User Manual

for Blender

2019 Edition

3D Modeling

and

World Building

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For: Computer Software Documentation (COM 400)

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3D Modeling in Blender (2019 Edition)

Introduction

This document is detailed for new users who have never experienced Blender before. As well as for those with little computer experience. The various ways and processes in using the tools will be avoided. This document will focus mainly on finding the necessary tools, and using the basics of them to reach the required result.

Using 3D Meshes

Startup

Upon starting Blender, you will be able to access multiple features on the **user interface**. The one feature we will be using is the “Add” tool. Confirm that you are in the “Layout” menu by selecting it towards the top left of the screen following the “Help” button. You should already load in to the “Layout” screen when starting up Blender.

You should be greeted with the current layout, in which you can see the 3D plane you’re working in, a cube, a camera object, and a light object. You can manipulate these objects by locating them in the “Scene Selection” over on the top right. If you so choose, right click the objects to delete them from the layout and you can start fresh.

Adding 3D Meshes to Your Layout

Your next step would be to select the “Add” button on the top left of the layout screen. Once you select the button, a **drop-down menu** will appear with options to add these objects to the layout. Select “Mesh”, and you can choose what shape to add (ex. cube, cylinder, cone).

Moving Your Mesh

Before you can begin editing your mesh, you must be able to move it around the layout. To do this, select your object by clicking on it once (it should be highlighted now), then over on the top left side of the layout screen is a **toolbar**. Select the “Move” option, which should be an icon of four arrows pointing in four directions.

Now your mesh should have three different colored arrows that represent the mesh moving in the **X-Axis**, **Y-Axis**, and **Z-Axis**. You can hold each distinctive arrow and move it in your desired location in the layout. The same principles apply if you choose movements such as “Rotate” or “Scale” in the **toolbar**.

Moving Your View

You might’ve discovered some difficulties with the view of the layout while moving your mesh. Such as you lost your mesh and can't find it on the screen. To move your view in accordance to your mesh, you can use any of these three methods:

The Axes - On the top right of the layout screen, there is a model of the three axes in the same color to the arrows that appear when moving the mesh. While holding the left-mouse button on the axis of your choosing, you can then drag the mouse in the direction you desire. The axis diagram is somewhat like a circle, so you can drag each axis around in a circular motion. This will change your view angle in the layout.

Zoom - Just under the axis diagram, there is an option to zoom in and out. While holding down the icon (a magnifying glass with a plus in it), you can move your mouse forward and backward to zoom in or out.

Move - Under the zoom tool is a hand icon. While this icon is held down, you can move the layout view in a two-dimensional fashion, being up, down, left, and right.

Basic Manipulation of Meshes

Changing Viewports

An important part of 3D modeling in Blender, is manipulating **viewports**. **Viewports** are used to view your layout in different ways. These **viewports** can be found directly to the left of the words “Scene Selection”, and the icons are four distinct circles. Each **viewport** is different:

Wireframe - All objects are now seen only through their outlines. The faces of your meshes are unviewable here.

Solid Mode - As you’d expect, your meshes are now solid and you can see the faces.

Material Preview - This will be important later. It allows you to see a preview of your object with any material/textures that you’ve given it.

Render Preview - This is very different from material preview. This is because even though you can see your mesh rendered fully, this view takes into account EVERYTHING in the layout. If your layout has only a mesh and no light objects, this viewport will make your mesh seem jet black in camera view. This is because the layout is essentially a ‘dark room’, so you would need a light in the layout to see the object in full effect. This will be referred to again later in the document.

Editing Your Mesh’s Materials

‘Materials’ are what your mesh is made out of. In particular, your mesh already has a basi material on it when adding it to your layout. To edit the material, you would go to the panel on the right just under the “Scene Selection”. There are many options on the **toolbar**, but for this we’ll focus on the icon that looks similar to a beach ball. This is the “Material Properties”.

From here, you’ll have many options as to how you’d like to edit the material on the selected object. You’ll have options to change the mesh’s color, metallic finish, and more.

Note, that when changing colors/materials, you’ll be able to view the changes ONLY in the “Material Preview” and “Render Preview” viewports.

When working with your materials, you can pull open the “Preview” **drop-down menu** to reveal a preview of your material. To add another material, select the plus sign to the side of your material name (should say ‘Material’ if you haven’t renamed it), and select “New” when it appears. To delete a material, select the material you want to remove and select the minus sign.

Many of the options available to edit materials can interfere with one another and cause an undesired material. Be sure to understand what each option can do individually BEFORE combining multiple options.

When creating a second material, you may notice that it won’t appear. To add your other materials to your mesh, you’ll have to enter “Edit Mode”. To the far left of the “Add” button, you’ll find it says “Object Mode”. Select this and another **drop-down menu** will appear where you can select “Edit Mode”. In this mode, that is detailed in later pages, you can edit specific faces of your mesh.

Vertices will appear on your mesh that differentiate the faces. Hold your left mouse button, and go over the four **vertices** that make up the face you’re trying to edit. Once they’re selected, you may return to your materials, and select the one you want that face to have.

Then click “Assign” just under your material names. Now your face should have the material you selected while keeping the other materials.

Editing Your Mesh’s Physicality

Once again, you must open “Edit Mode” if you wish to change the physicality of your mesh. Once there, your **toolbar** on the left has more options available. Each option has its own function like “Bevel”, “Extrude Region”, and the “Knife” tool. All editing to your mesh in this case will be dependent on the **vertices** you select.

Here’s the editing tools and their basic functions:

Extrude Region - Forcing out selection freely or by an axis

Inset Faces - Inserting new faces into a selected face

Bevel - Cutting into selected items at an angle to create **bevel** or **chamfer**

Loop Cut - Cutting the mesh loop and sliding it

Knife - Cutting new **topology**

Poly Build - Dragging selected **vertices** to transform the mesh

Spin - Forcing out selected **vertices** in a circle around the cursor

Smooth - Flattening the angles of the selected **vertices**

Edge Slide - Slide an **edge loop** along the mesh

Shrink/Fatten - Shrinking and fattening selected **vertices**

Shear - Shear selection along the horizontal screen axis

Rip Region - Ripping polygons (shapes/faces) from the mesh

To understand how to use these functions, skip over to the chapter ‘Transforming Meshes’.

Using One Mesh to Edit Another

Editing faces by **vertices** is difficult sometimes, especially when you need to edit for example a cube, and need to have a hole going through it. One great way to do this is to use another mesh in order to get your result (this can work on any mesh):

To begin, you must start off with your cube mesh that you want to edit, then add another cube mesh to the layout. This newly added cube will be your instrument to create an opening in your main mesh. Let’s call this mesh ‘Instrument Mesh’.

Edit the Instrument Mesh as needed to match the size of the hole you plan to create. If you want a small window for instance, edit the mesh to match the size of the window.

Once you’ve edited your Instrument Mesh, select it, and move it into your first mesh. The size of your hole will be dependent on how far in your Instrument Mesh is within your original mesh.

If you need your hole to go through your original mesh entirely, **elongate** the Instrument Mesh so that it goes through both sides of the original mesh.

If you want to make a hole that goes inward only slightly, take your Instrument Mesh and have it go as deep as necessary. You could either place the Instrument Mesh deeper, or **elongate** it to a desired depth.

Next, you need to add a boolean modifier to your original mesh. To do this, select your original mesh, and on the right side of the screen above “Material Properties”, there is a wrench icon. Select it and then click “Add Modifier”. When the dropdown menu appears, select “Boolean” under “Generate”.

****Remember:*** Do not touch your Instrument Mesh while doing this. Keep it where you’ve placed it or it won’t work.*

Now that you've added a boolean modifier to your original mesh, you want to select "Difference" in the modifier's options. Where it says "Object", select the Instrument Mesh you are using. Once that's done, to the right of where it says "Boolean" there is a 'v' symbol. Select it to reveal the dropdown menu, and select "Apply".

Once you've completed these steps, your original mesh should now have a hole that's in accordance to the shape of your Instrument Mesh. Again, this process works for ANY mesh shape. This tactic is the simplest way to create openings in meshes without fiddling with "Edit Mode".

Texturing Meshes

Adding texture to your meshes is fairly simple. Where most of your work has taken place in the layout, now you'll have to select the "Shading" tab on the top of the screen. Once there, select the mesh you want to give texture. What will appear is a **node**.

This **node** represents the material properties of the selected mesh. To add a texture, you must add a **node** first. Select "Add" on the bottom section of the screen. You'll then want to select "Texture" and add whatever texture you so choose from the given options.

Your new texture **node** will now appear on the bottom of the screen. When a **node** is created, it won't automatically connect to your mesh. To do that, there is a yellow dot next to the word "Color" on your **node**.

Click and hold on the yellow dot, then drag your mouse to the respective yellow dot named "Base Color" in your mesh's **node**. This will produce a line that connects the two **nodes**. These lines will help you in the future to understand what **node** connects to where.

You must be weary when adding textures, because when you do, any material color you've given your mesh will be replaced with the texture. To remove textures, click and drag the line away from the yellow dot on the mesh's **node**.

The great part about the "Shading" workspace, is that you have the ability to add many **nodes** that have different functions. You can add shaders, colors, and more!

Transforming Meshes

This portion will focus on “Edit Mode”, and the tools it provides. Each tool as mentioned in ‘Editing Your Mesh’s Physicality’ will be detailed here.

3D Cursor

Before getting into these tools, it's necessary to understand how to mess with the 3D Cursor. The cursor will be necessary for certain tools to function properly.

The icon on the left is the **toolbar** icon that you must select in order to change the cursor’s placement. The second icon is the cursor itself. Once the **toolbar** option is selected, the cursor will be placed anywhere on the layout that you click with your left mouse.

BE CAREFUL! Unless you deselect the cursor in the **toolbar**, you will continue to move the cursor with any left click inside the layout.

Extrude Region

When selecting this tool, your mesh’s **vertices** will be highlighted, and a yellow line with a plus in it will appear. This will be the tool you drag around to **extrude** the mesh’s selected **vertices**/faces.

The way to select multiple **vertices** would be to either:

a) Hold and drag the left mouse over the **vertices**.

OR

b) While holding the ‘Shift’ key, select each **vertex** individually.

Extruding a face will only work if at least two connecting **vertices** on the face are selected.

Inset Faces

This tool is essentially creating another face within a current one. This tool deals with the faces of a mesh, so the best way to use it is to have all **vertices** (of the face you plan to edit) selected. Once done, a similar yellow line will appear.

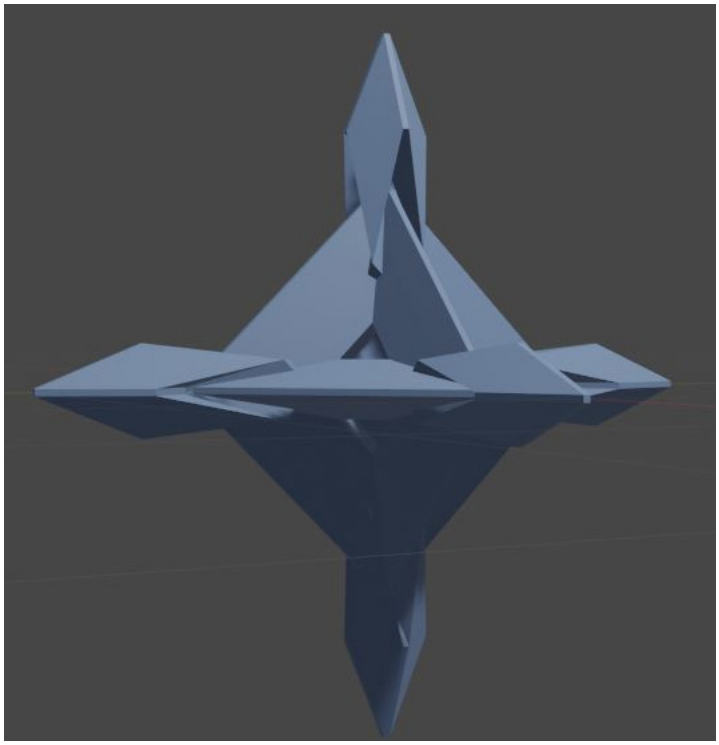
You'll be dragging this line to create a face within the current one. Dependant on your view angle, dragging the yellow line inward (towards you), will create the new face, and the size will be wherever you stop dragging the line.

This tool is great when you need to give a face multiple textures without ruining the main face. You could also use these new faces and extend them out to make something like a skyscraper without the use of multiple meshes.

Bevel

This tool does exactly what it describes. Using the same yellow line, and dragging process, you can drag the line inward of the mesh, and it will automatically **bevel** your selection.

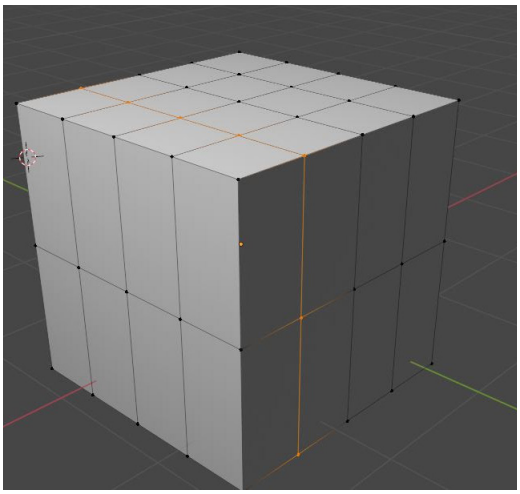
A fun tip: If you take a plain mesh and **bevel** it outward even further than usual, you could produce some interesting shapes/designs:



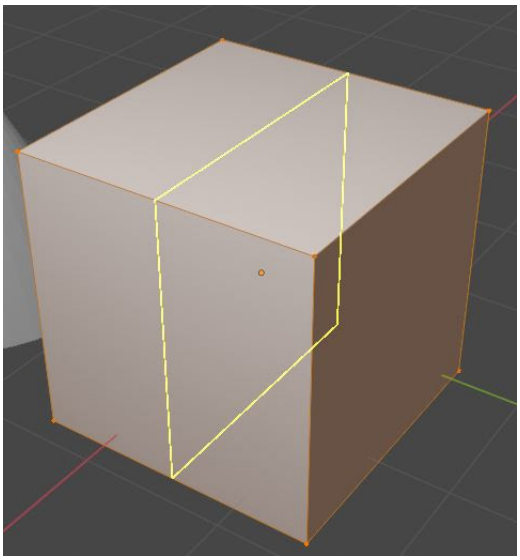
This interesting shape came about by going outward slowly with "Bevel" until this was the result.

Loop Cut

This tool is short, sweet, and to the point. This tool will automatically add new **vertices** that go around your mesh between two groups of **vertices**. The **vertices** will be added by orientation of the action preview. This is the best way to add **vertices** to your mesh for more refined edits.



This is the preview that will appear prior to the cut.



This is the result of adding multiple loop cuts.

Knife

Another very simple tool. This tool will cut new **vertices** into your mesh freely. While the tool is selected, you can add **vertices** wherever you like, whether they connect with previous **vertices**, or are entirely new. However, this tool will create as many **vertices** as it believes necessary between one another. If your knife cut is long enough, it could automatically create for instance, three **vertices** between the two you've made.

Quick note: After you use your tool, press 'Enter' on your keyboard to finalize the change. If not, it will reset your knife edits.

Poly Build

This tool will take any ONE **vertex** you have selected, and will morph it in any direction you click and drag it. It will still maintain all **vertices** and faces when being morphed. This tool will now allow selection of more than one **vertex** at a time.

If you attempt to **shift + click**, you will delete the **vertex** selected and the mesh will change shape.

Spin

The “Spin” tool will allow you to **extrude** any selection in a circular motion. The axis in which the circle will follow is dependent on the 3D cursor. It’s similar to using a protractor to draw a circle. So the selection being spun will go around wherever the 3D cursor is placed.

Using this tool will allow you to manipulate your mesh and create structures that can bend like a snake.

Smooth

The “Smooth” tool takes selected **vertices**, and will smoothen out the angle on them. Pulling the yellow line away from the mesh will smooth the angle inward, and pulling the yellow line inward will smoothen the angle outward.

You could use this tool to make all kinds of indents and protrusions on a mesh.

Edge Slide

This tool will take any selected **vertices**, and pull them towards the **vertices** they are connected to. To which of these **vertices** they travel is dependent on which direction you pull them towards. As hard as you may pull, the selected **vertices** will ONLY move towards **vertices** connected to them and none others.

Shrink / Fatten

This tool is very similar in function to the “Smooth” tool. However, this tool takes selected **vertices** and shrinks or fattens them (depending which direction you drag them). This is, in essence, extending the **vertices**.

Rip Region

"Rip Region" will take a **vertex**, or selected **vertices**, and rip them apart from the mesh. There will be a circle that appears that will allow you to pull your selection away. When a single **vertex** is selected, the yellow circle will hover over it. For multiple **vertices**, the circle will appear between the two. Make sure your mouse is within the yellow circle before you hold down and drag.

Take some time with each tool and practice with them before going into a project. These tools have more uses and options than described, though these basic instructions to use the tools will be the gateway to various mesh designs.

World Building

Creating a Low-Poly World

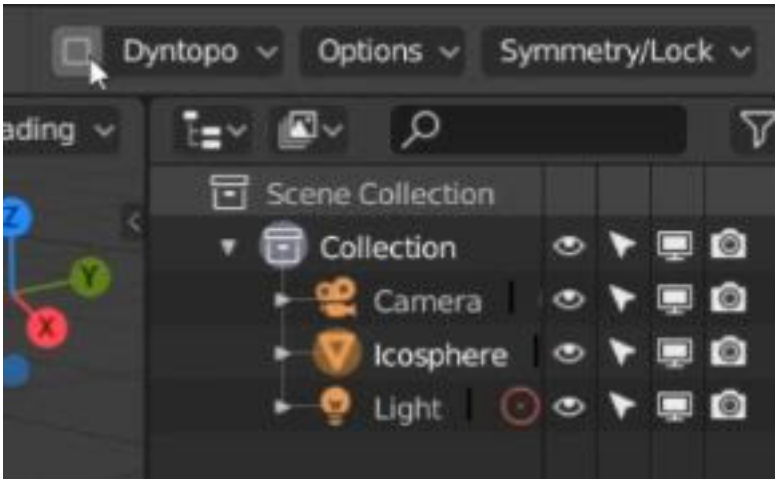
Something as big as creating a world in Blender may seem difficult at first, but it's not as difficult as it seems! Creating a **low-poly** world is a fairly straightforward task that will be detailed just below. Be wary as there are many new techniques in this portion of the manual.

Just below are the necessary steps to create a **low-poly** world, with examples of a floating island that has a river and waterfall.

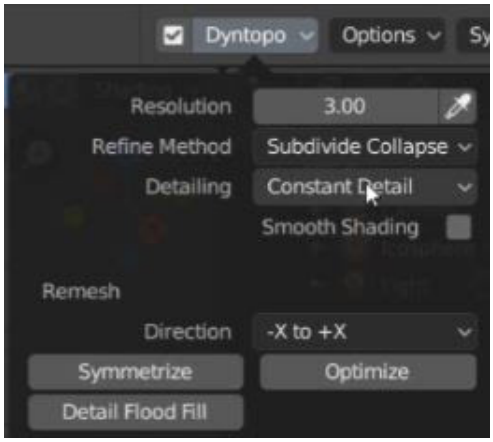
- Begin with adding in a mesh you feel necessary to build your world. Scale the mesh to a preferred size.

- Either select "Sculpt Mode", or select the 'Sculpting' Tab on the top of the screen. Then select the Draw tool.

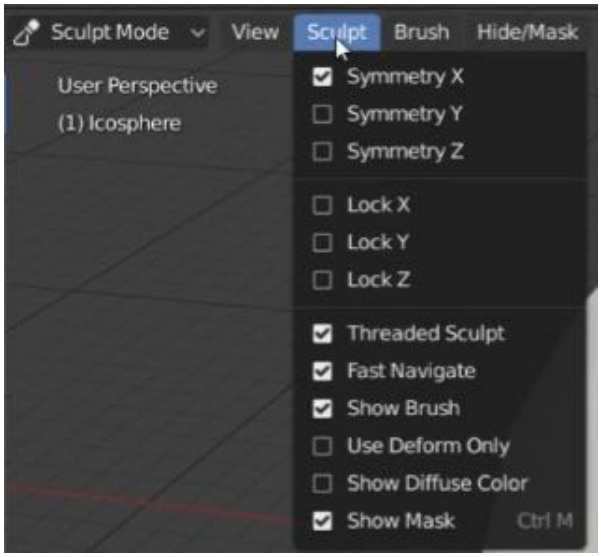
- You'll then want to enable "Dynamic Topology", and you'd do that by checking the box next to "Dyntopo". If a warning message appears, select "OK":



- To keep consistency in sculpting while zooming in, you'll want to change your **topology** settings to "Constant Detail" as shown below:

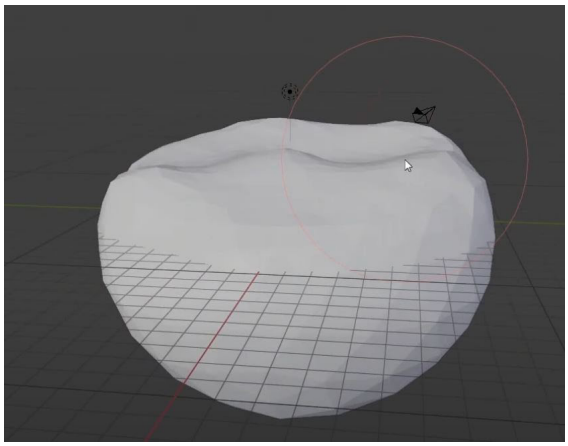


- If your sculpting edits begin to **symmetrize**, deselect the symmetry on any axis necessary through the "Sculpt" button:



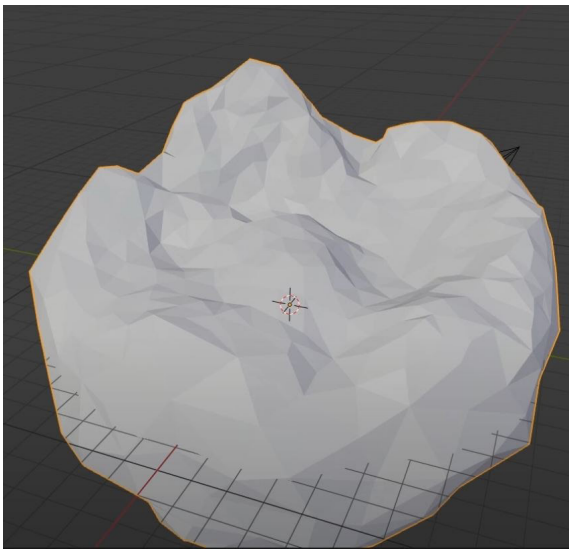
- To change the brush's width and strength, use the "Radius" and "Strength" bars on the top of the screen.

- Select the Z-Axis to have a top-down view of your mesh. While holding down the 'Ctrl' key, use the "Draw" brush on the mesh until you have successfully shaved off half of your mesh. Holding 'Ctrl' allows you to sculpt inwards/take away from the mesh:



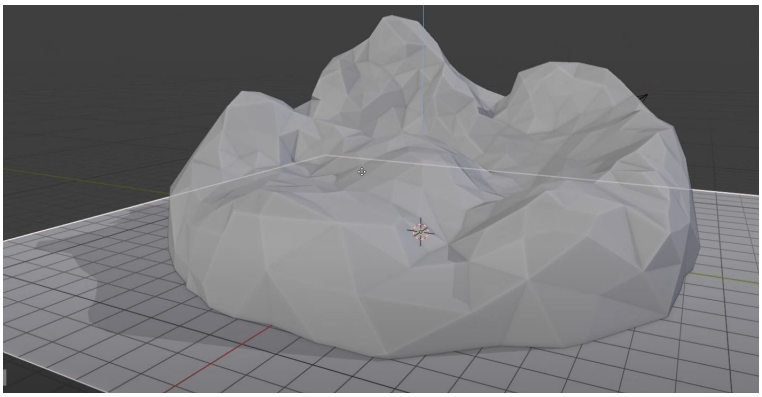
This is the result of shaving down an Ico-Sphere mesh.

- Continue to sculpt your mesh to match the terrain you need. Below is an example of sculpting to allow for a river later:

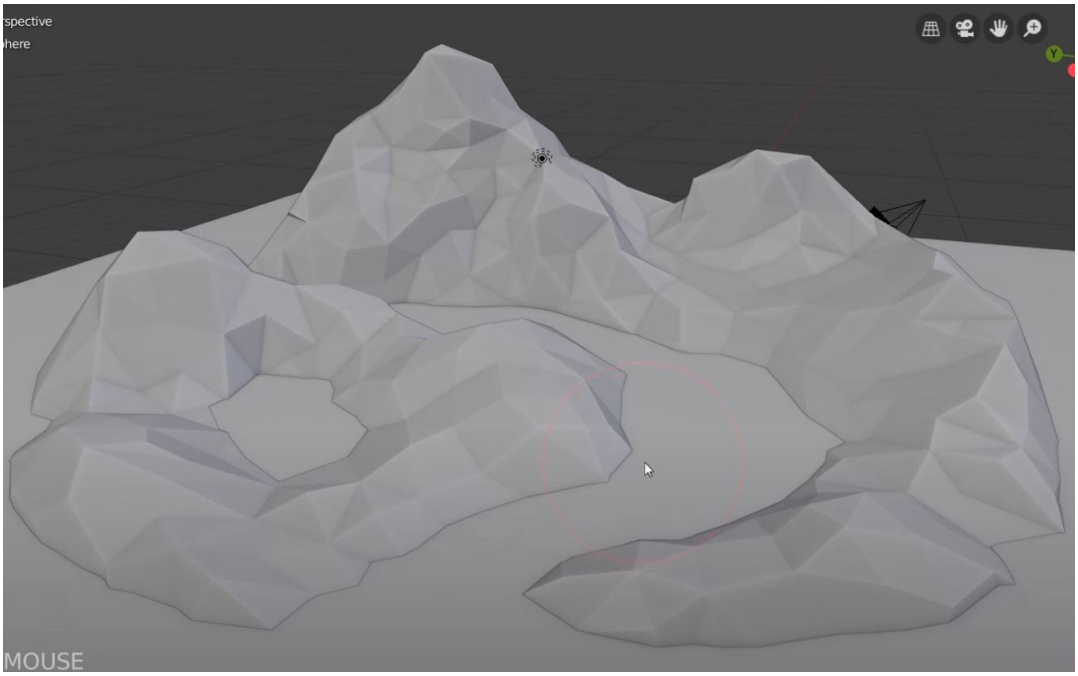


Adding a River and Waterfall

- If you so choose, add a plane mesh to your layout and make it slightly larger than your world such as below. You'll then want to move it upwards into the crevices you'd like to have water.



- For any unwanted portion of the world covered my the plane, you can use the sculpt tool on the plane to shave off it and reveal the landscape:



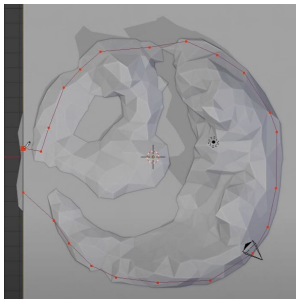
- If you so choose, add a plane mesh to your layout and make it slightly larger than your world such as below. You'll then want to move it upwards into the crevices you'd like to have water.

- Select the "Wireframe" **viewport**, then select the two **vertices** on the side of the plane in which you want the waterfall to be on. Once selected, drag them to line up with the edge of the mesh.

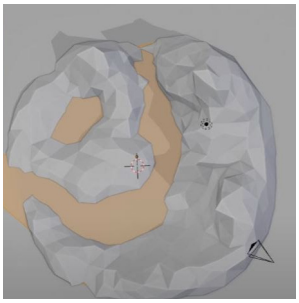
- Use the "Extrude" tool to bring the **vertices** downward some as this will be of use to the water fall.

- Using the "Knife" tool in "Edit Mode", cut out any excess parts of the plane mesh. Have the "Knife" tool create cuts around the world (and the area of the waterfall) so that it will rid of anything outside the space like so:

Before Cut

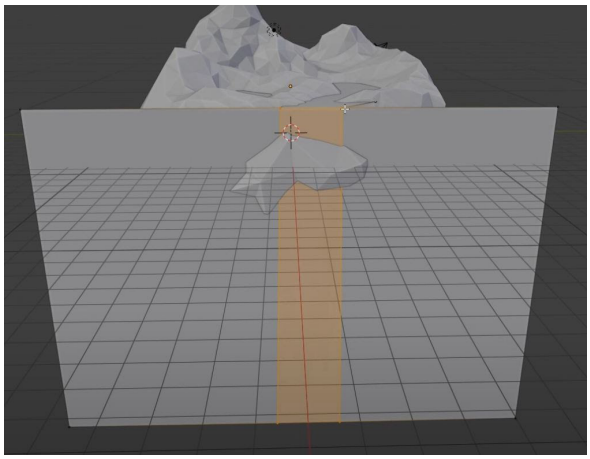


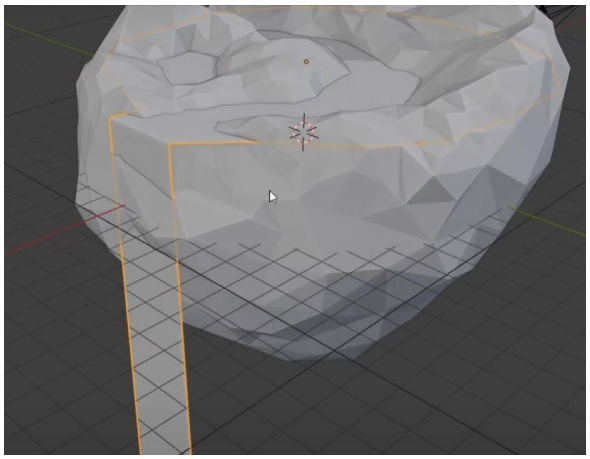
After Cut



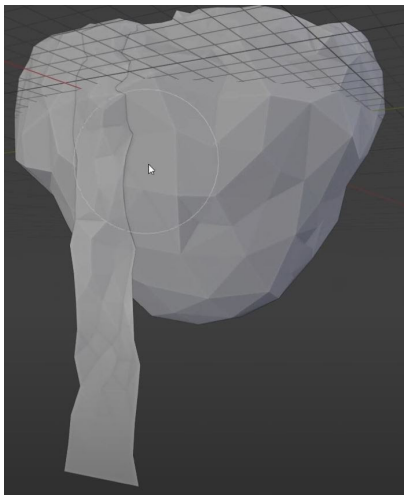
- While still in “Edit Mode”, just next to the mode selection is an icon with a white square with an unfilled hiding behind it. That will allow you to select a face. Select the face you want to cut (everything not highlighted in orange above will now be highlighted when selected). Now, delete the selected face.

- Now you’ll want to use the “Knife” tool again on the other side of the plane to connect two new **vertices** to the ends of the waterfall. Then just as above, select the unwanted faces and delete them:





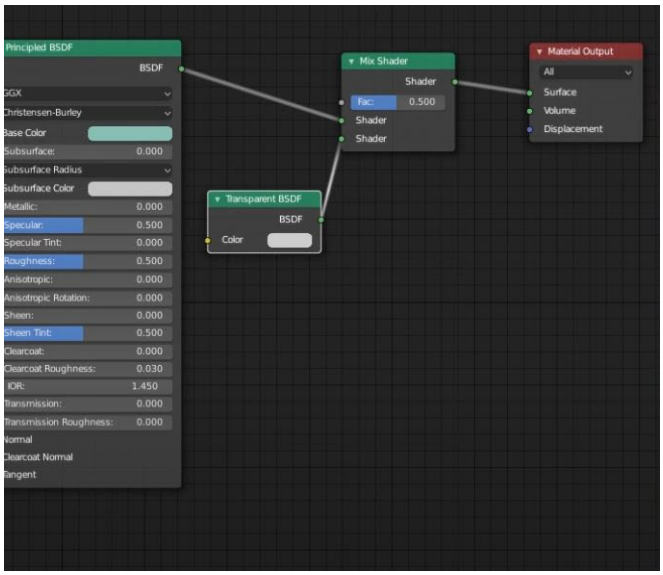
- Once again, enable “Dynamic Topology” mentioned previously, and return to “Sculpting” mode to sculpt the waterfall over the ‘rocks’. Sculpt the waterfall and the water using any of the sculpting tools provided:



- Add color to the main mesh as you please. For the above example it will be colored a light tan.

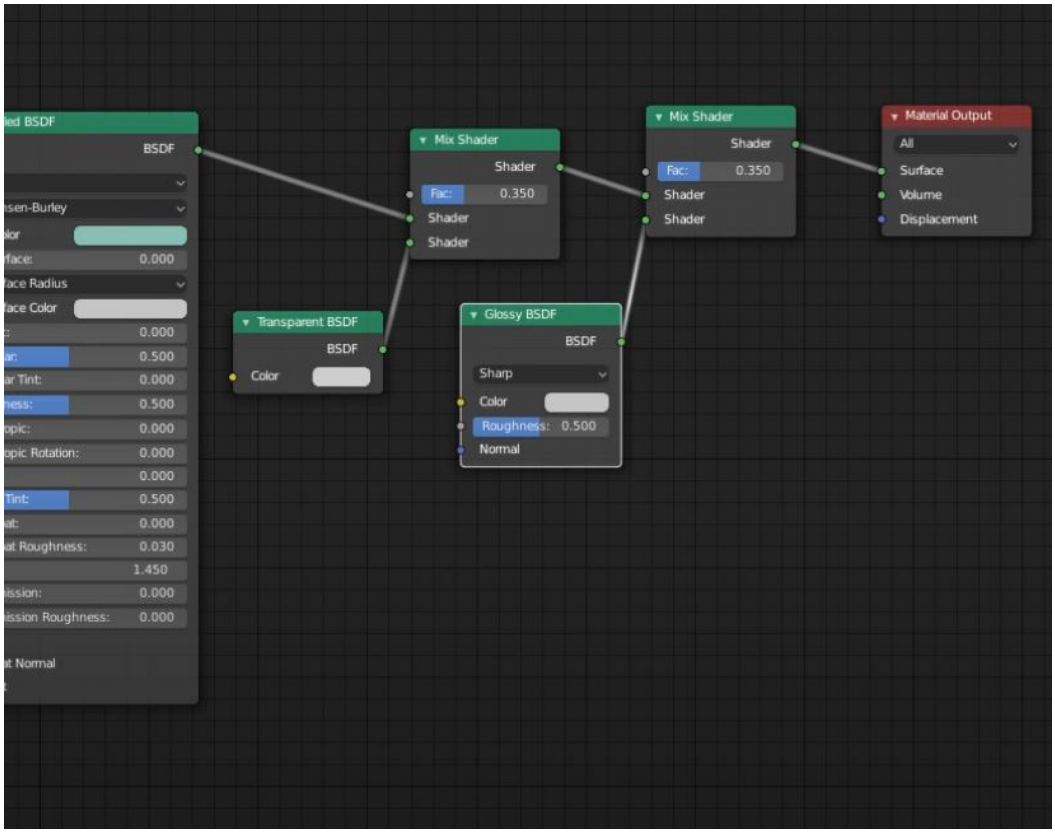
- Enter the “Shading Editor” as mentioned before. Select the mesh that represents the water, and change the base color to a water color. Then select “Add” and in the dropdown menu under “Shader”, select “Mix Shader”. Drag the mouse to the area containing the **node,** then left click to add the shader **node**.

- Add another shader, this time being the “Transparent BSDF” shader. Connect these shader **nodes** to the mesh’s material **node** like so:



- Enter the water mesh’s material properties (where you change material colors), and under “Settings”, change the blend mode to “Alpha Blend”. This will allow the mesh to apply the **shaders**.

- To give the water reflection, add the **nodes** as shown below:

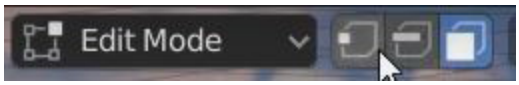


Detailing the World

- Staying in the “Shading Editor”, change from “Object Mode” to “Vertex Paint”. Choose your color and use this tool to paint over your mesh. Paint over the water if you choose, as any paint over the water will be corrected ahead.

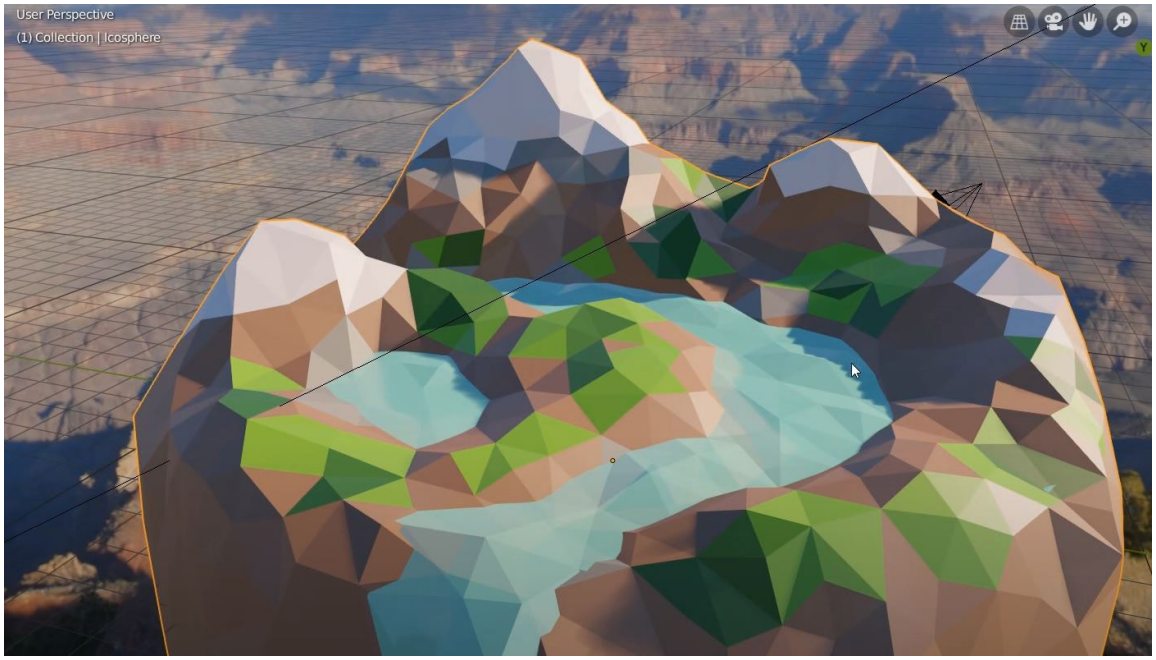
- The paint will look undetailed and blotchy. Return to the **node** section, and add an “Input”, “Attribute” **node**. Connect to the **node** to “Base Color”. This will add the color to the mesh. As a suggestion, in “Nam”, add a word such as “color” or “col”. This will remind you later that “Attribute” is meant for the color of the mesh.

- Return to the “Modeling Editor” and select “Edit Mode”. Ensure that “Face Select Mode” is on (the blue highlighted selection below):



- The paint will look undetailed and blotchy. Return to the **node** section, and add an “Input” > “Attribute” **node**. Connect to the **node** to “Base Color”. This will add the color to the mesh.

- Hold the ‘Shift’ key while selecting each face with the mouse, or dragging the mouse over the faces you want to color. Color these selected portions as you prefer.



Following these steps, you can create a similar world build, or even more complex creations using these steps as a baseline. You could easily create simple trees and clouds to add more to the world. Looking to broaden your knowledge in Blender could allow you to create even more outstanding models.

Finalizing Projects

By the time you've completed all of your work, you should be ready to finalize and export the project. There are a few necessary steps in order to ensure you export and/or render properly.

The next three sections are steps needed to render your model in image format. If this is not needed, skip to 'Exporting'

Setting Up the Camera

If you haven't already deleted it from your layout, there should naturally be two items aside from the mesh, a camera, and a light object. The camera is necessary in order to render and export a certain view of your models.

Select the camera object (if not already there, add it to the layout). To view through the camera, select the camera icon just below the red, blue, and green axis model mentioned previously.

To zoom in/out, either use the mouse wheel while within the camera view, or click and drag the arrow just above the camera object. To view your model the way it will export, make sure you have the "Rendering Viewport" selected.

Lighting

One of the most important aspects of rendering a model would be the use of lighting. Blender's layout naturally is a dark space. When rendering your creation, it will be almost unseen because there is no light to show it.

Select the light object, and go to "Object Data Properties" which will be a light bulb icon. From here you can select the lights color, power, and form of light.

The best form of light to use for rendering would be "Sun", as it covers a wider range of the layout. Click and drag the line coming from the light to angle its direction. Click and drag the object itself to further or bring the light closer.

Make sure you use the "Rendering Viewport" and the camera view to find the best lighting angle as you move your light. Your light could easily be too strong or at a bad angle in respect to the camera view. This could cause the render to come out incorrectly.

Rendering

Rendering and exporting are the easiest steps of the finalization process. On the top-left of the screen, select “Render”, then “Render Image”. Keep note, the render will ONLY come out in the camera view that you have placed. The placement of objects in the layout have no effect on the image render.

Exporting

Select “File” > “Export” and select the kind of file you want your model to export as. Make sure you are aware of the kind of file necessary for however you plan to use your model. For example, you’d export as an FBX if you plan to use your model in Unity.

Conclusion

Hopefully this document was able to assist you in learning and creating 3D models in Blender 2019 Edition!

With what you’ve read thus far, you should be able to use the basics of 3D modeling and work up from there; fiddling with many of the tools offered within the program.

Glossary

Bevel - a sloping surface or edge

Chamfer - cut away to make a symmetrical sloping edge

Drop Down Menu - displays a list of values, from which the user may select one

Edge Loop - a set of connected edges across a surface

Elongate - make something longer

Extrude - thrust or force out

Low Poly - polygon mesh with a small number of polygons

Node - a point at which lines or pathways intersect or branch

Shaders - a program that runs in the graphics pipeline that tells the computer how to render each pixel

Shift + Click - a method of highlighting text or other objects by holding down the Shift key and clicking with the mouse

Symmetrize - to make symmetrical

Toolbar - a strip of icons used to perform certain functions

Topology - the way in which constituent parts are interrelated or arranged

User Interface - the means by which the user and a computer system interact

Vertex/Vertices - a data structure that describes the position of a point in 2D or 3D space

Viewports - a framed area on a display screen for viewing

X Axis - horizontal axis of a system of coordinates

Y Axis - vertical axis of a system of coordinates

Z Axis - the axis on a graph of three dimensions that shows the range of values of a variable dependent on two other variables

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