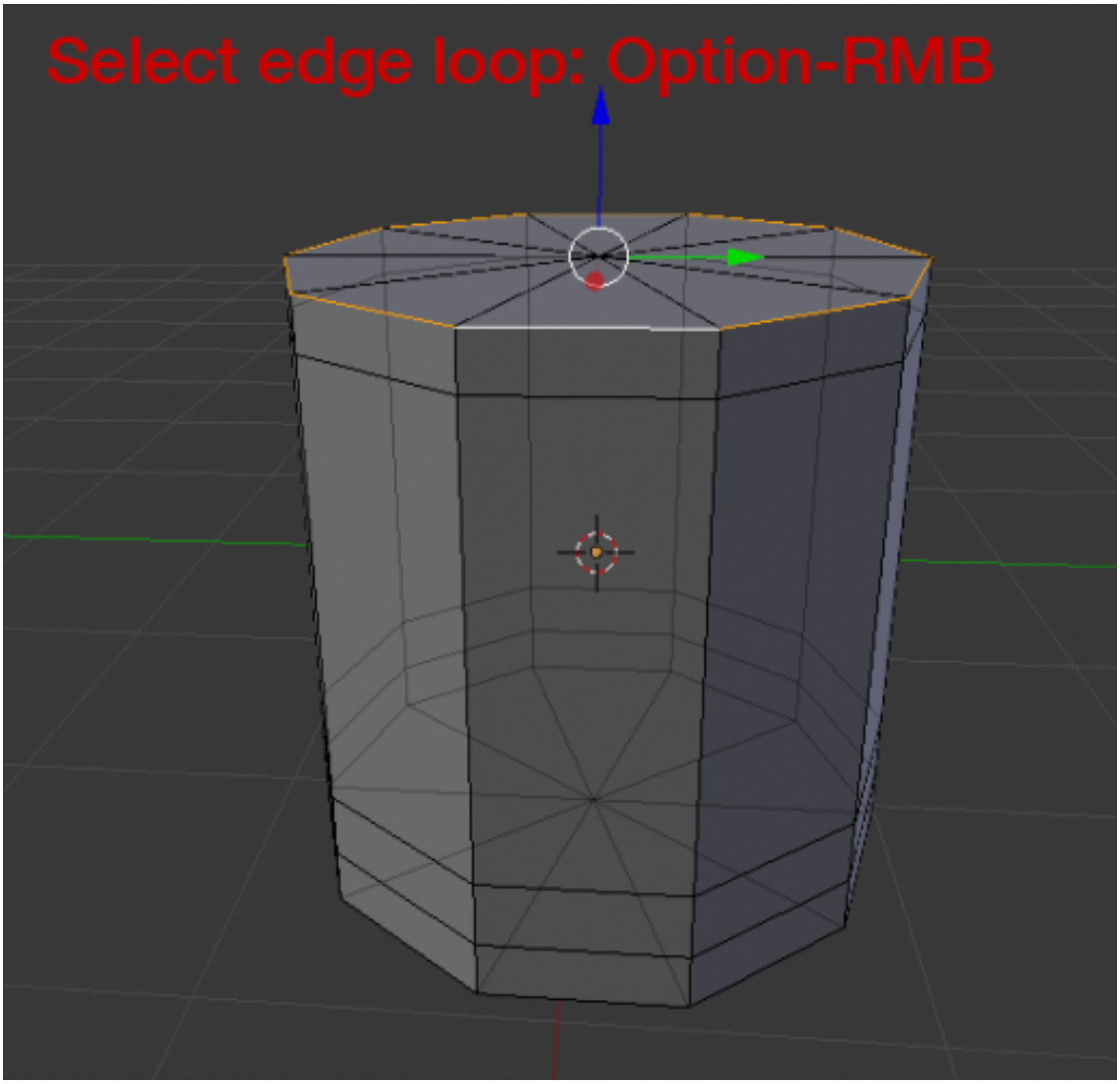


Add a bit more detail to your cylinder by performing Loop Cut and Slide functions. Place these new loops toward the bottom of your cylinder, as shown below:

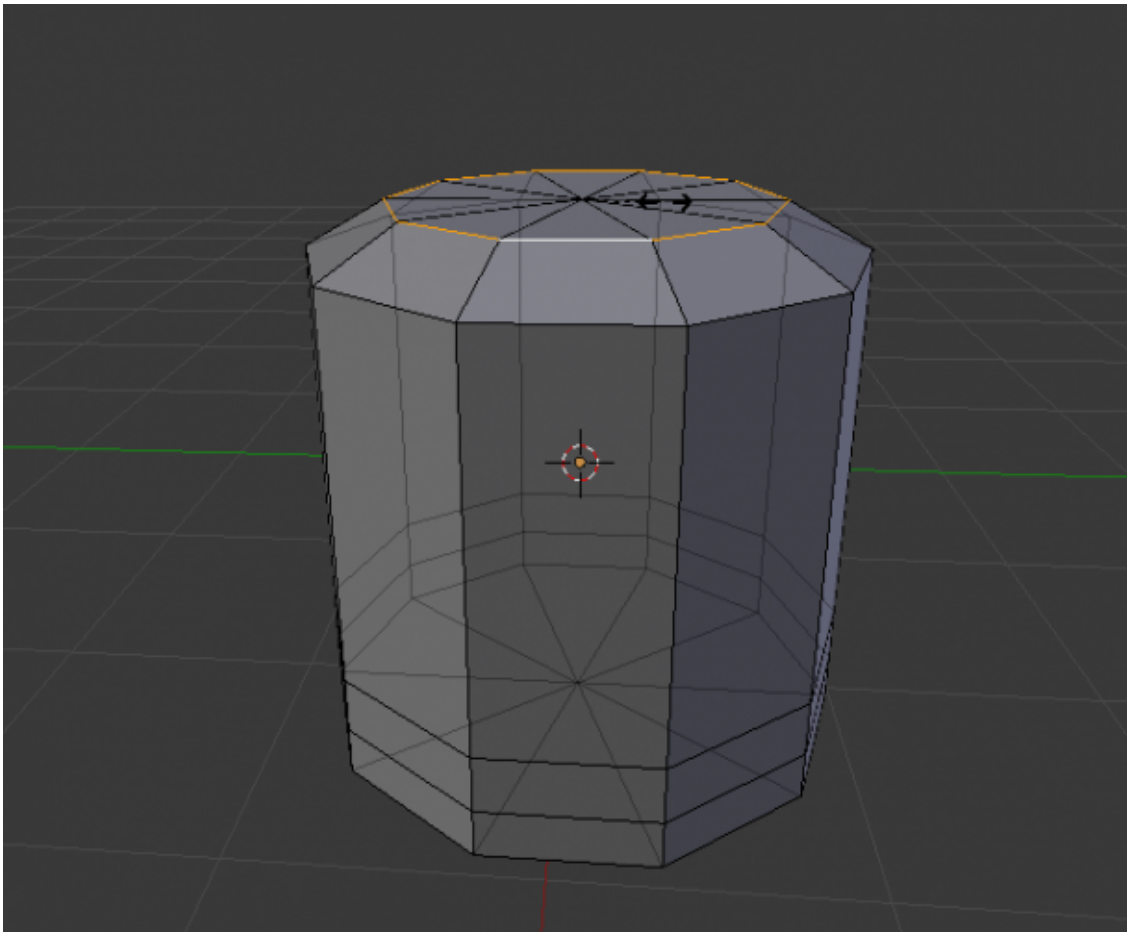


Now it's time to alter the edges and faces to create the top of your mushroom!

You're going to be selecting edge loops a lot; luckily, there is a shortcut to selecting them. Hold down Alt (or ⌥), and click the right mouse button on one of the top edges of the cylinder. This selects the entire loop that contains the edge that you click on, as below:

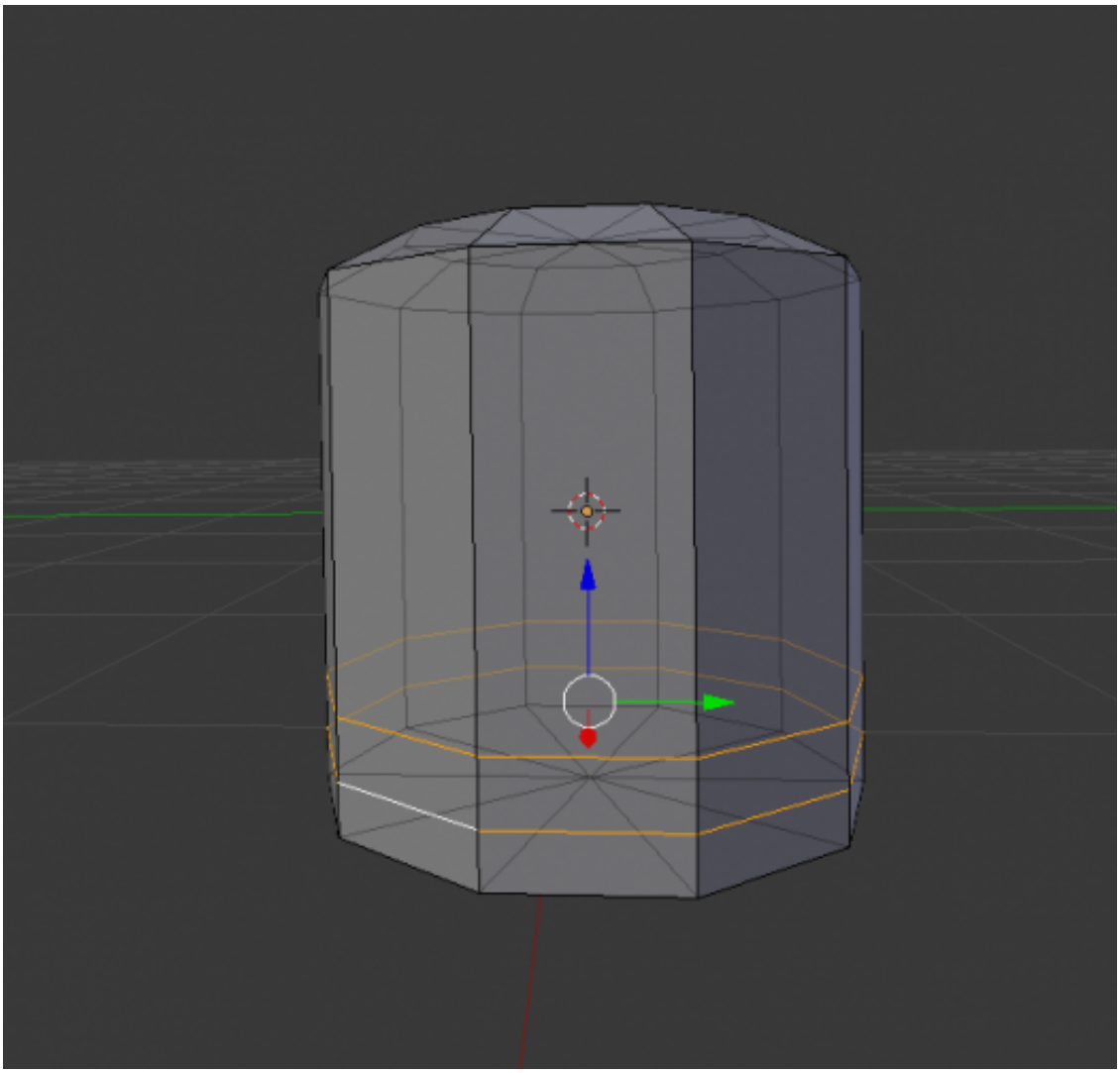


You'll want to scale these edges down to create the top of your mushroom. Press S to scale the edge loop, and drag the mouse so that the edge loop is a bit smaller, as below:



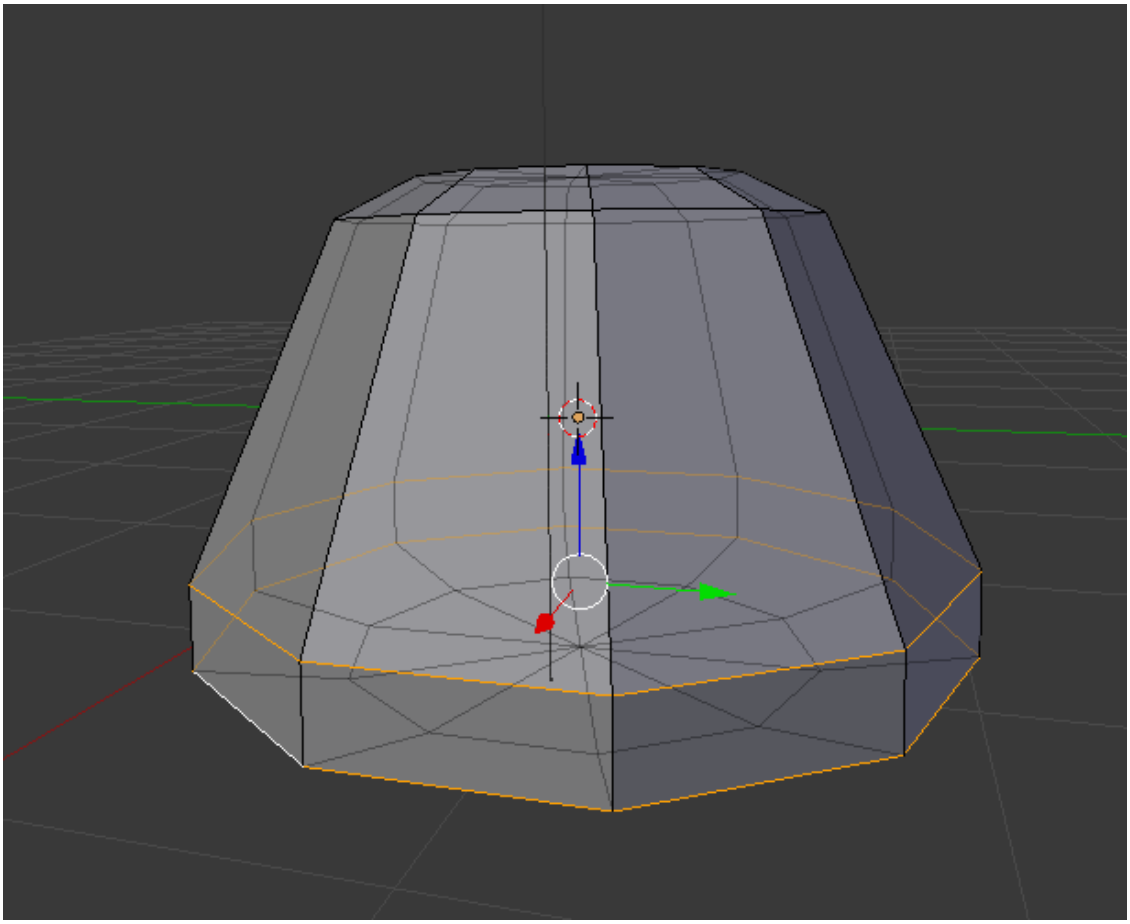
Click the left mouse button to confirm the transform.

Now you need to make the bottom edge of the top part of the mushroom larger than the top. Select the two inner edge loops near the bottom of the cylinder by holding down ⇧+ Alt and clicking the right mouse button, as below:



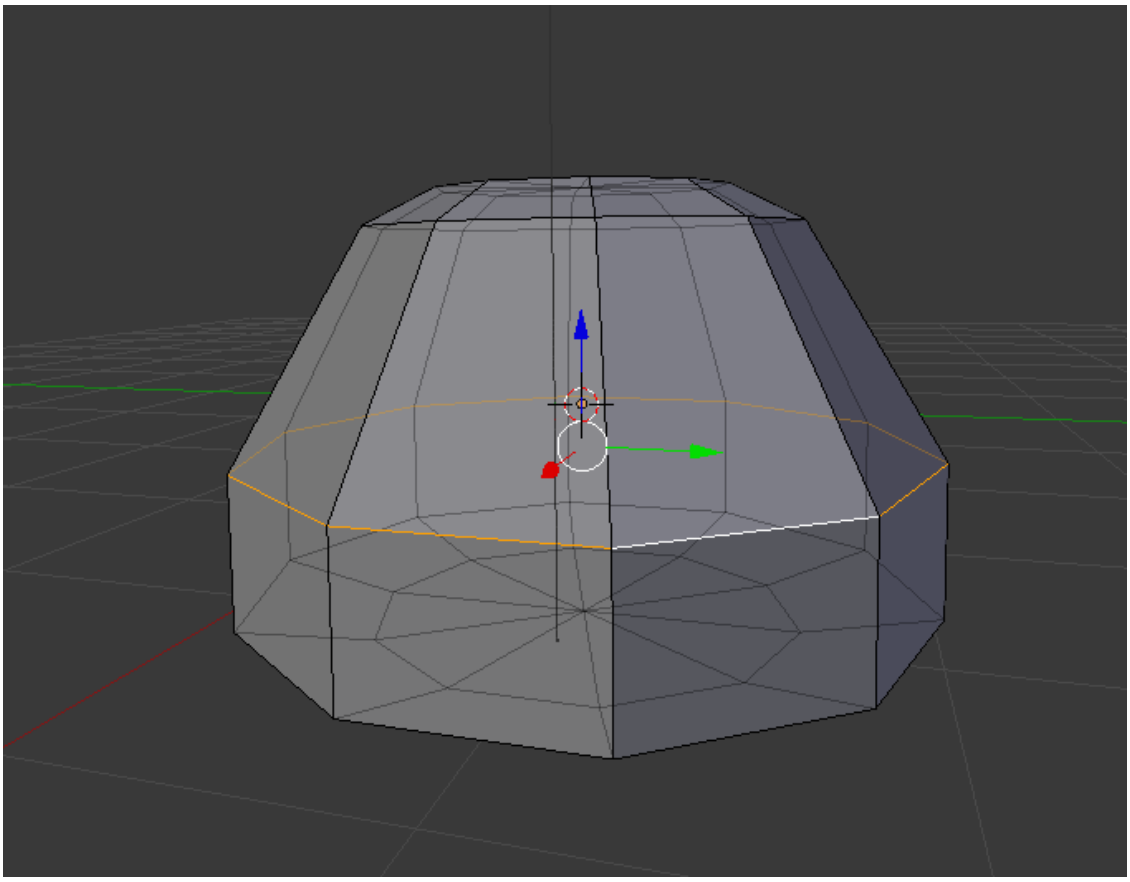
Be careful to select only the very bottom edge of the cylinder.

Press S to scale, and move the cursor away from the center to scale the bottom edges up, as shown below:



Click the left mouse button to confirm the transform.

Now you need to make the lower edge of your mushroom look a little thicker. Press A to deselect everything, and then select just the upper edge loop using Alt + right mouse button. Drag up on the blue arrow to transform it, as shown below:



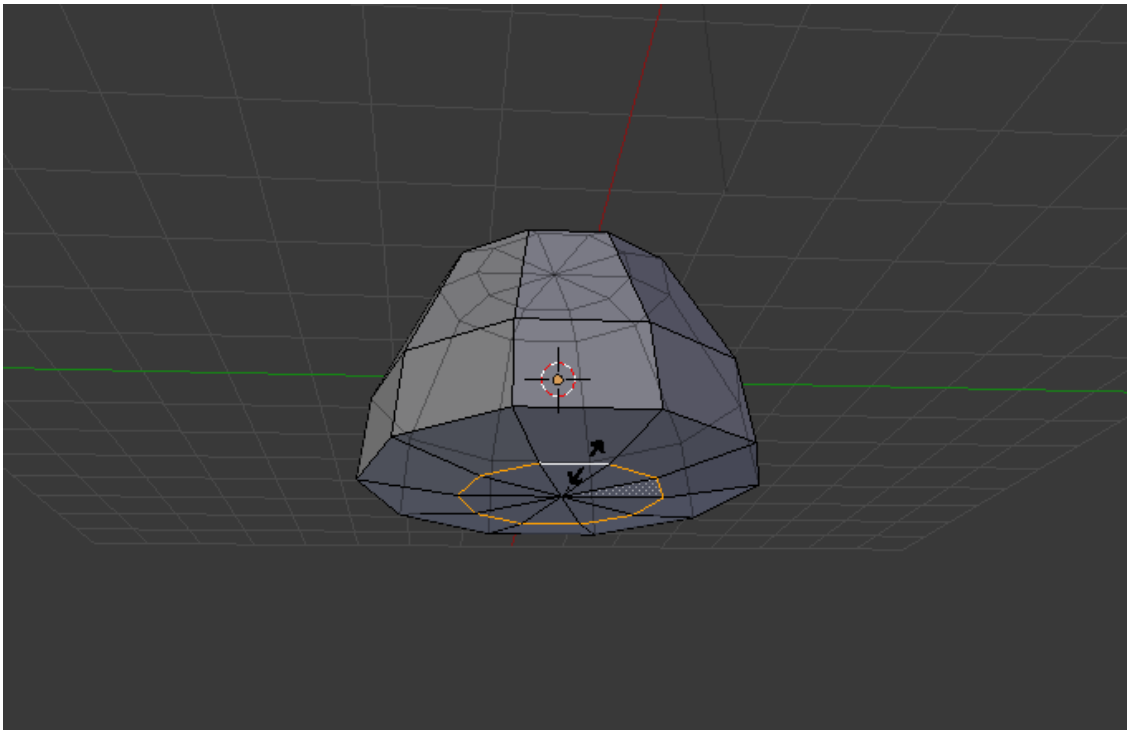
It's looking more like a mushroom now! Scale the currently selected edge loop a bit to round off the mushroom a little. Press S to scale, and pull the edge loop in just a bit.

Step 8 – Using the Extrude Transform

Your mushroom head is looking pretty good; but every good mushroom needs a stalk! You'll do this by using the Extrude feature.

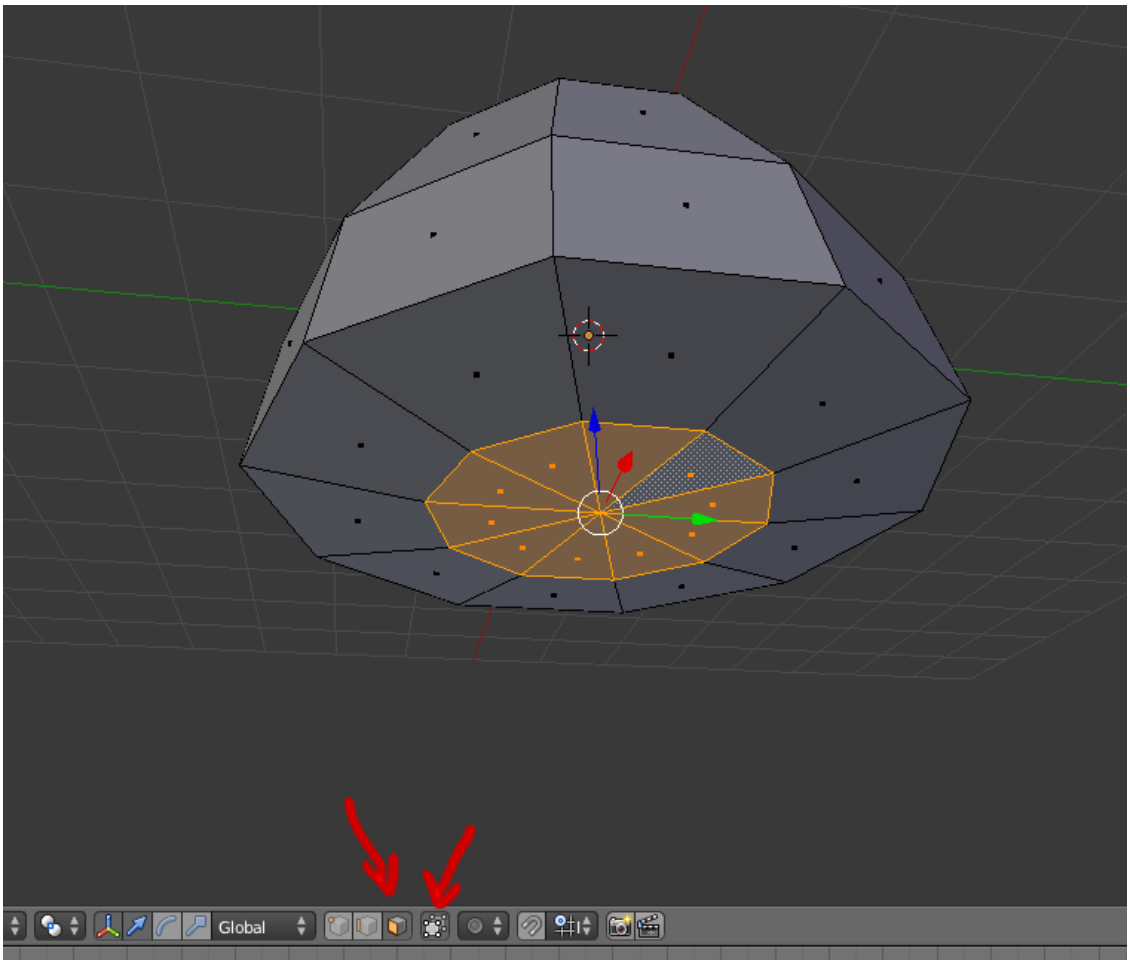
Move the view around so you can see the bottom of the mushroom head. If you need to pan downwards, hold down ⇧ while scrolling.

You're going to create the stalk by extruding the bottom faces of your mushroom head. Before you do that, you'll need to scale the bottom edge ring so that your stalk won't be as thick as your mushroom. Select the edge loop, press S to scale, and scale the bottom ring in to about half the size of the mushroom head, as shown below:

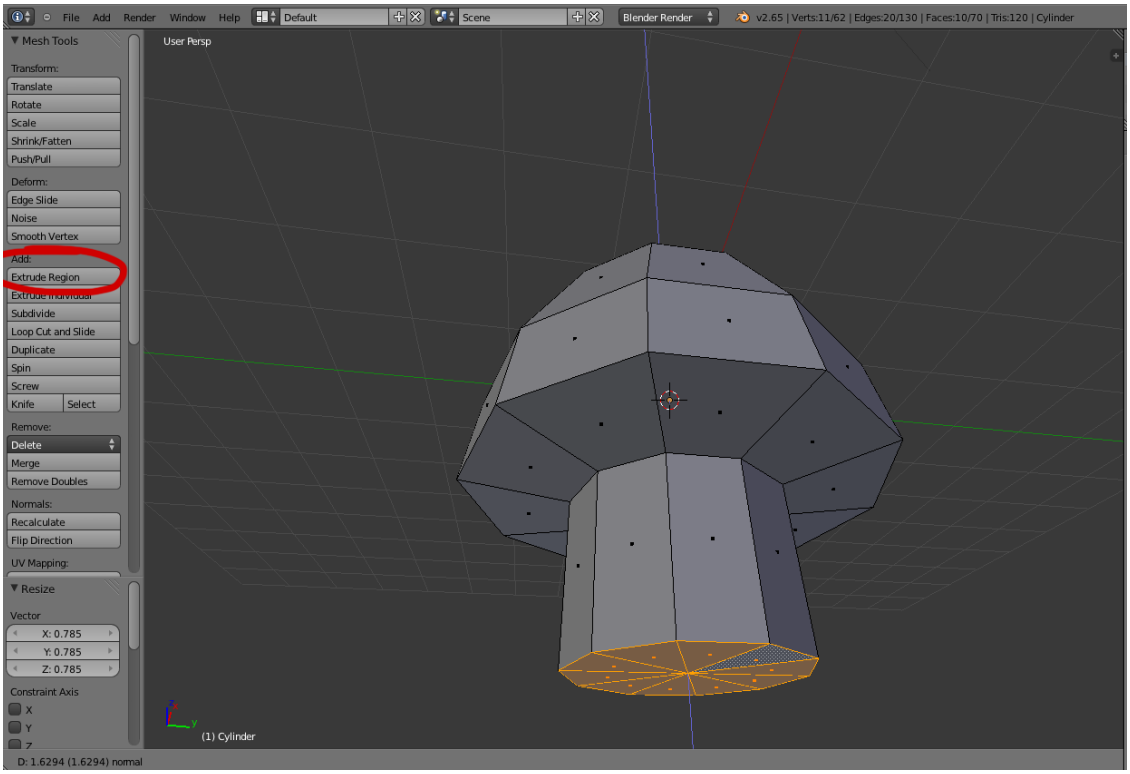


Click the left mouse button to confirm the transform.

Now, switch to Face Select mode by clicking the Face Select icon. Turn off the Transparency toggle icon so that it's easier to see what you are selecting. Hold down ⇧ and click the right mouse button on each of the ten faces that form the bottom of the mushroom head, as shown below:

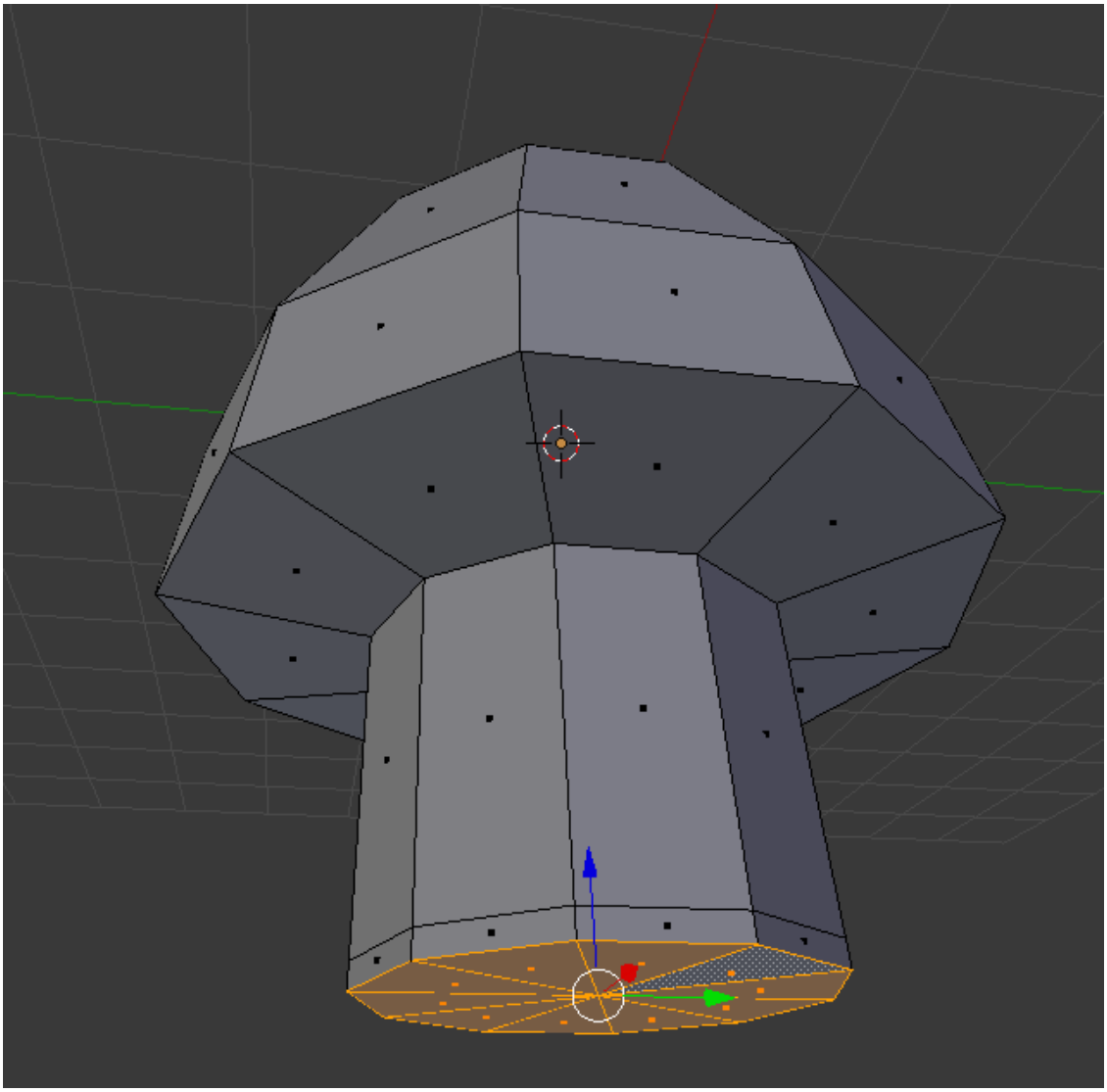


Go to the left tool panel, and click on Extrude Region. As soon as you do so, your mouse movement extrudes those faces. Using your mouse, extrude the bottom face to a reasonable length for a mushroom stem, as shown below:

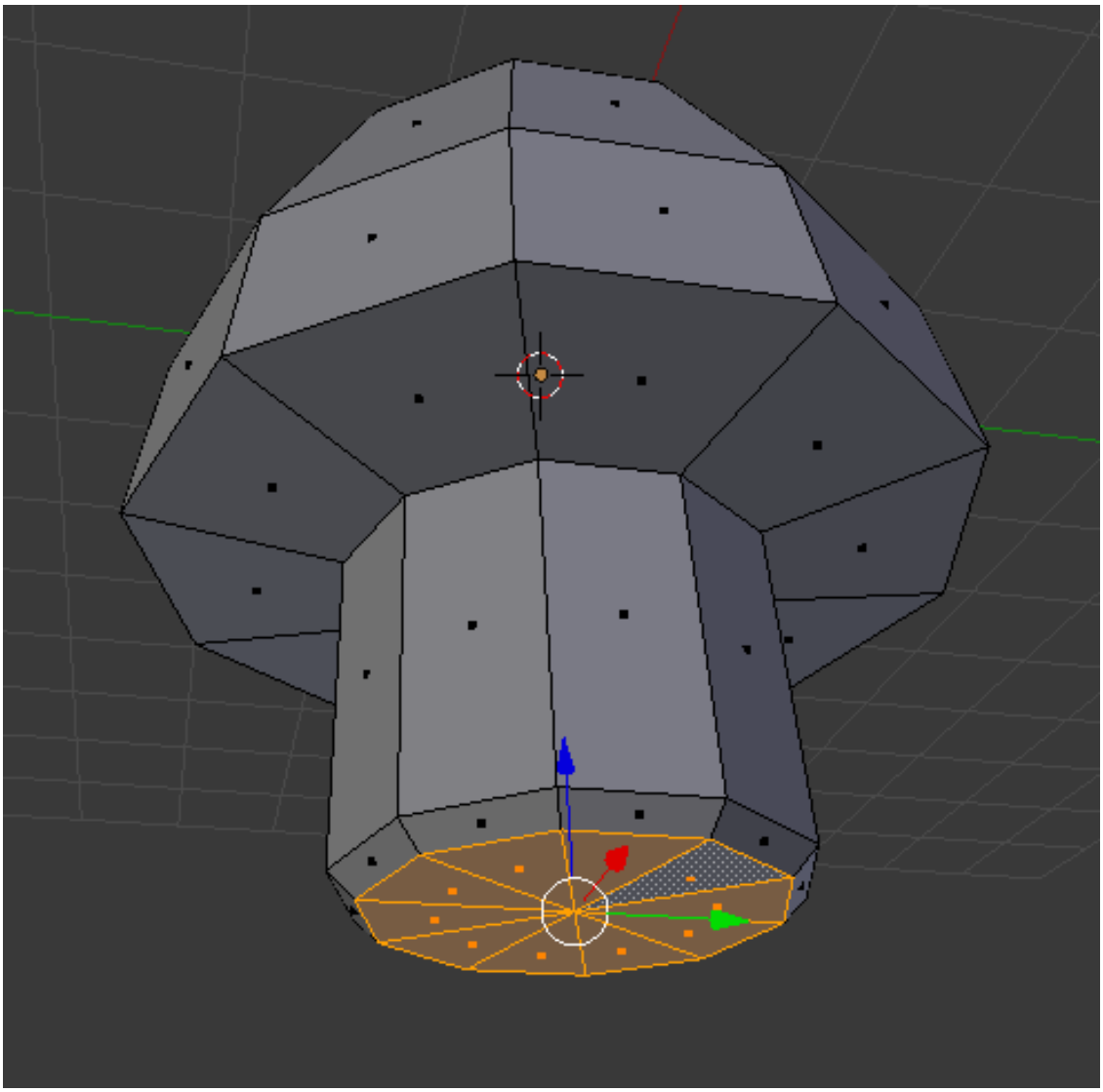


Click the left mouse button to confirm the transform.

Extrude the faces one more time, so that you can create the rounded bottom of the stalk. Click Extrude Region, and extrude the faces just a little bit, as shown below:



Click the left mouse button to confirm the transform. Now scale the faces inward. Your mushroom should look like the following fine specimen:

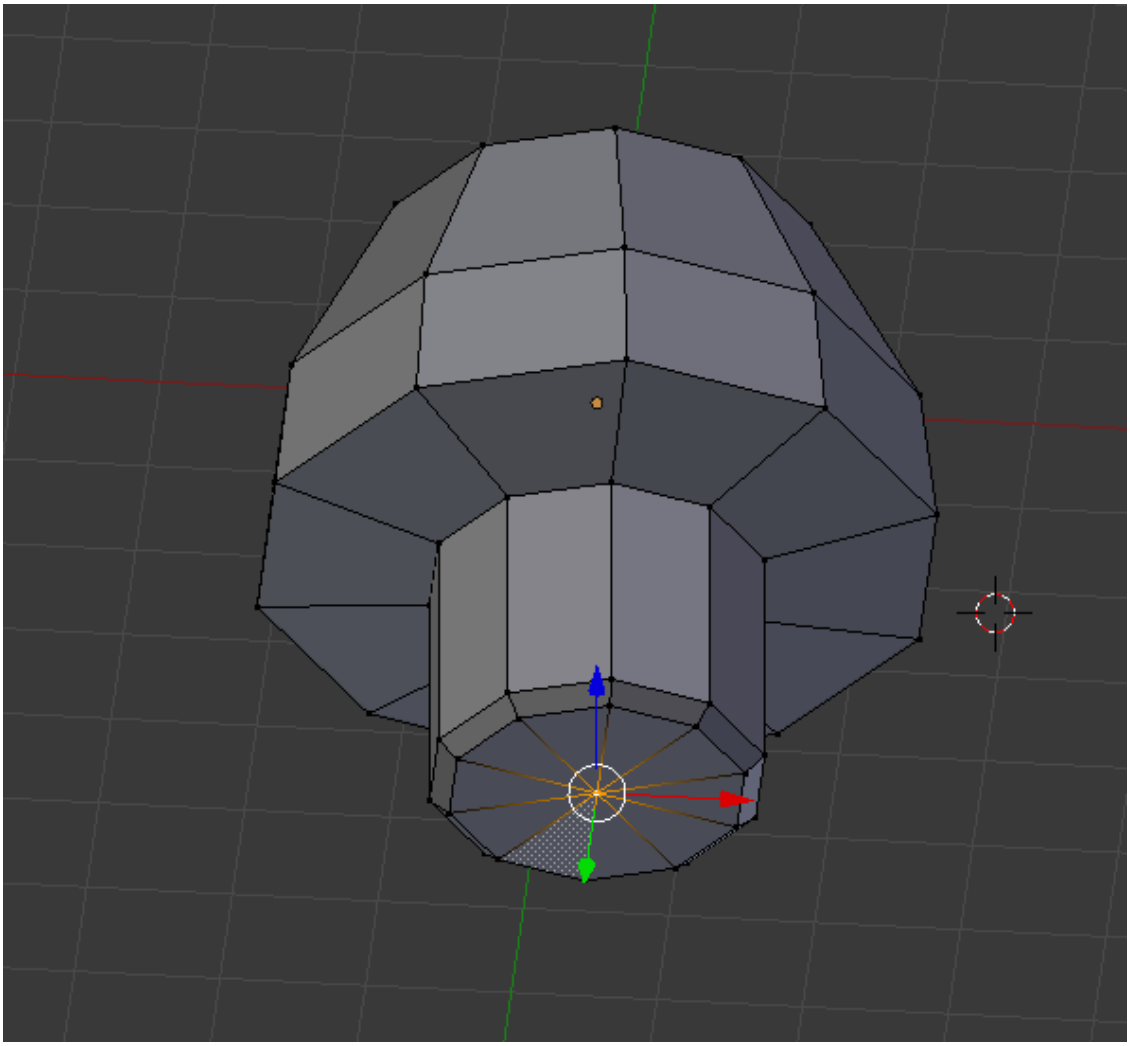


Step 9 – Changing the Object Origin

Your mushroom is sprouting up nicely! However, at the moment your mushroom is not exactly sitting on the ground; it passes through the XY plane. You'll need to move your mushroom upwards a little bit to have it sitting properly on the XY plane.

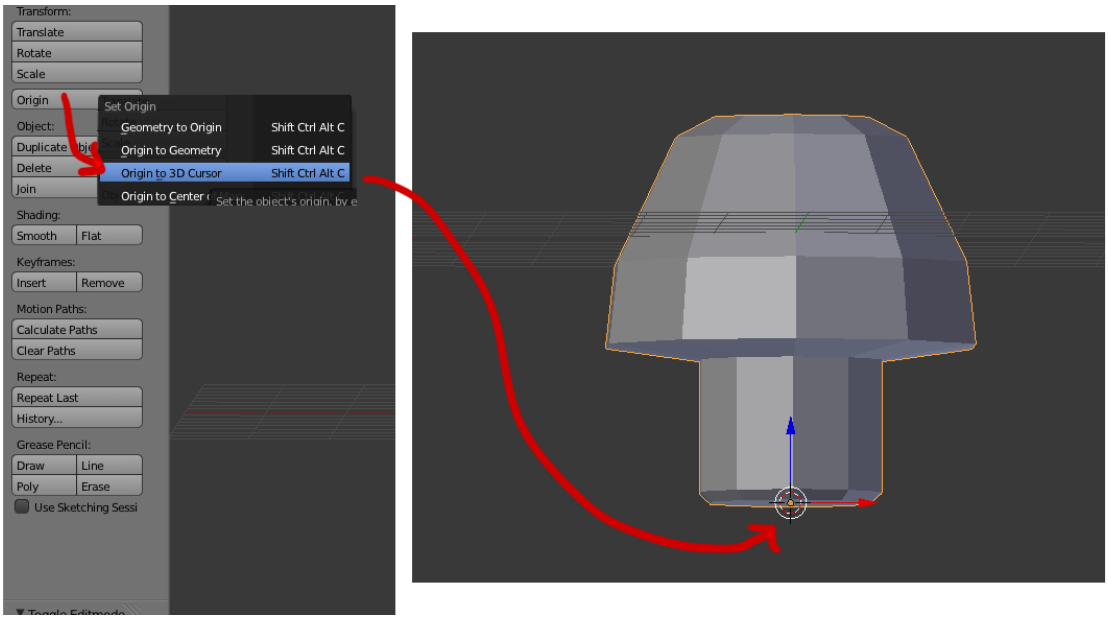
In order to get it placed properly, you will first place the 3D cursor at the base of your mushroom (at the center of the bottom of the stalk), and then move the object's origin to the 3D cursor location.

To do this, hit the A key to deselect everything. Next, switch to vertex select (by clicking the button in the bottom toolbar), and select the center bottom vertex in the stalk, as shown below:



Now press ⇧- S and choose Cursor to Selected. The 3D cursor will move to the vertex that is selected. Hit A to deselect all.

Hit →| to switch to Object Mode. Notice how the red, blue, and green object origin is up on the XY plane. You want to move the object origin down to the location of your 3D cursor. Go to the tool shelf and choose Origin » Origin to 3D Cursor.



Now you can move the object by placing its origin at the coordinates (0,0,0), which will put your mushroom's base squarely on the XY plane. Go over to the Object tab, and change the Z value of Location to 0. Well Done!

You are now free to design your own model that you can import as a virtual object (instead of the cylinders) as .obj files or to print the object and interact with it as a tangible obstacle. To prepare a model for 3D printing, follow carefully the guidelines provided in the `Week6 - 3D printing assignment sheet`.

Optional: Texturing

You want to add color to your mushroom? Follow the tutorial at `https://www.raywenderlich.com/49955/blender-tutorial-for-beginners-how-to-make-a-mushroom/`

Other Resources and Credits

Here is a list of videos we recommend to watch if something is not clear or if you want to know more about Blender modeling. Videos can be found at `https://vimeo.com/channels/blendervideotutorials`

- 01-03 - 3D Editor Viewport Window Viewport Window
- 01-06 - Blender Controls
- 01-07 - Mesh Modeling Modes And Viewport Shading
- 01-08 - Blender Grid - Blender Units And Scale
- 01-11 - Selecting In Object Mode
- 01-12 - Moving Objects

- 01-13 - Rotating Objects
- 01-14 - Scaling Objects
- 02-01 - Adding Mesh Objects In Edit Mode
- 02-04 - Undo - Redo
- 02-06 - Global And Local Orientation
- 02-07 - Center Point Object Origin
- 02-08 - Pivot Points
- 03-06 - Subdivide
- 03-07 - Loop Cut And Slide
- 03-08 - Knife Cut
- 03-09 - Rip Tool
- 03-11 - Extrude Part 2
- 03-12 - Spin
- 04-04 - Joining Objects
- 04-05 - Separating Objects
- 08-01 - Array Modifier
- 08-02 - Bevel Modifier
- 08-03 - Boolean Modifier
- 09-07 - Cutting A Hole Out Of A Curved Surface
- 12-01 - UV Textures Part 1 - Unwrapping UVs
- 12-04 - Sculpt Mode

Mushroom Tutorial
`https://www.raywenderlich.com/49955/blender-tutorial-for-beginners-how-to-make-a-mushroom/`